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25–29 April 2011

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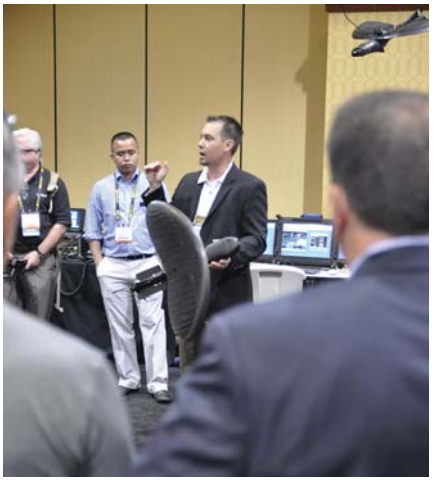

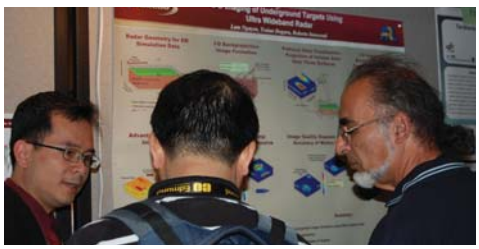

Plan now to participate!

We invite you to attend SPIE Defense, Security, and Sensing 2011 – the industry's leading meeting for scientists and engineers from industry, military, government agencies, and academia throughout the world. We are pleased to announce that Dr. Regina E. Dugan, Director, Defense Advanced Research Projects Agency has graciously accepted our invitation to deliver the Symposium-Wide Plenary Presentation.

This year's event brings you three new conferences; Sensing – Technologies for Global Health, Military Medicine, Disaster Response and Environmental Monitoring; Scanning Microscopies 2011: Advanced Microscopy Technologies for Defense, Homeland Security, Forensic, Life, Environmental and Industrial Sciences; and Geospatial InfoFusion Systems and Solutions for Defense and Security Applications.

A single trip lets you present your research, learn from others, take advantage of training opportunities, and network with top researchers and companies doing cutting-edge work covering a broad spectrum of commercial and defense applications.

We have a great event in the works, and we look forward to your participation. Come build your future today by attending Defense, Security, and Sensing 2011.

William Jeffrey, HRL Labs., LLC (USA), Symposium Cochair

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SPIE would like to express its deepest appreciation to the symposium chairs, conference chairs, program committees, session chairs, and authors who have so generously given of their time and advice to make this symposium possible.

The symposium, like our other conferences and activities, would not be possible without the dedicated contribution of our participants and members. This program is based on commitments received up to the time of publication and is subject to change without notice.

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Special Events Daily Schedule

Monday	Tuesday	Wednesday	Thursday	Friday
25 April	26 April	27 April	28 April	29 April
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INVITED PANEL DISCUSSION: **Real-World Issues and Challenges in Hard and Soft Fusion** (Panel Organizer: Kadar) 7:15 to 9:40 pm, p. 10	**Student Lunch with the Experts,** 12:30 to 1:30 pm, p. 15	GOVERNMENT FUNDING SPECIAL SESSION (Moderator: McManamon) 3:30 to 5:30 pm, p. 12 **Air Force Research Lab. Presentation** (Sciabica) **DARPA Presentation** (Neyland) **IARPA Presentation** (Baranoski)		
	PANEL DISCUSSION: **Getting Hired in 2011 and Beyond**, 1:45 to 3:00 pm, p. 11	PANEL DISCUSSION: **Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications 2011** (Moderator: Braun) 4:50 to 5:50 pm, p. 13		
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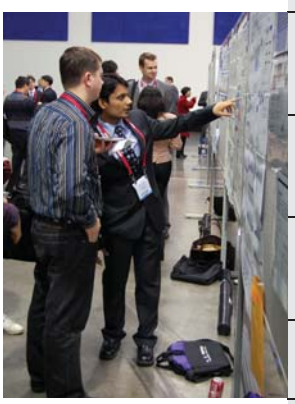

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Wednesday 27 April · 10:00 am to 5:00 pm

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Special Events

MONDAY 25 April

PANEL DISCUSSION

Less-Than-Lethal Technologies to Minimize Civilian Casualties (Conf. 8019)

Monday • 9:30 am to 11:30 am

Moderator: **David B. Law**
Joint Non-Lethal Weapons Directorate (JNLWD)

The panel will include members from the following organizations: USMC, JFCOM, CENTCOM, DDRE, and US Army.

All Symposium Welcome Reception

Monday • 6:00 to 7:00 pm

All attendees are invited to the Welcome Reception. Relax, socialize, and enjoy the refreshments. Please remember to wear your registration badges. Dress is casual.

Vendor Presentations and Reception

Monday • 5:00 to 8:30 pm

The Infrared Applications: ThermoSense XXXIII conference Vendors Session features brief presentations from hardware and software exhibitors at DSS whose product lines impact thermal imaging applications. This event allows vendors to showcase new products on display at this year's exhibit, and provides attendees with an advance glimpse of what's new in thermal imaging applications. All DSS exhibitors are eligible to present.

This event was started five years ago and has been a popular, well-attended success. It allows the busy technical conference attendees to better prioritize their time when visiting the exhibits. It also provides a relaxed atmosphere for informal conversations between vendors and conference attendees.

The session begins with 10- to 15-minute presentations and is followed by a reception and mixer with snacks and soft drinks.

Any exhibitor offering products or services related to infrared sensing or imaging can participate, but vendor time slots are limited and available on a first-come first-served basis.

The list of participating vendors and the content of their presentations see page 31. If you are interested in participating or have any questions, please contact:

Vendors Session 2011 Moderators:

Herb Kaplan, Honeyhill Technical Co., hkaplan@earthlink.net

Andres Rozlosnik, SI Termografía Infrarroja (Argentina), aer@termografia.com

INVITED PANEL DISCUSSION

Real-World Issues and Challenges in Hard and Soft Fusion (Conf. 8050)

Monday • 7:15 to 9:40 pm

Panel Organizer: **Ivan Kadar,** Interlink Systems Sciences, Inc.

Panel Moderators: **Chee-Yee Chong,** BAE Systems Advanced Information Technologies; **Ivan Kadar,** Interlink Systems Sciences, Inc.

Panelists: **Richard Antony,** SAIC, Inc.; **Chee-Yee Chong,** BAE Systems Advanced Information Technologies; **Erik Blasch,** Air Force Research Lab.; **Ivan Kadar,** Interlink Systems Sciences, Inc.; **Thiagalingam Kirubarajan,** McMaster Univ. (Canada); **James Llinas,** Univ. at Buffalo; **Ronald P. Mahler,** Lockheed Martin Maritime Systems and Sensors

The panel will address salient real-world issues and challenges in hard and soft data fusion illuminated by invited experts. Accurate situation assessment sometimes cannot be accomplished using just hard or soft data sources alone. Specifically sources of "hard information" are physics-based sources that provide sensor observables such as radar or video data, while "soft information" is usually provided by human-based sources. Fusion of hard and soft data can provide situation pictures that are better than those using hard or soft data alone. For example, patrol reports provide soft data in addition to hard data from physical sensors in urban operational environments. While algorithms for fusing information from physical sensors has a substantial development history as well as maturity, complex technical issues remain in the representation of human-based information to make it suitable for combining with sensor based information. Conceptual real-world related examples associated with the overall complex problem will be addressed by the panel to highlight issues and challenges. Audience participation is welcomed to provide a forum for exchange of ideas.

TUESDAY 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Open to All Attendees
exhibition visitors, exhibitors, and technical conference attendees

Dr. Regina E. Dugan
Director, Defense Advanced Research Projects Agency (DARPA)

Dr. Regina Dugan, Director, DARPA will deliver the Symposium-wide Plenary Presentation at this year's meeting.

In her role as Director, Dr. Dugan leads the DoD agency responsible for the creation and prevention of strategic technology surprise. From its founding more than 50 years ago to current day, this mission implies one imperative for the Agency: radical innovation for national security. Today DARPA is the principal agency within the DoD for research, development and demonstration of high-risk, high-payoff projects for the current and future combat force.

Appointed by Secretary of Defense, Robert M. Gates, and announced by the Director, Defense Research and Engineering, Zachary Lemnios, Dr. Regina E. Dugan was sworn in as the 19th director of the Defense Advanced Research Projects Agency (DARPA) on July 20, 2009.

Founded in 1958 as a response to the Soviet Union's launch of Sputnik, DARPA's mission is to prevent strategic surprise for the United States as well as create strategic surprise for our adversaries. From its founding more than 50 years ago to current day, this mission implies one imperative for the Agency: radical innovation for national security. Today DARPA is the principal agency within the Department of Defense for research, development and demonstration of high-risk, high-payoff projects for the current and future combat force.

Experienced in counterterrorism and defense against explosive threats, Dr. Dugan first served the Nation as a DARPA program manager from 1996 to 2000. During this first tour with the Agency, she directed a diverse $100 million portfolio of programs including the "Dog's Nose" program, an effort focused on the development of an advanced, field-portable system for detecting the explosive content of land mines. In 1999, Dr. Dugan was named DARPA Program Manager of the Year for her efforts, and in 2000 she was awarded the prestigious Bronze deFleury medal by the Army Engineer Regiment. She is also the recipient of the Office of the Secretary of Defense Award for Exceptional Service and the Award for Outstanding Achievement.

Dr. Dugan's contributions to the United States military are numerous. She led a counterterrorism task force for the Deputy Secretary of Defense in 1999 and, from 2001 to 2003, she served as a special advisor to the Vice Chief of Staff of the Army, completing a Quick Reaction Study on Countermine for Enduring Freedom. The results of this study were subsequently briefed to joint senior military leadership and successfully implemented in the field.

Prior to her appointment as director of DARPA, Dr. Dugan co-founded Dugan Ventures, a niche investment firm, where she served as President and CEO. In 2005, Dugan Ventures founded RedXDefense, LLC, a privately held company devoted to innovating solutions for combating explosive threats, where she also served as President and CEO. From private industry, Dr. Dugan brings a wealth of management, finance, product development, and marketing experience to the Agency.

Widely recognized for her leadership in technology development and as an experienced public speaker, Dr. Dugan has appeared on the Discovery Channel, National Public Radio, and The AAAS Science Report. Her projects have been the subject of articles in The New York Times Science Times, The New York Times Circuits, Forbes, The Wall Street Journal, Chemical and Engineering News and Science News. Additionally, Dr. Dugan previously participated in wide-ranging studies for the Defense Science Board, Army Science Board, National Research Council, and the Science Foundation, and sat on the Naval Research Advisory Committee and the Defense Threat Reduction Agency and Technology Panel.

Dr. Dugan obtained her doctorate degree in mechanical engineering from the California Institute of Technology and her master's and bachelor's degrees from Virginia Tech. She is the sole inventor or co-inventor on multiple patents and patents pending. Dr. Dugan is the co-author of Engineering Thermodynamics, 1996. She is the first female director of DARPA.

PANEL DISCUSSION

Getting Hired in 2011 and Beyond

Tuesday • 1:45 to 3:00 pm

Join us for a panel discussion on careers in the defense industry. Learn about getting hired and working with defense contractors directly from human resource professionals in the defense sector.

WORKSHOP

New NVESD Performance

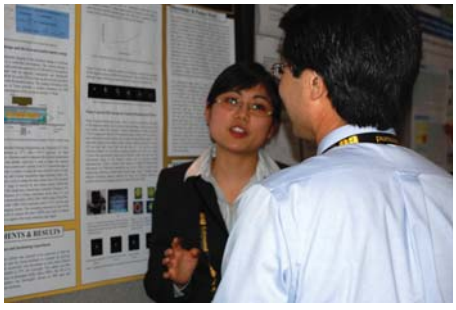
(Conf. 8014)

Tuesday • 4:50 to 6:00 pm

Moderator: **Gerald C. Holst,** JCD Publishing

Speaker: **Brian Teaney, Joseph Reynolds,** U.S. Night Vision & Electronic Sensors Directorate

The US Army Night Vision and Electronic Sensors Directorate (NVESD) recently released a beta version of the next generation Integrated Performance Model (NV-IPM). Details concerning the changes to the model interface along with a discussion of model capabilities and a demonstration of existing model functionality will be the focus of this presentation. A discussion of updates to the model theory including revisions to the noise model, aliasing as noise, and the development of a fully 2D model will also be included.



Interactive Poster Session

Tuesday • 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

WEDNESDAY 27 April

Government Funding Special Session

Wednesday • 3:30 to 5:30 pm

High-level personnel in government funding agencies describe areas of interest to them. This is a chance to guide internal company R&D into areas with a higher probability of funding, based on the insights you will receive during this session. Three major government funding agencies will provide insights into their vision and perceived needs.

Moderator

Paul F. McManamon
Air Force Research Lab. (Ret.),
Univ. of Dayton

Air Force Research Lab. Presentation

Joe Sciabica
Executive Director, Senior Executive Service
Air Force Research Lab.

Mr. Sciabica is Executive Director of the Air Force Research Laboratory at Wright-Patterson Air Force Base (WPAFB), Ohio. He serves as the Principal Assistant to the Commander and the senior civilian executive responsible for managing the Air Force's $2.5 billion science and technology program; additional customer funded research and development of $2.5 billion, and a workforce of 10, 800 people in the Laboratory's component technology directorates, the USAF School of Aerospace Medicine and the Air Force Office of Scientific Research. He began his career with the Air Force in 1982 at the Air Force Rocket Propulsion Laboratory, Edwards AFB, California developing technologies for Small ICBM. He was later assigned to Kirtland AFB, Albuquerque New Mexico where he developed space satellite systems. Mr. Sciabica was appointed to the Senior Executive Service in 2003 as Associate Director for Space Technology serving as the principal executive within AFRL responsible for integration of space technologies throughout DoD Science and Technology activities. He Chaired the Space Technology Alliance and the Office of the Secretary of Defense (OSD) Defense Technology Area Plan Space Panel Committee providing the executive leadership required to infuse space technologies throughout DoD into the U.S. industrial base to meet future defense needs. Next as Sensors Director, WPAFB, Ohio he led the discovery, development, and integration of affordable sensor and countermeasure technologies for air, space, and cyber systems. Mr. Sciabica is a 1993 graduate of the Defense Systems Management College Program Management Course and a 2000 graduate of the National War College. Throughout his 28 year career that spanned 13 civil service assignments he has served in a variety of engineering and senior technical management positions. He has been known for the depth and breadth of his extraordinary contributions as a visionary leader and his technical leadership across the Laboratory and Air Force. His accomplishments have demonstrated exemplary integrity, leadership, ingenuity, and excellence. In 2008, his executive leadership and significant accomplishments earned him the Meritorious Service Presidential Rank Award.

DARPA Presentation

David L. Neyland
Director, Tactical Technology Office, DARPA

Mr. David L. Neyland is Director, Tactical Technology Office, at the Defense Advanced Research Projects Agency. DARPA is the principal Agency within the Department of Defense (DoD) for advanced research and development and TTO specifically addresses technology development and demonstration for Air/Space/Land/Sea platforms, Precision Strike, Unmanned Systems, and Space Operations.

Prior to joining DARPA, Mr. Neyland was a Technical Director at the Charles Stark Draper Laboratory, responsible for studies to evaluate future tactical technology investment. Before Draper, Mr. Neyland was a Vice President and Division Manager at Science Applications International Corporation, and was Senior Program Manager for the development and international deployment of a critical national sensor system for nuclear monitoring.

Prior to SAIC, Mr. Neyland spent the Dot-Com era as Director of Program Management and Vice President of Engineering at three Dot-Coms: Network Solutions, iBrite and inphoMatch. Before boarding the Dot-Com rollercoaster, Mr. Neyland retired as Lieutenant Colonel from a 20 year Air Force career in Research and Development. During his Air Force years, Lieutenant Colonel Neyland (Ret.) was a DARPA Program Manager, a Flight Test Engineer and a Space Shuttle Flight Controller. Mr. Neyland is a PMP Certified Program Manager, a Distinguished Graduate of the Industrial College of the Armed Forces, a Program Manager Graduate of the Defense Systems Management College and a Flight Test Engineer Graduate of the Air Force Test Pilot School.

Mr. Neyland has a Master of Science in Astronautical Engineering from the Air Force Institute of Technology, a Master of Science in Resource Management from the Industrial College of the Armed Forces, and a Bachelor of Science in Applied Physics from the University of Miami.

IARPA Presentation

Edward J. Baranoski
Director, Office of Smart Collection, IARPA

Dr. Edward J. Baranoski is currently the Director of the Office of Smart Collection at Intelligence Advanced Research Projects Activity (IARPA) where the focus is on dramatically improving the value of collected data from all sources. He is a former program manager in the Special Projects Office and Strategic Technology Office at DARPA where his focus was on sensing, communication, and navigation in urban environments. From 1990 through 2004, he worked at MIT Lincoln Laboratory. He received Ph.D. from Carnegie Mellon University, and was an Associate Editor for IEEE Transactions on Antennas and Propagation and has served on the IEEE Underwater Acoustics Signal Processing and Sensor Array and Multichannel (SAM) Technical Committees from 2000-2007, and was co-chair of the first IEEE Sensor Array and Multichannel (SAM 2000) Signal Processing Workshop. He received the Office of the Secretary of Defense Medal for Exceptional Public Service in 2008.

PANEL DISCUSSION

Cross-Conference Hot Topic: Data to Decisions: “Sensors are No Longer King”

Wednesday • 10:30 am to 12:30 pm

Moderator: **John M. Pellegrino**
Director, U. S. Army Research Lab., Computational and Information Sciences Directorate (CISD)

This cross-conference hot topic provides a unique forum for senior leaders from different organizational perspectives to discuss the shifting paradigm of what is needed to achieve the required situational understanding to make the best actionable battlefield decisions. We need to get away from the "autistic" view of sensing and learn to integrate other non-traditional information sources including HUMINT, cultural understanding, social networks, policies and behavior modeling.

Identifying the technology needs from a holistic perspective

PANEL DISCUSSION

Verification, Validation, and Accreditation

(Conf. 8060)

Wednesday • 11:30 am to 12:10 pm

Panel Moderator: **Eric J. Kelmelis**
EM Photonics, Inc.

PANEL DISCUSSION

Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications 2011 (Conf. 8064)

Wednesday • 4:50 to 5:50 pm

Panel Moderator: **Jerome J. Braun**
MIT Lincoln Lab.

TRACK PLENARY PRESENTATION

Evolution of Airborne Chemical and Radiological Remote Sensing for Emergency and Natural Disaster Response (Conf. 8048)

Wednesday • 5:00 to 6:00 pm

Presenter: **Paul E. Lewis**
National Geospatial-Intelligence Agency

In 2001 the United States Environmental Protection Agency’s (EPA) Airborne Spectral Photometric Environmental Collection Technology (ASPECT) Program became the United States only civil 24/7 operational airborne chemical, radiological, and situational awareness reporting capability. Since 2001 the ASPECT aircraft has completed 107 successful airborne emergency response and homeland security related missions. The ASPECT model of operation combines an airborne operational remote sensing suite with a research and development support team to provide essential situational awareness information to first responders and their local, state and federal lead agencies in accordance with the National Contingency Plan and EPA’s responsibility under Emergency Support Function 10 of the National Response Plan. This presentation will showcase the effectiveness and necessity of the ASPECT operational model in meeting the needs of the civil emergency response and homeland security communities. Highlights from a variety of ASPECT airborne missions will be presented including industrial accidents, homeland security situational awareness missions, and natural and anthropogenic disasters such as Hurricane Katrina and the Deepwater Horizon Oil Spill along with issues, and lessons learned.

Banquet and DSS Lifetime Achievement Award Announcement

Wednesday • 7:00 to 9:30 pm

Ticket Required
Banquet tickets $95

Dinner will start at 7:00 pm followed by the introduction of the SPIE New Fellows, and DSS Lifetime Achievement Award presentation. Tickets for the banquet and presentation are $95 per person and are sold separately from the conference registration fees. Tickets may be ordered on your registration form or purchased onsite at the SPIE Cashier. Banquet tickets must be purchased by Monday 25 April at 5:00 pm.

Please join your colleagues for the presentation of the DSS Lifetime Achievement Award to General James E. Cartwright!

General James E. Cartwright
Vice-Chairman of the Joint Chiefs of Staff

General Cartwright serves as the eighth Vice Chairman of the Joint Chiefs of Staff. In this capacity, he is a member of the Joint Chiefs of Staff and the Nation's second highest ranking military officer. As Vice Chairman, General Cartwright chairs the Joint Requirements Oversight Council, Co-Chairs the Defense Acquisition Board, and serves as a member of the National Security Council Deputies Committee, the Nuclear Weapons Council and the Missile Defense Executive Board. In addition, he Co-Chairs the Deputies Advisory Working Group, which provides advice to the Deputy Secretary of Defense on resourcing and other high-level departmental business issues.

General Cartwright was commissioned a second lieutenant in the Marine Corps in November 1971. He completed Naval Flight Officer training in April 1973 and graduated from Naval Aviator training in January 1977. He has operational assignments as an NFO in the F-4, and as a pilot in the F-4, OA-4, and F/A-18. He is a distinguished graduate of the Air Command and Staff College at Maxwell AFB, received his Master of Arts in National Security and Strategic Studies from the Naval War College, Newport, Rhode Island and completed a fellowship with Massachusetts Institute of Technology.

General Cartwright's command assignments include: Commander, United States Strategic Command (2004-2007); Commanding General, First Marine Aircraft Wing (2000-2002); Deputy Commanding General, Marine Forces Atlantic (1999-2000).

General Cartwright's joint staff assignments include: Director for Force Structure, Resources and Assessment, J-8 the Joint Staff (2002-2004); Deputy Director for Force Structure, Requirements, J-8 the Joint Staff (1996-1999).

THURSDAY 28 April

PANEL DISCUSSION

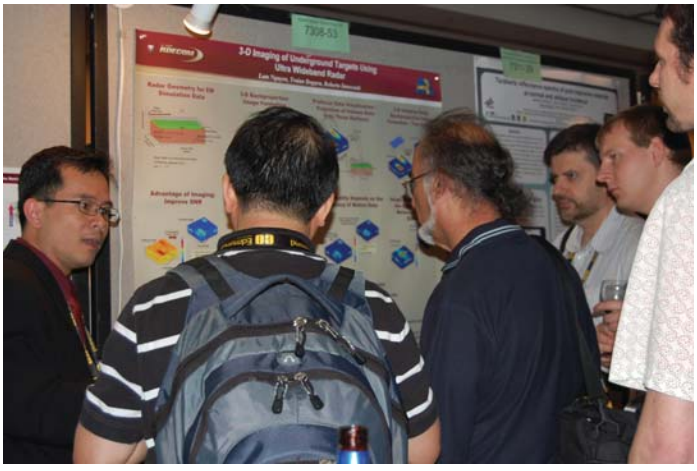
Contemporary Concerns in Geographical/ Geospatial Information Systems (GIS) Processing (Conf. 8053)

Thursday • 2:00 to 3:00 pm

Moderator: **Michael E. Gangl**
MacAulay-Brown, Inc.

Panelists: **Erik P. Blasch**, **Gunasekaran Seetharaman,** Air Force Research Lab.; **Jason S. Brown,** Schafer Corp.; **Matthew Pellechia, Shiloh L. Dockstader,** ITT Corp. Geospatial Systems; **Paul B. Deignan,** L-3 Communications Integrated Systems; **Kannappan Palaniappan,** Univ. of Missouri-Columbia

With the advent of advances in Geospatial Information System (GIS), there is a need to determine the areas of research concern and new tools available for GIS systems. GIS consists of the collection, integration, storage, exploitation, and visualization of geographic and contextual data and information. This paper brings together panelists to assess the current directions of GIS research. The consolidated areas discussed by the panelists give a general direction of GIS needs, techniques, models, and standards. The summary of selected areas include: use of information fusion, support of meta-data, production of challenge problems, adherence to open standards, generation of architectures, and detailed standards and metrics.



Interactive Poster Session

Thursday • 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Network

Networking Receptions · Student Social Events · SPIE Member Events

Join your colleagues and develop new relationships at these relaxed-atmosphere events; enjoy light refreshments as you continue the day's discussions.

Fellows Luncheon

Monday • 12:00 to 1:30 pm

All Fellows of SPIE are invited to join your colleagues for an SPIE hosted luncheon. The new SPIE Fellows attending Defense, Security + Sensing will be introduced and recognized. Please join us for this informal gathering and a chance to interact with other Fellows. Fellows planning to attend are asked to RSVP to Brent Johnson.

All Symposium Welcome Reception

Monday • 6:00 to 7:00 pm

All attendees are invited to the Welcome Reception. Relax, socialize, and enjoy the refreshments. Please remember to wear your registration badges. Dress is casual.

Student Lunch with the Experts

A Student Networking Event

Tuesday • 12:30 to 1:30 pm

Seating is Limited. Tickets Required

Enjoy a casual meal with colleagues at this engaging networking opportunity. Hosted by SPIE Student Services, this event features experts willing to share their experience and wisdom on career paths in optics and photonics. Students receive one complimentary ticket with registration.

Women in Optics Presentation and Reception

Tuesday • 4:30 to 6:00 pm

Open to all conference attendees

Join us for an evening of networking, information and inspiration. Connect with others in our industry while enjoying wine and cheese refreshments.

The Hand in the Snow

Colleen Fitzpatrick, PhD

Colleen Fitzpatrick is a Forensic Genealogist who has been recognized for her work with the Armed Forces DNA Identification Laboratory on identifying the remains found in the Alaskan crash of Northwest Flight 4422. Retired from the optical industry in 2005, she now assists nonprofits, military organizations, and the FBI with forensic identification, and has been instrumental at exposing two high profile Holocaust literary frauds. As a world traveler and multilingual, Colleen specializes in international cases. She has written three books and numerous articles on forensic genealogy. Her article on Flight 4422 will be published in Scientific American early in 2011.

Early Career Networking Social

Wednesday • 5:30 to 6:30 pm

Meet distinguished SPIE contributors for a casual pre-dinner social. This event boasts one-on-one networking opportunities with SPIE volunteers from committees and leadership.

Job Fair

Top employers are coming together to interview and hire candidates at SPIE Defense, Security, and Sensing!

Tuesday 26 April | 9:30 am to 5:00 pm

Wednesday 27 April | 10:00 am to 5:00 pm

Whether you're looking for a better job, re-entering the workforce or just starting your career, plan to visit the Job Fair at SPIE Defense, Security, and Sensing – come prepared to discuss your skills and talents with industry leaders.

- Discuss career options with employers
- Build your network
- Gain visibility with hiring companies
- Post your resume today! Visit the Career Center on SPIE.org/career-center

Admission is free; Registration is required.

NOTE: Many of the positions posted at this job fair require an active security clearance or the ability to acquire one.

Tip: Be prepared to tell the recruiter about yourself in less than two minutes. That may not seem like a much time but it's all you'll probably get. Write down everything you want them to know about you and then condense it as much as possible. Practice it until you feel comfortable and ask everyone you know to listen to your tale. During these practice sessions focus on talking slowly, because when you're nervous you're bound to speed up. Remember, the more you practice, the less likely you are to make a mistake during the actual event.

Employers

Over the years SPIE has worked with more than 3,000 companies, recruiters and research institutions to help them find technicians, technical sales people, scientists and engineers. Each year hundreds of companies and research institutions participate in SPIE Job Fairs and post jobs online.

Contact: Sara Liebert for more information.
Call 360.715.3705 or email JobSales@spie.org

Professional Development

Spend some time focusing on your career development while you're at SPIE Defense, Security, and Sensing. These workshops and presentations will help you be more successful.

PANEL DISCUSSION

Getting Hired in 2011 and Beyond

Tuesday • 1:45 to 3:00 pm

Included with conference registration.

Join us for a panel discussion on careers in the defense industry. Learn about getting hired and working with defense contractors directly from human resource professionals in the defense sector.

Leading Successful Product Innovation

WS951 · Course level: Intermediate
CEU .35 Member $275 / Non-member $325 USD
Tuesday 8:30 am to 12:30 pm

The fundamental goal of this course is to answer the question: "How do I take an idea off the white-board and turn it into a windfall product?" We will explore and apply the principles of good leadership to create a culture of excellence within your organization-the most basic ingredient for success. A special emphasis will be placed on learning how to develop and construct an effective new project pitch using the instructor's "Disciplined Creativity" concept and framework. We will then describe the "Spiral Development Process" for rapid, effective, and successful prototype development, followed by an in-depth examination of the life-cycle approach to product development. This course will also enable you to conduct a "red teaming" exercise to identify competitive threats, identify weaknesses in your company, and most importantly, develop solution strategies. We will also place an emphasis on how to properly vet an idea and how to ask tough-minded questions designed to ferret out shortcomings.

Instructor: **John Carrano** is President of Carrano Consulting. Previously, he was the Vice President, Research & Development, Corporate Executive Officer, and Chairman of the Scientific Advisory Board for Luminex Corporation, where he led the successful development of several major new products from early conception to market release and FDA clearance..

Basic Optics for Non-Optics Personnel

WS609 • Course level: Introductory
CEU .20 $100 / Non-member $150 USD
Tuesday 1:30 to 4:00 pm

This course will provide the technical manager, sales engineering, marketing staff, or other non-optics personnel with a basic understanding of the terms, specifications, and measurements used in optical technology to facilitate effective communication with optics professionals on a functional level. Topics to be covered include basic concepts such as interference, diffraction, polarization and aberrations, definitions relating to color and optical quality, and an overview of the basic measures of optical performance such as MTF and wavefront error. The material will be presented with a minimal amount of math, rather emphasizing working concepts, definitions, rules of thumb, and visual interpretation of specifications. Specific applications will include defining basic imaging needs such as magnification and depth-of-field, understanding MTF curves and interferograms, and interpreting radiometric terms.

Instructor: **Kevin Harding** has been active in the optics industry for over 30 years, and has taught machine vision and optical methods for over 25 years in over 70 workshops and tutorials, including engineering workshops on machine vision, metrology, NDT, and interferometry used by vendors and system houses to train their own engineers. He has been recognized for his leadership in optics and machine vision by the Society of Manufacturing Engineers, Automated Imaging Association, and Engineering Society of Detroit.

Registration required for workshops

Complying with the ITAR: A Case Study

WS933 · Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Wednesday 8:30 am to 12:30 pm

In the world of international trade, it's what you don't know that can hurt you. With the U.S. government's focus on homeland security and its increasing reliance on photonics for the development and production of defense-related products and services, your activities may well be subject to the ITAR.

This workshop will begin with a brief contextual overview of U.S. export controls, including the Export Administration Regulations, the ITAR, and special sanction programs administered by the Treasury Department's Office of Foreign Assets Control. We will then transition into a case study focused on the ITAR. Real world situations and lessons learned will be shared. Various aspects of the case study will likely be familiar to you in the context of your own experiences, allowing you to learn effectively how to spot ITAR issues before they negatively impact your business. You will also learn about current enforcement trends and best practices for avoiding violations.

Instructor: **Kerry Scarlott** is a Director at the law firm of Goulston & Storrs. With an office in Boston, MA and Washington, D.C., Kerry focuses his practice on business law and international trade law, with particular expertise in assisting technology-based companies.

Advanced Topics in U.S. International Trade Regulations

WS1037 • Course level: Intermediate
CEU .35 Member $275 / Non-member $325 USD
Thursday 8:30 am to 12:30 pm

U.S. businesses are subject to increasing regulatory controls on the export of their products, services and technical data, as well as their sales activities in foreign jurisdictions. Recent increases in penalty amounts and coordination among federal agencies have sharpened the ability of export enforcement authorities to target wrongdoers. These developments coincide with a dramatic up-tick in investigative and enforcement activity involving businesses of every size.

During this fast-paced program, you will be provided with cutting edge information designed to forestall enforcement activities against your company. Real world situations and lessons learned will be provided, as well as practical tips on best practices.

Instructor: **Kerry Scarlott** is a Director at the law firm of Goulston & Storrs. With an office in Boston, MA and Washington, D.C., Kerry focuses his practice on business law and international trade law, with particular expertise in assisting technology-based companies.




Walk the floor and see the latest defense, security, sensing homeland security, robotic, and environmental technologies

SPIE Defense, Security + Sensing

Tuesday 26 April . . . . . 9:30 am to 5:00 pm
Wednesday 27 April . . . . . 10:00 am to 5:00 pm
Thursday 28 April . . . . . 10:00 am to 2:00 pm

Defense Exhibitors Include:

AXSYS Technologies-General Dynamics-AIS · Raytheon · Lockheed Martin · Elbit Systems of America · FLIR Commercial · L-3 Communications · Northrop Grumman Cutting Edge Optronics · DRS Technologies · General Atomics · Textron Defense Systems · SCHOTT North America, Inc.-Defense

Visit with reps from the largest prime contractors and the most dynamic startups at the SPIE Defense, Security, and Sensing Exhibition. The free 500-company exhibition showcases the newest products, latest innovations, and cutting-edge technologies, including:

- Chemical and Biological Sensing
- Infrared Sources, Detectors, and Systems
- Lasers and Other Light Sources, Laser Accessories, and Laser Systems
- Cameras and CCD Components
- Displays
- Electronic Imaging Components, Equipment, and Systems
- Fiber Optic Components, Equipment, and Systems
- Optical Components
- High Speed Imaging and Sensing
- Optics Manufacturing
- Nanotechnology
- Law Enforcement Technologies
- Robotics and Unmanned Systems – Featuring Live Product Demos and Special Technology Displays

Exhibitor Product Demonstrations

Various exhibiting companies will be showcasing new and successful products in half-hour demonstration/question and answer sessions.

Don't Miss the
New Technology Demos and Displays

SPIE Defense, Security and Sensing Exhibition will again feature the New Technology Demos and Displays. Located in the Palms Exhibition Hall.

Attendees will see:

Latest technology developments of imaging and sensing technologies for:

- Defense, Industrial, and Commercial Applications
- Situational Awareness Top-Mount Surveillance System
- High-Power Scanning-Electron Microscopes
- Real-World Applications of Laser Power Beaming Systems for UAVs
- High-Speed, High-Precision Imaging at Work with Audience Participation

SPIE Defense, Security, and Sensing is

- Over 500 companies—connect face-to-face with suppliers
- Over 6,000 attendees from over 1,600 prime contractors and suppliers

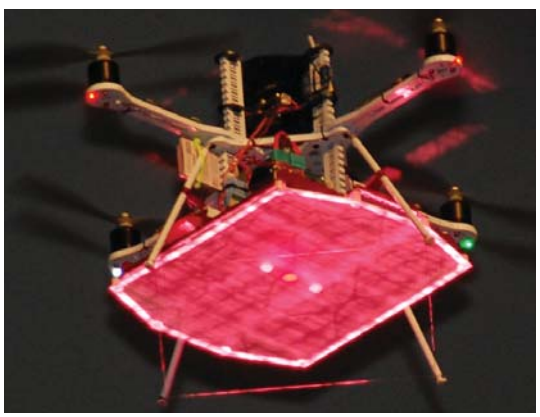
Products being featured at the New Technology Demos and Displays:

PVP Advanced EO Systems, Inc.

Night Hawk Static Azimuth mount is a high-performance pan-and-tilt system ideal for day/night surveillance and perimeter security.

JEOL

The JEOL InTouchScope with multi-touch screen features EDS analysis in a compact full-featured Scanning Electron Microscope (SEM) for failure analysis and forensics.



LaserMotive, LLC

Example of an innovative laser power beaming system powering unmanned aerial vehicles.

Boulder Imaging, Inc.

Demonstration on high-speed, high-performance, and high-precision imaging systems.

For more information contact:

Al Ragan: alr@spie.org

spie.org/dssexhibition

Job Fair

Two Days Only

Tuesday 26 April · 9:30 am to 5:00 pm
Wednesday 27 April · 10:00 am to 5:00 pm

Top employers are coming together to interview and hire candidates at SPIE Defense, Security, and Sensing!

Whether you're looking for a better job, re-entering the workforce or just starting your career, plan to visit the Job Fair at SPIE Defense, Security, and Sensing – come prepared to discuss your skills and talents with industry leaders.

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- Build your network
- Gain visibility with hiring companies
- Post your resume today! Visit the Career Center on **spie.org/careercenter**

Admission is free; Registration is required.

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Contact: Sara Liebert for more information.
Call 360.715.3705 or email JobSales@spie.org

spie.org/careercenter

SPIE

Monday	Tuesday	Wednesday	Thursday	Friday
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One fee gains you access to all of these conferences

IR Sensors and Systems

8012 **Infrared Technology and Applications XXXVII** *(Andresen, Fulop, Norton)* p. 24				
	8013 **Thermosense: Thermal Infrared Applications XXXIII** *(Safai, Brown)* p.31			
	8014 **Infrared Imaging Systems: Design, Analysis, Modeling, and Testing XXII** *(Holst, Krapels)* p. 34			
		8015 **Technologies for Synthetic Environments: Hardware-in-the-Loop XVI** *(Mobley)* p. 37		
		8016 **Window and Dome Technologies and Materials XII** *(Tustison)* p. 39		

Defense, Homeland Security, and Law Enforcement

8017 **Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XVI** *(Harmon, Holloway, Broach)* p. 41				
8029B **Biometric Technology for Human Identification VIII** *(Vijaya Kumar, Prabhakar, Ross)* p. 70	8018 **Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing XII** *(Fountain, Gardner)* p. 44			
8019 **Sensors, and Command, Control, Communications, and Intelligence (C3I) Technologies for Homeland Security and Homeland Defense X** *(Carapezza)* p. 47				

Imaging and Sensing

8021 **Radar Sensor Technology XV** *(Ranney, Doerry)* p. 52			8022 **Passive Millimeter-Wave Imaging Technology XIV** *(Wikner, Luukanen)* p. 54	
8023 **Terahertz Physics, Devices, and Systems V: Advance Applications in Industry and Defense** *(Anwar, Dhar, Crowe)* p. 56		8020 **Airborne Intelligence, Surveillance, Reconnaissance (ISR) Systems and Applications VIII** *(Henry)* p. 49		

Sensing for Industry, Environment, and Health

8024 **Advanced Environmental, Chemical, and Biological Sensing Technologies VIII** *(Vo-Dinh, Lieberman, Gauglitz)* p. 58			8025 **Smart Biomedical and Physiological Sensor Technology VIII** *(Cullum, McLamore)* p. 60	
8026 **Photonic Applications for Aerospace, Transportation, and Harsh Environment II** *(Kazemi, Kress, Chan)* p. 61				
	8027 **Sensing for Agriculture and Food Quality and Safety III** *(Kim, Tu, Chao)* p. 63		8028 **Fiber Optic Sensors and Applications VIII** *(Mihailov, Du, Pickrell)* p. 65	
8029A **Sensing Technologies for Global Health, Military Medicine, Disaster Response, and Environmental Monitoring** *(Montgomery, Southern, Taylor, Weigl)* p. 67				
	8030 **Ocean Sensing and Monitoring III** *(Hou, Arnone)* p. 71			

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Emerging Technologies

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8032 **Next-Generation Spectroscopic Technologies IV** *(Druy, Crocombe)* p. 77		8033 **Advanced Photon Counting Techniques V** *(Itzler, Campbell)* p. 79		
		8034 **Photonic Microdevices/Microstructures for Sensing III** *(Xiao, Fan, Wang)* p. 81		
8035 **Energy Harvesting and Storage: Materials, Devices, and Applications II** *(Dhar, Wijewarnasuriya, Dutta)* p. 83				
	8036 **Scanning Microscopies 2011: Advanced Microscopy Technologies for Defense, Homeland Security, Forensic, Life, Environmental, and Industrial Sciences** *(Postek, Newbury, Platek)* p. 86			

Laser Sensors and Systems

		8037 **Laser Radar Technology and Applications XVI** *(Turner, Kamerman)* p. 88		
	8038 **Atmospheric Propagation VIII** *(Wasiczko Thomas, Spillar)* p. 91			
8039 **Laser Technology for Defense and Security VII** *(Dubinskii, Post)* p. 92				
		8040 **Active and Passive Signatures II** *(Gilbreath, Hawley)* p. 94		

Innovative Defense and Security Applications for Displays

8042A **Display Technologies and Applications for Defense, Security, and Avionics V** *(Thomas, Desjardins)* p. 96			8041 **Head- and Helmet-Mounted Displays XVI: Design and Applications** *(Marasco, Havig)* p. 95	
	8042B **Enhanced and Synthetic Vision 2011** *(Güell, Bernier)* p. 97	8043 **Three-Dimensional Imaging, Visualization, and Display 2011** *(Javidi, Son)* p. 98		

Space Technologies and Operations

8044 **Sensors and Systems for Space Applications IV** *(Pham, Zmuda, Cox, Meyer)* p. 100				

Program on

Unmanned, Robotic, and Layered Systems

		8045 **Unmanned Systems Technology XIII** *(Gage, Shoemaker, Karlsen, Gerhart)* p. 102		
			8046 **Unattended Ground, Sea, and Air Sensor Technologies and Applications XIII** *(Carapezza)* p. 105	
	8047 **Ground/Air Multisensor Interoperability, Integration, and Networking for Persistent ISR II** *(Kolodny)* p. 107			

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Sensor Data and Information Exploitation

8048 **Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XVII** *(Shen, Lewis)* p. 109				
8049 **Automatic Target Recognition XXI** *(Sadjadi, Mahalanobis)* p. 112			8053 **Geospatial InfoFusion Systems and Solutions for Defense and Security Applications** *(Pellechia, Sorensen)* p. 121 	
8050 **Signal Processing, Sensor Fusion, and Target Recognition XX** *(Kadar)* p. 114				
8052 **Acquisition, Tracking, Pointing, and Laser Systems Technologies XXV** *(Thompson, McManamon)* p. 119		8051 **Algorithms for Synthetic Aperture Radar Imagery XVIII** *(Zelnio, Garber)* p. 117		

Signal, Image, and Neural Net Processing

8054 **Enabling Photonics Technologies for Defense, Security, and Aerospace Applications VII** *(Hayduk, Delfyett)* p. 123		8058 **Independent Component Analyses, Wavelets, Neural Networks, Biosystems, and Nanoengineering IX** *(Szu)* p. 131	
	8056 **Visual Information Processing XX** *(Rahman, Reichenbach, Neifeld)* p. 127		8055 **Optical Pattern Recognition XXII** *(Casasent, Chao)* p. 125
			8057 **Quantum Information and Computation IX** *(Donkor, Pirich, Brandt)* p. 129

Information Systems and Networks: Processing, Fusion, and Knowledge Generation

		8059 **Evolutionary and Bio-Inspired Computation: Theory and Applications V** *(Blowers, O'Donnell, Mendoza-Schrock)* p. 134	
	8060 **Modeling and Simulation for Defense Systems and Applications VI** *(Kelmelis)* p. 135		8061 **Wireless Sensing, Localization, and Processing VI** *(Dianat, Zoltowski)* p. 137
		8062 **Defense Transformation and Net-Centric Systems 2011** *(Suresh)* p. 138	
8063 **Mobile Multimedia/Image Processing, Security, and Applications 2011** *(Agaian, Jassim, Du)* p. 140		8064 **Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications 2011** *(Braun)* p. 142	

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Infrared Technology and Applications XXXVII

Conference Chairs: **Bjørn F. Andresen,** SCD Semiconductor Devices (Israel); **Gabor F. Fulop,** Maxtech International, Inc.; **Paul R. Norton,** U.S. Army Night Vision & Electronic Sensors Directorate

Program Committee: **Christopher C. Alexay,** StingRay Optics, LLC; **Timothy Ashley,** QinetiQ Ltd. (United Kingdom); **J. Bajaj,** Teledyne Imaging Sensors; **Stefan T. Baur,** Raytheon Vision Systems; **Philippe F. Bois,** Alcatel-Thales III-V Lab. (France); **Wolfgang A. Cabanski,** AIM INFRAROT-MODULE GmbH (Germany); **John T. Caulfield,** Cyan Systems; **John W. Devitt,** Georgia Tech Research Institute; **Nibir K. Dhar,** Defense Advanced Research Projects Agency; **Michael T. Eismann,** Air Force Research Lab.; **Martin H. Ettenberg,** Sensors Unlimited, Inc., part of Goodrich Corp.; **Sarath D. Gunapala,** Jet Propulsion Lab.; **Charles M. Hanson,** L-3 Electro-Optical Systems; **Masafumi Kimata,** Ritsumeikan Univ. (Japan); **Hee Chul Lee,** Korea Advanced Institute of Science and Technology (Korea, Republic of); **Paul D. LeVan,** Air Force Research Lab.; **Chuan C. Li,** DRS Technologies, Inc.; **Wei Lu,** Shanghai Institute of Technical Physics (China); **Paul L. McCarley,** Air Force Research Lab.; **R. Kennedy McEwen,** SELEX Galileo Ltd. (United Kingdom); **John L. Miller,** FLIR Systems, Inc.; **A. Fenner Milton,** U.S. Army RDECOM CERDEC NVESD; **Peter W. Norton,** BAE Systems; **Joseph G. Pellegrino,** U.S. Army Night Vision & Electronic Sensors Directorate; **Ray Radebaugh,** National Institute of Standards and Technology; **Manijeh Razeghi,** Northwestern Univ.; **Colin E. Reese,** U.S. Army Night Vision & Electronic Sensors Directorate; **Ingmar G. Renhorn,** Swedish Defence Research Agency (Sweden); **Antoni Rogalski,** Military Univ. of Technology (Poland); **Ingo Rühlich,** AIM INFRAROT-MODULE GmbH (Germany); **Gabby Sarusi,** Elbit Systems Electro-Optics ElOp Ltd. (Israel); **Piet B. W. Schwering,** TNO Defence, Security and Safety (Netherlands); **Itay Shtrichman,** SCD Semiconductor Devices (Israel); **Rengarajan Sudharsanan,** Spectrolab, Inc.; **Stefan P. Svensson,** U.S. Army Research Lab.; **Venkataraman S. Swaminathan,** U.S. Army Armament Research, Development and Engineering Ctr.; **Simon Thibault,** Univ. Laval (Canada); **Meimei Z. Tidrow,** U.S. Army Night Vision & Electronic Sensors Directorate; **Jean-Luc M. Tissot,** ULIS (France); **Philippe Tribolet,** SOFRADIR (France); **Jay N. Vizgaitis,** U.S. Army Night Vision & Electronic Sensors Directorate; **James R. Waterman,** U.S. Naval Research Lab.; **Lucy Zheng,** Institute for Defense Analyses

Monday 25 April

Opening Remarks . . . . . Mon. 8:00 to 8:10 am

Session Chair: **Gabor F. Fulop,** Maxtech International, Inc.

SESSION 1 . . . . . Mon. 8:10 to 10:10 am

Target Acquisition with Today's Leading Imaging Technologies

Session Chair: **Rainer Breiter,**
AIM INFRAROT-MODULE GmbH (Germany)

Sofradir latest developments for infrared space detectors, Philippe Chorier, Patricia Pidancier, Yoanna-Reine Nowicki-Bringuier, Anne Delannoy, Bruno Fieque, SOFRADIR (France) . . . . . [8012-01]

First flights of a new airborne thermal infrared imaging spectrometer with high area coverage, Jeffrey L. Hall, Richard H. Boucher, David J. Gutierrez, Steven J. Hansel, Brian P. Kasper, Eric R. Keim, Nery M. Moreno, Mark L. Polak, Mazaher G. Sivjee, David M. Tratt, David W. Warren, The Aerospace Corp. (USA) . . . . . [8012-02]

SCD's uncooled detectors and video engines for a wide-range of applications, Rami Frenkel, Udi Mizrahi, Leonid Bikov, Avihoo Giladi, Niv Shiloah, Shimon Elkind, Tomer Czyzewski, Rotem Gazit, Igal Kogan, Shay Maayani, Asaf Amsterdam, Ilan Vaserman, Offir Duman, Yoav Hirsh, Fabian Schapiro, SCD Semiconductor Devices (Israel); Avi Tuito, Israel Ministry of Defense (Israel) . . . . . [8012-03]

The new megapixel thermal imager family, Jörg Fritze, Mario O. Münzberg, Carl Zeiss Optronics GmbH (Germany). . . . . [8012-04]

A family of handheld thermal imagers, Ludovic Sogno, Qioptiq S.A.S. (France); Jean-Claude L. Fontanella, Thales Optronique S.A. (France) . . . . . [8012-06]

New applications with a SWIR imager employing extended wavelengths, Gil A. Tidhar, Optigo Directorate IAI-ELTA (Israel) . . . . . [8012-07]

SESSION 2 . . . . . Mon. 10:40 to 11:40 am

Threat Identification I

Session Chair: **Mario O. Münzberg,**
Carl Zeiss Optronics GmbH (Germany)

Blast investigation by fast multispectral radiometric analysis, Adam D. Devir, Yossi Bushlin, Ilan Mendelewicz, Alex B. Lessin, Michael Y. Engel, IARD Sensing Solutions Ltd. (Israel) . . . . . [8012-08]

Open path FTIR detection of threat chemicals in air and on surfaces, Samuel P. Hernandez-Rivera, John R. Castro-Suarez, Leonardo C. Pacheco-Londoño, Orlando Ruiz-Pesante, Miguel Velez-Reyes, Univ. de Puerto Rico Mayagüez (USA); Max Diem, Northeastern Univ. (USA). . . . . [8012-09]

Multicolour microbolometer and VPD PbSe hybrid focal plane sensors for analytical applications, María del Carmen Torquemada, Germán Vergara, María Teresa Rodrigo, Cristina Sierra, Clara Gutierrez, Gloria Pérez, Marta Sánchez, Inés Génova, Marina Verdú, Irene Catalán, Luis Jorge Gómez, Victor Villamayor, Raúl Gutiérrez, Alfredo Heras, Mario Álvarez, David Fernández, Carlos Rivera, María Teresa Magaz, Rosa María Almazán, Ministerio de Defensa (Spain); Sandro Mengali, Roberto Viola, Nicola Liberatore, Carlo Corsi, Consorzio CREO (Italy) . . . . . [8012-10]

Lunch Break . . . . . 11:40 am to 1:00 pm

SESSION 3 . . . . . Mon. 1:00 to 2:20 pm

Threat Identification II

Session Chair: **Ingmar G. Renhorn,**
Swedish Defence Research Agency (Sweden)

Simultaneous multispectral framing infrared camera using an embedded diffractive optical lenslet array, Michele Hinnrichs, Pacific Advanced Technology, Inc. (USA) . . . . . [8012-11]

Infrared-based early warning system for bird strike prevention at Frankfurt airport, Mario O. Münzberg, Holger Vogel, Alexa Schilling, Markus Welk, Carl Zeiss Optronics GmbH (Germany); Heiko Cramer, Jan Schlosshauer, FusionSystems GmbH (Germany). . . . . [8012-12]

Time-varying phase diversity turbulence compensation, Adam van Eekeren, Klamer Schutte, Judith Dijk, Piet B. W. Schwering, TNO Defence, Security and Safety (Netherlands) . . . . . [8012-13]

Scene understanding and task optimisation using multimodal imaging sensors and context: a real-time implementation, Barry Connor, Iain Carrie, Thales Optronics Ltd. (United Kingdom); Jonathan Letham, Neil M. Robertson, Heriot-Watt Univ. (United Kingdom) . . . . . [8012-152]

SESSION 4 . . . . . Mon. 2:20 to 4:30 pm

Smart Image and Signal Processing

Session Chairs: **Paul L. McCarley,** Air Force Research Lab.; **John T. Caulfield,** Cyan Systems

Focal plane generation of multi-resolution and multi-scale image representation for low-power vision applications *(Invited Paper)*, Jorge Fernández-Berni, Ricardo A. Carmona-Galán, Luis Carranza-González, IMSE-CNM (Spain); Akos Zarandy, Computer and Automation Research Institute (Hungary); Ángel B. Rodríguez-Vázquez, IMSE-CNM (Spain). . . . . [8012-14]

Advanced multi-function infrared detector with on-chip processing *(Invited Paper)*, Lidia Langof, Dan Nussinson, Elad Ilan, Shimon Elkind, Roman Dobromislin, Itzik Nevo, Fanny Khinich, Michael Labilov, Zipora Calahorra, Shay Vaserman, Tuvy Markovitz, SCD Semiconductor Devices (Israel); Ofer Manela, Elbit Systems Electro-Optics El-Op Ltd. (Israel) . . . . . [8012-15]

Fast full-search template matching based on normalized cross correlation *(Invited Paper)*, Jik-Han Jung, Hwal-Suk Lee, Ayoung Heo, Jai-Hoon Lee, Dong-Jo Park, KAIST (Korea, Republic of) . . . . . [8012-16]

Analysis and simulation of CTIA-based pixel reset noise *(Invited Paper)*, Daniel A. Van Blerkom, Forza Silicon Corp. (USA). . . . . [8012-18]

Calibration method for division of focal plane polarimeters in the optical and near-infrared regime *(Invited Paper)*, Timothy York, Viktor Gruev, Washington Univ. in St. Louis (USA) . . . . . [8012-19]

SESSION 5 . . . . . Mon. 4:30 to 5:50 pm

QWIP and QDIP

Session Chair: **Philippe F. Bois,** Alcatel-Thales III-V Lab. (France)

Thermo-electrically cooled shortwave infrared and longwave infrared dual-band quantum-dot photodetector, Jarrod N. Vaillancourt, Applied NanoFemto Technologies (USA); Xuejun Lu, Univ. of Massachusetts Lowell (USA) . . [8012-20]

Design of broadband QWIPs, Vincent Guériaux, Alexandru Nedelcu, Agnès Coulibaly, Lydie Dua, Nadia Brière de l'Isle, Virginie Trinité, Xavier Marcadet, Alcatel-Thales III-V Lab. (France) . . . . . [8012-21]

Performance of the QWIP focal plane arrays for NASA's Landsat Data Continuity Mission, Murzy D. Jhabvala, NASA Goddard Space Flight Ctr. (USA); Kwong-Kit Choi, U.S. Army Research Lab. (USA); Augustyn Waczynski, Anh T. La, NASA Goddard Space Flight Ctr. (USA); Mani Sundaram, QmagiQ, LLC (USA); Eric M. Costard, Thales Research & Technology (France); Christine A. Jhabvala, Emily Kan, Duncan M. Kahle, Roger Folz, NASA Goddard Space Flight Ctr. (USA); Nicholas Boehm, Mike Hickey, Global Science & Technology, Inc. (USA); Jason Sun, U.S. Army Research Lab. (USA); Tomoko Adachi, Catholic Univ. of America (USA); Nicholas P. Costen, Larry A. Hess, Munz Engineering Inc. (USA); Hugues Facoetti, Alcatel-Thales III-V Lab. (France) . . . . . [8012-22]

Electromagnetic modeling of C-QWIP FPA pixels, Kwong-Kit Choi, U.S. Army Research Lab. (USA); Murzy D. Jhabvala, NASA Goddard Space Flight Ctr. (USA); David P. Forrai, L-3 Communications Cincinnati Electronics (USA); Augustyn Waczynski, NASA Goddard Space Flight Ctr. (USA); Jason Sun, U.S. Army Research Lab. (USA); Robert A. Jones, L-3 Communications Cincinnati Electronics (USA) . . . . . [8012-23]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 6 . . . . . Tues. 10:00 am to 12:00 pm

Type II Superlattice FPAs I

Session Chairs: **Meimei Z. Tidrow,** U.S. Army Night Vision & Electronic Sensors Directorate; **Manijeh Razeghi,** Northwestern Univ.; **Lucy Zheng,** Institute for Defense Analyses

Update on III-V superlattice material characterization and FPA performance *(Invited Paper)*, Meimei Z. Tidrow, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Lucy Zheng, Institute for Defense Analyses (USA); Sumith Bandara, Leslie Aitcheson, Neil Supola, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8012-24]

Recent advances in high-performance antimonide-based superlattice FPAs *(Invited Paper)*, Manijeh Razeghi, Northwestern Univ. (USA) . . . . . [8012-25]

Current developments for type-II superlattice imaging systems *(Invited Paper)*, Frank Rutz, Robert H. Rehm, Martin Walther, Michael Masur, Andreas Wörl, Johannes Schmitz, Matthias Wauro, Jasmin Niemasz, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany); Ralf Scheibner, Johann Ziegler, AIM INFRAROT-MODULE GmbH (Germany) . . . . . [8012-26]

Performance optimization of long-wave infrared detectors based on InAs/GaSb strained layer superlattices, Elena A. Plis, Nutan Gautam, Stephen A. Myers, Maya N. Kutty, Brianna Klein, Mikhail Naydenkov, Sanjay Krishna, Ctr. for High Technology Materials (USA) . . . . . [8012-27]

Effects of the phonon energy and carrier concentration on the carrier lifetime in LWIR and MWIR type-2 SLS and MCT materials for IR photodetector technology, Gregory Belenky, Stony Brook Univ. (USA); Stefan P. Svensson, U.S. Army Research Lab. (USA); Dmitry V. Donetsky, Sergey D. Suchalkin, Ding Wang, Stony Brook Univ. (USA); David Westerfeld, Power Photonic Corp. (USA); Amy W. Liu, Joel M. Fastenau, Dmitry Loubychev, IQE Inc. (USA) . . . . . [8012-28]

Lunch/Exhibition Break . . . . . 12:00 to 1:30 pm

SESSION 7 . . . . . Tues. 1:30 to 4:40 pm

Type II Superlattice FPAs II

Session Chairs: **Meimei Z. Tidrow,** U.S. Army Night Vision & Electronic Sensors Directorate; **Manijeh Razeghi,** Northwestern Univ.; **Lucy Zheng,** Institute for Defense Analyses

Dual-band response from InAs/GaSb strained layer superlattice detectors with nBn design, Elena Plis, Sanchita Krishna, Sanjay Krishna, SK Infrared LLC (USA) . . . . . [8012-29]

Minority carrier vertical transport in InAs/GaSb type-II strained layer superlattices for infrared focal plane array applications, Jarek Antoszewski, Hemendra Kala, Gilberto A. Umana-Membreno, Mariusz P. Martyniuk, John M. Dell, Lorenzo Faraone, The Univ. of Western Australia (Australia); B. Klein, G. Gautam, Maya N. Kutty, Elena Plis, Sanjay Krishna, The Univ. of New Mexico (USA) . . . . . [8012-30]

Noise performance analysis of MWIR InAs/GaSb superlattice pin photodiodes, Isabelle Ribet-Mohamed, Katarzyna Jaworowicz, ONERA (France); Cyril Cervera, Jean-Baptiste Rodriguez, Philippe Christol, Institut d'Electronique du Sud (France). . . . . [8012-31]

Low-temperature noise measurements of an InAs/GaSb-based nBn MWIR detector, Vincent M. Cowan, Christian P. Morath, Air Force Research Lab. (USA); Stephen A. Myers, Elena A. Plis, Sanjay Krishna, Ctr. for High Technology Materials (USA) . . . . . [8012-32]

Scaling up antimonide wafer production: innovation and challenges for epitaxy ready GaSb and InSb substrates, Mark J. Furlong, Rebecca Martinez, Sasson Amirhaghi, Andrew Mowbray, Brian Smith, Wafer Technology Ltd. (United Kingdom). . . . . [8012-33]

Fabrication and performance of InAs/GaSb superlattice LWIR detectors, Sevag Terterian, Hasan Sharifi, Pierre-Yves Delaunay, Brett Z. Nosho, Mark S. Roebuck, Rajesh D. Rajavel, HRL Labs., LLC (USA) . . . . . [8012-34]

Performance analysis of symmetrical and asymmetrical InAs/GaSb superlattice pin photodiode, Philippe Christol, Rachid Taalat, Cyril Cervera, Jean-Baptiste Rodriguez, Univ. Montpellier 2 (France); Katarzyna Jaworowicz, Isabelle Ribet-Mohamed, ONERA (France); Leszek Konczewicz, Sylvie Contreras, Univ. Montpellier 2 (France). . . . . [8012-35]

Superlattice barrier infrared detector development at the Jet Propulsion Laboratory *(Invited Paper)*, David Z. Ting, Alexander Soibel, Jean Nguyen, Arezou Khoshakhlagh, Linda Höglund, Sir Don B. Rafol, Sam A. Keo, Jason M. Mumolo, John K. Liu, Sarath D. Gunapala, Jet Propulsion Lab. (USA) . . . . . [8012-36]

SESSION 8 . . . . . Tues. 4:40 to 6:00 pm

Emerging Uncooled Technologies

Session Chairs: **Colin E. Reese,** U.S. Army Night Vision & Electronic Sensors Directorate; **Charles M. Hanson,** L-3 Electro-Optical Systems

Toward 17µm pitch heterogeneously integrated Si/SiGe quantum well bolometer focal plane arrays, Per S. Ericsson, Acreo AB (Sweden); Andreas C. Fischer, Fredrik Forsberg, Niclas Roxhed, Royal Institute of Technology (Sweden); Björn Samel, Susan M. Savage, Acreo AB (Sweden); Göran Stemme, Royal Institute of Technology (Sweden); Stanley G. E. Wissmar, Olof Öberg, Acreo AB (Sweden); Frank Niklaus, Royal Institute of Technology (Sweden) . . . . . [8012-37]

Experimental LWIR spectral characterization of wavelength selective microbolometers, Dean P. Neikirk, Joo-Yun Jung, Jong Yeon Park, The Univ. of Texas at Austin (USA); Aniruddha S. Weling, Foster-Miller, Inc. (USA); Will Hafer, James H. Goldie, Infoscitex Corp. (USA); Paul D. Willson, U.S. Army Armament Research, Development and Engineering Ctr. (USA) . . . . . [8012-38]

Infrared phased-array sensor, Brian A. Slovick, Jeffrey A. Bean, Glenn D. Boreman, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8012-39]

High-speed uncooled MWIR hostile fire indication sensor, Lei Zhang, Francis P. Pantuso, Guanghai Jin, Alex Mazurenko, Matthew Erdtmann, Shankar Radhakrishnan, Jack P. Salerno, Agiltron, Inc. (USA). . . . . [8012-40]

Wednesday 27 April

Sessions 9 runs concurrently with session 13.

SESSION 9 . . . . . Wed. 8:00 to 11:30 am

Uncooled FPAs and Applications I

Session Chairs: **Jean-Luc M. Tissot,** ULIS (France); **Avraham Fraenkel,** SCD Semiconductor Devices (Israel)

Uncooled detector development at Raytheon, Steve H. Black, Raytheon Co. (USA) . . . . . [8012-41]

Development of Terahertz focal plane arrays and handy video camera, Naoki Oda, Masahiko Sano, Seiji Kurashina, Hajime Yoneyama, Tokuhito Sasaki, Masaru Miyoshi, Ken'ichi Sonoda, NEC Corp. (Japan); Iwao Hosako, Norihiko sekine, National Institute of Information and Communications Technology (Japan). . . . . [8012-42]

VGA 17 µm development for compact, low-power systems, Jean-Luc M. Tissot, Alain Durand, Patrick Robert, Sébastien Cortial, Cécile Roman, Michel Vilain, Olivier Legras, ULIS (France) . . . . . [8012-43]

Modular, open architecture uncooled video engines based on a DSP processor, Fabian Schapiro, Rotem Gazit, Alex Neboshchik, Yogev Ben Simon, Igal Kogan, Igal Lerman, Adi Aharon, Udi Mizrahi, Shay Maayani, Asaf Amsterdam, Ilan Vaserman, Offir Duman, Rami Frenkel, SCD Semiconductor Devices (Israel) . . . . . [8012-44]

Development of new SOI diode structure for beyond 17 µm pixel pitch SOI diode uncooled IRFPAs, Daisuke Takamuro, Tomohiro Maegawa, Takaki Sugino, Yasuhiro Kosasayama, Takahiro Ohnakado, Hisatoshi Hata, Masashi Ueno, Hiroshi Fukumoto, Kozo Ishida, Mitsubishi Electric Corp. (Japan); Haruyoshi Katayama, Tadashi Imai, Munetaka Ueno, Japan Aerospace Exploration Agency (Japan). . . . . [8012-45]

Improvements of a digital 25 µm pixel-pitch uncooled amorphous silicon TEC-less VGA IRFPA with massively parallel Sigma-Delta-ADC readout, Dirk Weiler, Marco Russ, Daniel Würfel, Renee Lerch, Pin Yang, Jochen Bauer, Jennifer Hess, Piotr Kropelnicki, Holger Vogt, Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme (Germany) . . . . . [8012-46]

Scale down of p-n junction diodes of an uncooled IR-FPA for improvement of the sensitivity and thermal time response by 0.13 µm CMOS technology, Ikuo Fujiwara, Keita Sasaki, Kazuhiro Suzuki, Hitoshi Yagi, Honam Kwon, Hiroto Honda, Koichi Ishii, Masako Ogata, Masaki Atsuta, Risako Ueno, Mitsuyoshi Kobayashi, Hideyuki Funaki, Toshiba Corp. (Japan). . . . . [8012-47]

17 µµm 1024×768 a-Si microbolometer core with low size, weight, and power, Charles M. Hanson, John Brady, Phillip Namour, L-3 Electro-Optical Systems (USA). . . . . [8012-48]

Pixel level packaging for uncooled IRFPA, Geoffroy Dumont, Wilfried Rabaud, Xavier Baillin, Laurent Carle, Michel Pellat, Emanuelle Lagoutte, Valérie Goudon, Claire Vialle, Agnès Arnaud, CEA Leti-MINATEC (France) . . . . . [8012-49]

Standby Oral/Poster Presentation

This poster paper may also be given as an oral presentation in this session.

1024 x 768 XGA uncooled camera core achieves new levels of performance in a small package, C. Alicandro, Sofradir EC, Inc. (USA) . . . . . [8012-150]

SESSION 13 . . . . . Wed. 8:00 to 11:30 am

IR Optics I

Session Chairs: **Jay N. Vizgaitis,** U.S. Army Night Vision & Electronic Sensors Directorate; **Christopher C. Alexay,** StingRay Optics, LLC

Somewhere under the rainbow: the visible to far infrared imaging lens, Troy A. Palmer, Nathanael P. Powers, Christopher C. Alexay, Darin A. Murray, Robert W. Ball, StingRay Optics, LLC (USA) . . . . . [8012-63]

Refractive lens design for simultaneous SWIR and LWIR imaging, Scott W. Sparrold, Eric Herman, Edmund Optics, Inc. (USA) . . . . . [8012-64]

Compact dual field of view SWIR/MWIR optical system, Jay N. Vizgaitis, Kyle Witte, Roy T. Littleton, Philip Perconti, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8012-65]

Optical design of compact multichannel and all-reflective system for infrared imaging, Min Wang, François Châteauneuf, Christian Proulx, INO (Canada) . . . . . [8012-66]

Advanced manufacturing technologies for reduced cost and weight in portable, ruggedized, VIS-IR, multi-mode optical systems, for land, sea, and air, Michael N. Sweeney, Robert Spinazzola, General Dynamics Axsys Technologies (USA). . . . . [8012-67]

Toward infrared DDCA with an imaging function, Guillaume Druart, Nicolas Guérineau, Florence de la Barriere, Joel R. Deschamps, ONERA (France); Manuel Fendler, Nicolas Lhermet, Jacques Rullière, CEA Leti-MINATEC (France); Serge Magli, Yann Reibel, SOFRADIR (France). . . . . [8012-68]

Compact designs of hyper- or multispectral imagers compatible with the detector dewar, Nicolas Guérineau, Guillaume Druart, Frédéric Gillard, Yann Ferrec, Sylvain Rommeluère, Riad Haidar, ONERA (France); Jean Taboury, Lab. Charles Fabry (France); Manuel Fendler, CEA Leti-MINATEC (France) . . [8012-69]

Microcameras based on curved infrared retina: a biomimetic approach, Delphine Dumas, Manuel Fendler, Gilles Lasfargues, Frédéric Berger, Christophe Largeron, Laetitia Adelmini, CEA Leti-MINATEC (France); Guillaume Druart, Jérôme Primot, ONERA (France); Etienne le Coarer, Lab. d'Astrophysique de l'Observatoire de Grenoble (France); Hervé Ribot, CEA Leti-MINATEC (France) . . . . . [8012-70]

Challenges, constraints, and results of lens design for 17 micron-bolometer-FPAs in 8-12 micron waveband, Norbert Schuster, Umicore Electro-Optic Materials (Belgium); John Franks, Umicore Coating Services (United Kingdom). . . . . [8012-71]

SESSION 10 . . . . . Wed. 11:30 am to 12:00 pm

Joint Keynote Session with Conference 8014

Session Chair: **Paul R. Norton,**
U.S. Army Night Vision & Electronic Sensors Directorate

Wide-area infrared surveillance: performance requirements and technology needs *(Keynote Presentation),* Michael T. Eismann, Air Force Research Lab. (USA) . . . . . [8012-50]

Lunch/Exhibition Break . . . . . 12:00 to 1:30 pm

Sessions 11, 12 run concurrently with sessions 14, 15.

SESSION 11 . . . . . Wed. 1:30 to 2:50 pm

Uncooled FPAs and Applications II

Session Chairs: **Masafumi Kimata,** Ritsumeikan Univ. (Japan); **Stefan T. Baur,** Raytheon Vision Systems

Comparison of ion beam and magnetron sputtered vanadium oxide thin films for uncooled IR imaging, Orlando M. Cabarcos, Jing Li, Bryan D. Gauntt, The Pennsylvania State Univ. (USA); Sami Antrazi, 4Wave Inc. (USA); Elizabeth C. Dickey, Dave L. Allara, Hitesh A. Basantani, Mark W. Horn, The Pennsylvania State Univ. (USA) . . . . . [8012-51]

Performance improvement in amorphous silicon-based uncooled microbolometers through pixel design and materials development, Sameer Ajmera, John Brady, William McCardel, Tom Schimert, A. J. Syllaios, Michael Taylor, L-3 Electro-Optical Systems (USA) . . . . . [8012-52]

Uncooled infrared detectors toward smaller pixel pitch with newly proposed pixel structure, Shigeru Tohyama, Tokuhito Sasaki, Tsutomu Endoh, Masahiko Sano, Kouji Katoh, Seiji Kurashina, Masaru Miyoshi, Takao Yamazaki, NEC Corp. (Japan); Munetaka Ueno, Haruyoshi Katayama, Tadashi Imai, Japan Aerospace Exploration Agency (Japan) . . . . . [8012-53]

Uncooled VO_x infrared sensor development and application, Chuan C. Li, DRS Technologies, Inc. (USA) . . . . . [8012-54]

Standby Oral/Poster Presentation

This poster paper may also be given as an oral presentation in this session.

Impacts and mitigation strategies of sun exposure on uncooled microbolometer image sensors, D. A. Dorn, O. Herrera, C. Tesdahl, E. Shumard, A. Wang, Pelco Ft. Collins (USA) . . . . . [8012-149]

SESSION 12 . . . . . Wed. 3:20 to 6:00 pm

NIR/SWIR FPAs and Applications

Session Chair: **Martin H. Ettenberg,** Sensors Unlimited, Inc., part of Goodrich Corp.

Dual-band imaging technology on indium gallium arsenide focal plane arrays, Peter E. Dixon, John A. Trezza, Sensors Unlimited, Inc., part of Goodrich Corp. (USA); Cory D. Hess, Chuan C. Li, DRS Technologies (USA); Martin H. Ettenberg, Sensors Unlimited, Inc., part of Goodrich Corp. (USA) . . . . . [8012-55]

Toward a single-chip TECless/NUCless InGaAs SWIR camera with 120 dB intrinsic operation dynamic range, Yang Ni, New Imaging Technologies SAS (France) . . . . . [8012-56]

Recent advances in SWIR MEMS-based tuneable Fabry-Pérot microspectrometers, Jarek Antoszewski, Thuyen H. Nguyen, Mariusz P. Martyniuk, John M. Dell, Lorenzo Faraone, The Univ. of Western Australia (Australia) . . . . . [8012-57]

Analytic modeling and explanation of ultra-low noise in dense SWIR detector arrays, John A. Trezza, Navneet G. Masaun, Martin H. Ettenberg, Sensors Unlimited, Inc., part of Goodrich Corp. (USA) . . . . . [8012-58]

Modeling of the electrical characteristics of SWIR/MWIR InGaAs/GaAsSb type-II MQW photodiodes, Baile Chen, Jinrong Yuan, Archie L. Holmes, Jr., Univ. of Virginia (USA) . . . . . [8012-59]

MOVPE grown InGaAs/GaAsSb type II quantum well photodiode on InP substrate for SWIR focal plane array, Hiroshi Inada, Hiroki Mori, Youichi Nagai, Yasuhiro Iguchi, Tadashi Saitoh, Kei Fujii, Takashi Ishizuka, Katsushi Akita, Sumitomo Electric Industries, Ltd. (Japan) . . . . . [8012-60]

InGaAs focal plane arrays for low-light-level SWIR imaging, Michael H. MacDougal, Jon Geske, Jim Wang, David Follman, Juan Manzo, Aerius Photonics, LLC (USA); Jonathan Getty, Raytheon Vision Systems (USA) [8012-61]

IR CMOS: ultrafast laser-enhanced silicon detection, Martin U. Pralle, James E. Carey III, SiOnyx Inc. (USA) . . . . . [8012-62]

Standyby Oral/Poster Presentation

This poster paper may also be given as an oral presentation in this session.

Characterization of SiGe-detector arrays for visible-NIR imaging sensor applications, A. K. Sood, E. J. Egerton, Y. R. Puri, Magnolia Optical Technologies, Inc. (USA); N. DiLello, J. L. Hoyt, Massachusetts Institute of Technology (USA); N. Dhar, Defense Advanced Research Projects Agency (USA); R. S. Balcerak, Raymond S. Balcerak, LLC (USA); T. G. Bramhall, U.S. Army Aviation and Missile Command (USA) . . . . . [8012-151]

SESSION 14 . . . . . Wed. 1:30 to 2:10 pm

IR Optics II

Session Chairs: **Christopher C. Alexay,** StingRay Optics, LLC; **Jay N. Vizgaitis,** U.S. Army Night Vision & Electronic Sensors Directorate

Influence of Spinel head window thickness on the performance characteristics of a submarine, panoramic, infrared imaging system, Jonathan M. Nichols, James R. Waterman, Shyam S. Bayya, Ishwar D. Aggarwal, Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA) . . . . . [8012-72]

Development of the automatic focus control unit (AFCU) for the Mobile InfraRed Telescope (MIRT), John S. Allen, U. S. Dept of Defense (USA)[8012-73]

SESSION 15 . . . . . Wed. 2:10 to 5:50 pm

Cryocoolers for IR Focal Plane Arrays

Session Chairs: **Alexander Veprik,** RICOR-Cryogenic & Vacuum Systems (Israel); **Ingo Rühlich,** AIM INFRAROT-MODULE GmbH (Germany); **Ray Radebaugh,** National Institute of Standards and Technology

Development of miniature moving magnet cryocooler, Ingo Rühlich, Markus Mai, Carsten Rosenhagen, AIM INFRAROT-MODULE GmbH (Germany) [8012-74]

Micro cryogenic coolers for IR imaging *(Invited Paper)*, Ryan J. Lewis, Martin Lin, Yunda Wang, Jill Cooper, Victor M. Bright, Yung Cheng Lee, Univ. of Colorado at Boulder (USA); Peter Bradley, Ray Radebaugh, Marcia Huber, National Institute of Standards and Technology (USA) . . . . . [8012-75]

Adaptation of the low-cost and low-power tactical split Stirling cryogenic cooler for aerospace applications, Alexander Veprik, Semeon Zechtzer, Nachman Pundak, RICOR-Cryogenic & Vacuum Systems (Israel); Carl S. Kirkconnell, Jeremy Freeman, Iris Technology Corp. (USA); Sergey V. Riabzev, EADS Astrium Ltd. (United Kingdom) . . . . . [8012-76]

Low-vibration microminiature tactical split Stirling cryogenic cooler for infrared aerospace applications, Alexander Veprik, Semeon Zechtzer, Nachman Pundak, RICOR-Cryogenic & Vacuum Systems (Israel); Carl S. Kirkconnel, Jeremy Freeman, Iris Technology Corp. (USA); Sergey V. Riabzev, EADS Astrium Ltd. (United Kingdom) . . . . . [8012-77]

FLIR submicro cooler IDCA, Uri Binnun, FLIR Systems, Inc. (USA) . . . . [8012-78]

Release for production if the most compact microcooler in the Thales cryogenic rotary monobloc range, Jean-Yves Martin, Sebastien Freche, Rene J. Griot, Tonny Benschop, Thales Cryogénie S.A. (France) . . . . . [8012-79]

1/5 W linear cryocooler for infrared applications, Mark Squires, Cobham Mission Systems (USA) . . . . . [8012-80]

Lifetime testing results and diagnostic performance prediction of linear coolers at Thales Cryogenics, Hans van der Weijden, Thales Cryogenics B.V. (Netherlands) . . . . . [8012-81]

RICOR's new development of a highly reliable integral rotary cooler - engineering and reliability aspects, Avishai Filis, Zeev Porat, RICOR-Cryogenic & Vacuum Systems (Israel) . . . . . [8012-82]

Thursday 28 April

SESSION 16 . . . . . Thurs. 8:00 to 11:30 am

HOT - High Operating Temperature FPAs

Session Chairs: **Michael T. Eismann,** Air Force Research Lab.; **Stuart B. Horn,** U.S. Army Night Vision & Electronic Sensors Directorate

High-operating temperature MWIR photon detectors based on type II InAs/GaSb superlattice *(Invited Paper)*, Manijeh Razeghi, Binh-Minh Nguyen, Siamak A. Pour, Guanxi Chen, Minh-Anh Hoang, Simeon Bogdanov, Northwestern Univ. (USA) . . . . . [8012-83]

MWIR InAsSb XBn detector arrays operating at 150 K *(Invited Paper)*, Philip Klipstein, Olga Klin, Steve Grossman, Noam Snapi, Inna Lukomsky, Maya Brumer, Michael Yassen, Daniel Aronov, Eyal Berkowitz, Alexander Glozman, Tal Fishman, Osnat Magen, Itay Shtrichman, Eliezer Weiss, SCD Semiconductor Devices (Israel) . . . . . [8012-84]

InAsSb detectors for visible to MWIR high-operating temperature applications *(Invited Paper)*, Arvind I. D'Souza, Adrian C. Ionescu, Michael M. Salcido, Ernest Robinson, Larry C. Dawson, Daniel Okerlund, DRS Sensors & Targeting Systems, Inc. (USA); Terry J. deLyon, Rajesh D. Rajavel, Hasan Sharifi, Daniel Yap, Michael L. Beliciu, HRL Labs., LLC (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA). . . . . [8012-85]

Use of unipolar barriers to block dark currents in infrared detectors *(Invited Paper),* Gary W. Wicks, Gregory R. Savich, Janet R. Pedrazzani, Shimon Maimon, Univ. of Rochester (USA). . . . . [8012-86]

Development of interband cascade infrared photodetectors, Zhaobing Tian, Rui Q. Yang, The Univ. of Oklahoma (USA); John F. Klem, Sandia National Labs. (USA); Tetsuya D. Mishima, Michael B. Santos, Matthew B. Johnson, The Univ. of Oklahoma (USA) . . . . . [8012-87]

High-operating temperature IR-modules with reduced pitch for SWaP sensitive applications, Rainer Breiter, Joachim C. Wendler, Holger Lutz, Stefan Rutzinger, Tobias Ihle, Johann Ziegler, AIM INFRAROT-MODULE GmbH (Germany) . . . . . [8012-88]

HOT infrared detectors using MCT technology, Michel Vuillermet, Michel Zecri, Laurent Rubaldo, Alexandre Kerlain, SOFRADIR (France); Laurent R. Mollard, Johan Rothman, Nicolas Baier, CEA Leti-MINATEC (France). . . . . [8012-89]

High-operating temperature (HOT) broadband quantum-dot infrared photodetector (QDIP), Puminun Vasinajindakaw, Guiru Gu, Xifeng Qian, Shivashankar R. Vangala, William D. Goodhue, Xuejun Lu, Univ. of Massachusetts Lowell (USA) . . . . . [8012-90]

Digital 640×512/15 µm InSb detector for high-frame rate, high-sensitivity, and low-power applications, Tuvy Markovitz, Igor Pivnik, Zipora Calahorra, Elad Ilan, Itay Hirsh, Eran Zeierman, Ezra Kahanov, Igal Kogan, Nir Fishler, SCD Semiconductor Devices (Israel). . . . . [8012-91]

SESSION 17 . . . . . Thurs. 11:30 am to 12:10 pm

Active Imaging I

Session Chair: **R. Kennedy McEwen,** SELEX Galileo Ltd. (United Kingdom)

Ion implantation study of Be in InSb for the fabrication of IR detectors, Josh Duran, Univ. of Dayton (USA) and Air Force Research Lab. (USA); Andrew M. Sarangan, Univ. of Dayton (USA); Thomas R. Nelson, Air Force Research Lab. (USA) . . . . . [8012-92]

New developments in HgCdTe APDs and ladar receivers, Michael D. Jack, Raytheon Co. (USA) . . . . . [8012-93]

Lunch/Exhibition Break . . . . . 12:10 to 1:30 pm

SESSION 18 . . . . . Thurs. 1:30 to 2:10 pm

Active Imaging II

Session Chair: **R. Kennedy McEwen,** SELEX Galileo Ltd. (United Kingdom)

Design and development of 256x256 linear mode low-noise avalanche photodiode arrays, Ping Yuan, Rengarajan Sudharsanan, Xiaogang Bai, Joseph C. Boisvert, Paul A. McDonald, James J. Chang, Spectrolab, Inc. (USA) [8012-94]

A 320x256 HgCdTe avalanche photodiode focal plane array for passive and active 2D and 3D imaging, Eric De Borniol, Johan Rothman, Fabrice Guellec, Pierre Castelein, Gérard L. Destéfanis, CEA Leti-MINATEC (France) . . . . [8012-95]

SESSION 19 . . . . . Thurs. 2:10 to 4:50 pm

HgCdTe

Session Chairs: **Philippe Tribolet,** SOFRADIR (France); **Joseph G. Pellegrino,** U.S. Army Night Vision & Electronic Sensors Directorate; **Michel Vuillermet,** SOFRADIR (France)

Remembering Philippe Tribolet *(Presentation Only)*, Philippe Bensussan, SOFRADIR (France). . . . . [8012-96]

Large format high-operability SWIR and MWIR focal plane array performance and capabilities, James W. Bangs, Raytheon Vision Systems (USA) . . . [8012-97]

MCT IR detectors in France, Gérard L. Destéfanis, CEA Leti-MINATEC (France); Philippe Tribolet, Michel Vuillermet, SOFRADIR (France) . . . . . [8012-98]

Latest detector developments with HgCdTe grown by MOVPE on GaAs substrates, Chris D. Maxey, Paul Abbott, Les G. Hipwood, Chris L. Jones, Peter Knowles, Jim P. Price, SELEX Galileo Infrared Ltd. (United Kingdom). . . [8012-99]

The development of 3rd gen IR detectors at AIM, Johann Ziegler, Detlef Eich, Karl-Martin Mahlein, Timo Schallenberg, Ralf Scheibner, Joachim C. Wendler, Jan Wenisch, Richard Wollrab, AIM INFRAROT-MODULE GmbH (Germany); Volker Daumer, Robert H. Rehm, Frank Rutz, Martin Walther, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany) . . . . . [8012-100]

Infrared dual-color and dual-band detectors for next generation, Yann Reibel, Fabien Chabuel, David Billon-Lanfrey, SOFRADIR (France); Jacques Baylet, Philippe Ballet, Gérard L. Destéfanis, CEA Leti-MINATEC (France) . . . . [8012-101]

Electro-optical characteristics of a p $^{+}$n long-wavelength HgCdTe photodiode limited by auger intrinsic carrier recombination for T>40K, Roger E. DeWames, Corbin Co. (USA); Patrick G. Maloney, Curtis Billman, Joseph G. Pellegrino, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [8012-102]

Standby Oral/Poster Presentation

This poster paper may also be given as an oral presentation in this session.

On the role of dislocations in influencing the electrical properties of HgCdTe photodiodes, R. K. Sharma, Solid State Physics Lab. (India); V. Gopal, IDST (India); R. Saxena, R. K. Bhan, R. Pal, V. Dhar, R. Muralidharan, Solid State Physics Lab. (India) . . . . . [8012-148]

SESSION 20 . . . . . Thurs. 4:50 to 6:10 pm

IR Optical Materials

Session Chair: **Simon Thibault,** Univ. Laval (Canada)

Dual-band antireflection coatings on 3rd Gen lenses, Thomas D. Rahmlow, Jr., Jeanne E. Lazo-Wasem, Rugate Technologies, Inc. (USA); Jay N. Vizgaitis, Justin Flanagan-Hyde, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [8012-103]

Infrared hybrid glass-polymer optics: combining the thermal stability of glass with low manufacturing cost of polymers, Valentina V. Doushkina, Qioptiq Polymer, Inc. (USA) . . . . . [8012-104]

Emerging results for producing low-scatter EN clad and bare Al mirrors: enabling technology for new tactical instruments, Keith G. Carrigan, Jay Daniel, J. B. Barentine, Tony B. Hull, L-3 Communications Tinsley Labs. Inc. (USA) . . . . . [8012-105]

Indium fluoride glass fiber for infrared applications up to 5.5 µm, Mohammed Saad, IRphotonics Inc. (Canada). . . . . [8012-106]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Technical and market trends for microbolometers for thermography and night vision, Eric Mounier, Yole Développement (France) . . . . . [8012-123]

100mm diameter GaSb substrates with extended IR wavelength for advanced space-based applications, Lisa P. Allen, Patrick Flint, Greg Meshew, Gordon Dallas, Daniel Bakken, Galaxy Compound Semiconductors, Inc. (USA); Gail J. Brown, Air Force Research Lab. (USA); Arezou Khoshakhlagh, Cory J. Hill, Jet Propulsion Lab. (USA) . . . . . [8012-124]

A high fill-factor high-SNR CMOS image sensor for IR camera applications, Varun Shenoy, Daniel McBride, Sungyong Jung, Hyejin Moon, The Univ. of Texas at Arlington (USA) . . . . . [8012-125]

A self-protecting uncooled microbolometer structure for uncooled microbolometer, Youngmin Jo, Il-Woong Kwon, Dong Soo Kim, Hyun Bin Shim, Hee Chul Lee, KAIST (Korea, Republic of) . . . . . [8012-126]

Electric characteristic of nickel oxide film for the mirobolometer, Yong Soo Lee, Kyungpook Univ. (Korea, Republic of); Dong Soo Kim, KAIST (Korea, Republic of); Jong Hoon Kim, Kyungpook Univ. (Korea, Republic of); Hee Chul Lee, KAIST (Korea, Republic of) . . . . . [8012-127]

Non-cryogenically cooled amorphous/polycrystalline InSb and $InAs_{0.3}Sb_{0.7}$ films for long-wavelength infrared detection, Timothy W. C. Zens, Massachusetts Institute of Technology (USA) and Air Force Institute of Technology (USA); Alvin J. Drehman, Air Force Research Lab. (USA); Piotr Becla, Anuradha M. Agarwal, Lionel C. Kimerling, Massachusetts Institute of Technology (USA) . . . . . [8012-128]

Design of multiple demeaning filters for small target detection in infrared imageries, Won-Chul Choi, Jai-Hoon Lee, Ayoung Heo, Dong-Jo Park, KAIST (Korea, Republic of) . . . . . [8012-129]

Image processing module for high-speed thermal camera with cooled detector, Henryk Madura, Grzegorz Bieszczad, Tomasz Sosnowski, Mariusz Kastek, Tomasz Orzanowski, Military Univ. of Technology (Poland) . . . [8012-130]

Design of ROIC based on switched capacitor TDI for MCT LWIR focal plane arrays, Huseyin Kayahan, Melik Yazici, Omer Ceylan, Yasar Gurbuz, Sabanci Univ. (Turkey) . . . . . [8012-131]

Suppression of saturation based on low histogram for uncooled infrared detector, Changhan Park, Samsung Thales Co., Ltd. (Korea, Republic of) . . . . . [8012-132]

Interpolation methods for division of focal plane polarimeters, Shengkui Gao, Viktor Gruev, Washington Univ. in St. Louis (USA) . . . . . [8012-133]

MWIR continuous zoom with large zoom range, Mark C. Sanson, James Cornell, Brian P. Roy, Stephen Herbert, Kenneth Woodard, Corning Incorporated (USA) . . . . . [8012-134]

Apache Point Observatory (APO) notch filter design, John S. Allen, U. S. Dept. of Defense (USA) . . . . . [8012-135]

The advantages of using a digital temperature controller in a miniature Stirling cryogenic refrigerator, Shilo Ninburg, RICOR-Cryogenic & Vacuum Systems (Israel) . . . . . [8012-136]

High-temperature Ricor controller, Shaul Keidar, RICOR-Cryogenic & Vacuum Systems (Israel) . . . . . [8012-137]

Performance of 4.0W/60K pulse tube cryocooler for large-scale long-wave infrared focal plane arrays, Haizheng Dang, Shanghai Institute of Technical Physics (China) . . . . . [8012-138]

Development of high-capacity pulse tube cryocoolers at 80K for infrared focal plane array applications, Haizheng Dang, Shanghai Institute of Technical Physics (China) . . . . . [8012-139]

Stirling-cycle cooler reliability growth at L-3 CE, David P. Arndt, Dan Kuo, Quang Phan, L-3 Communications Cincinnati Electronics (USA) . . . . . [8012-140]

Characterization of quantum cascade laser-based emissivity monitor for CORSAIR, Maung T. Lwin, Princeton Univ. (USA) and Utah State Univ., Energy Dynamic Lab. (USA); Michael D. Wojcik, Utah State Univ., Energy Dynamic Lab. (USA) . . . . . [8012-141]

Quantum cascade laser as a mid-infrared photovoltaic and photoconductive detector, Xing Chen, David Shyu, Fow-Sen Choa, Univ. of Maryland, Baltimore County (USA); Sudhir B. Trivedi, Brimrose Corp. of America (USA) . . . . [8012-142]

Radiation properties of a laser source suitable for a muonic-hydrogen experiment: a DFB-QCL emitting at 6,8 µm, Lyubomir I. Stoychev, The Abdus Salam International Ctr. for Theoretical Physics (Italy); Andrea Vacchi, Milohum M. Dzagli, Komlan Gadedjisso-Tossou, Istituto Nazionale di Fisica Nucleare (Italy); Joseph Niemela, The Abdus Salam International Ctr. for Theoretical Physics (Italy) . . . . . [8012-143]

Different approximation for carrier statistic in non-parabolic MWIR HgCdTe photovoltaic devices, Jun Wang, National Synchrotron Radiation Lab. (China) and Shanghai Institute of Technical Physics (China) and Univ. of Science and Technology of China (China); Xiaoshuang Chen, Weida Hu, Lin Wang, Yongguo Chen, Wei Lu, Shanghai Institute of Technical Physics (China); Faqiang Xu, National Synchrotron Radiation Lab. (China) and Univ. of Science and Technology of China (China) . . . . . [8012-144]

Study of photosensitive area extension in HgCdTe photodiodes using scanning laser microscopy, Yongguo Chen, Weida Hu, Xiaoshuang Chen, Jun Wang, Wei Lu, Shanghai Institute of Technical Physics (China) . . . . . [8012-145]

VPD PbSe technology fills the existing gap in uncooled, low-cost and fast IR imagers, Rodrigo Linares-Herrero, Raúl Gutiérrez, María Teresa Montojo, Arturo Baldasano, New Infrared Technologies, Ltd. (Spain) . . . . . [8012-146]

A detailed analysis for the absorption coefficient of multilevel uncooled infrared detectors, Seniz E. Kucuk, Yusuf Tanrikulu, Tayfun Akin, Middle East Technical Univ. (Turkey) . . . . . [8012-153]

A 2-stage digital-to-analog converter for bias correction in uncooled microbolometer arrays, Alperen Toprak, Murat Tepegoz, Tayfun Akin, Middle East Technical Univ. (Turkey) . . . . . [8012-154]

A thermal conductance optimization approach for uncooled microbolometers, Sukru U. Senveli, Yusuf Tanrikulu, Tayfun Akin, Middle East Technical Univ. (Turkey) . . . . . [8012-155]

Oral Standby/Posters . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Advanced manufacturing methods for chalcogenide molded optics, Gabriel S. Cogburn, LightPath Technologies, Inc. (USA) . . . . . [8012-147]

On the role of dislocations in influencing the electrical properties of HgCdTe photodiodes, Rajesh K. Sharma, Solid State Physics Lab. (India); Vishnu Gopal, IDST (India); Raghavendra Saxena, R. K. Bhan, Ravindra Pal, Vikram Dhar, Rangarajan Muralidharan, Solid State Physics Lab. (India) . . . . . [8012-148]

Impacts and mitigation strategies of sun exposure on uncooled microbolometer image sensors, David A. Dorn, Oscar Herrera, Curtis Tesdahl, Eric Shumard, Alan Wang, Pelco Ft. Collins (USA) . . . . . [8012-149]

1024 x 768 XGA uncooled camera core achieves new levels of performance in a small package, Christopher Alicandro, Sofradir EC, Inc. (USA) . . . [8012-150]

Characterization of SiGe-detector arrays for visible-NIR imaging sensor applications, Ashok K. Sood, Elwood J. Egerton, Yash R. Puri, Magnolia Optical Technologies, Inc. (USA); Nicole DiLello, Judy L. Hoyt, Massachusetts Institute of Technology (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA); Raymond S. Balcerak, Raymond S. Balcerak, LLC (USA); Thomas G. Bramhall, U.S. Army Aviation and Missile Command (USA) . . . . . [8012-151]

Friday 29 April

SESSION 21 . . . . . Fri. 8:00 to 10:20 am

Application of Selected Technologies

Session Chairs: **John L. Miller,** FLIR Systems, Inc.;
John W. Devitt, Georgia Tech Research Institute

A field spectral reflectometer to characterize surfaces in the infrared from the NIR to the LWIR, Louis M. Moreau, Hugo A. Bourque, Claude B. Roy, Christian A. Vallieres, ABB Analytical Measurement (Canada) . . . . . [8012-107]

Long-wave infrared (8 to 14 µm) hyperspectral imager based on an uncooled thermal camera and the traditional CI block interferometer, Dario Cabib, Moshe Lavi, Amir Gil, CI Systems (Israel) Ltd. (Israel). . . . . [8012-108]

Compact dewar and electronics for large-format infrared detectors, Alain Manissadjian, Serge Magli, Eric Mallet, François Barillot, SOFRADIR (France) . . . . . [8012-109]

Increasing dynamic range of cameras with Dynamic Sunlight Filter (DSF), Ariela Donval, Tali Fisher, Dima Cheskis, Yuval Ofir, Moshe Oron, KiloLambda Technologies, Ltd. (Israel) . . . . . [8012-110]

Integrated approach to optomechanical system development, Thomas E. Reney, Kenneth Woodard, Richard L. Wiggins, Lovell E. Comstock, Corning NetOptix (USA) . . . . . [8012-111]

Classification of thermal face images using radial basis function neural network, Mrinal K. Bhowmik, Debotosh Bhattacharjee, Dipak K. Basu, Jadavpur Univ. (India) . . . . . [8012-112]

The research on infrared small-target detection technology under complex background, Lei Liu, Xin Wang, Jilu Chen, Nanjing Univ. of Science & Technology (China) . . . . . [8012-113]

SESSION 22 . . . . . Fri. 10:50 to 11:50 am

Various Uncooled Detector Technologies I

Session Chairs: **John L. Miller,** FLIR Systems, Inc.;
Bjørn F. Andresen, SCD Semiconductor Devices (Israel)

Further applications for mosaic pixel FPA technology, Kevin C. Liddiard, Electro-optic Sensor Design (Australia). . . . . [8012-114]

Toward very high-resolution infrared camera core, Loïc Le Noc, Bruno Tremblay, Luc Mercier, Martin Morissette, Julie Lambert, INO (Canada); Denis Tang, Dept. of National Defence (Canada); Alain Bergeron, INO (Canada) . . . . . [8012-115]

A look at non-uniformity correction in the spatial frequency domain, Guy Raz, Yuval Weiss, Elbit Systems Electro-Optics El-Op Ltd. (Israel) . . . . . [8012-17]

Lunch Break . . . . . 11:50 am to 1:00 pm

SESSION 23 . . . . . Fri. 1:00 to 3:30 pm

Various Uncooled Detector Technologies II

Session Chairs: **John L. Miller,** FLIR Systems, Inc.;
Bjørn F. Andresen, SCD Semiconductor Devices (Israel)

Development of integrated noncryogenic cooled carbon nanotube-based infrared focal plane array, Ning Xi, Michigan State Univ. (USA). . . . . [8012-116]

New materials for uncooled IR imaging: nickel manganite thin films grown by spin spray, Song Won Ko, Jing Li, Elizabeth C. Dickey, Susan Trollier-McKinstry, The Pennsylvania State Univ. (USA) . . . . . [8012-117]

Microstructural aspects of thin film vanadium oxide used for uncooled infrared imaging, Bryan D. Gauntt, Orlando M. Cabarcos, Jing Li, Hitesh A. Basantani, S. S. N. Bharadwaja, Nikolas J. Podraza, Thomas N. Jackson, Elizabeth C. Dickey, Chandru Venkatasubramanian, The Pennsylvania State Univ. (USA); Sami Antrazi, 4Wave Inc. (USA); Dave L. Allara, Mark W. Horn, The Pennsylvania State Univ. (USA). . . . . [8012-118]

Thin film silicon and germanium for uncooled IR microbolometer applications, Nikolas J. Podraza, David B. St. John, Hang-Beum Shin, Myung-Yoon Lee, Elizabeth C. Dickey, Thomas N. Jackson, The Pennsylvania State Univ. (USA) . . . . . [8012-119]

A 256 pixel pyroelectric linear array with new black coating, Volkmar Norkus, Marco Schossig, Gerald U. Gerlach, Technische Univ. Dresden (Germany); Reinhard Köhler, DIAS Infrared GmbH (Germany) . . . . . [8012-120]

Small-pitch high-performance thermopile focal plane arrays, David Kryskowski, UD Holdings LLC (USA) . . . . . [8012-121]

Application of Graphene for infrared detection, Ahalapitiya H. Jayatissa, Madhav Gautam, The Univ. of Toledo (USA) . . . . . [8012-122]

Courses of Related Interest

SC067 **Testing and Evaluation of E-O Imaging Systems** (Holst) Thursday, 8:30 am to 5:30 pm
SC152 **Infrared Focal Plane Arrays** (Dereniak, Hubbs) Monday, 1:30 to 5:30 pm
SC154 **Electro-Optical Imaging System Performance** (Holst) Friday, 8:30 am to 5:30 pm
SC178 **Introduction to Radiometry and Photometry** (Grant) Monday, 8:30 am to 12:30 pm
SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Tuesday, 8:30 am to 5:30 pm
SC194 **Multispectral and Hyperspectral Image Sensors** (Lomheim) Wednesday, 8:30 am to 12:30 pm
SC214 **Infrared Window and Dome Materials** (Harris) Tuesday, 8:30 am to 5:30 pm
SC278 **Infrared Detectors** (Dereniak) Monday, 8:30 am to 12:30 pm
SC659 **Understanding Reflective Optical Design** (Contreras) Thursday, 8:30 am to 5:30 pm
SC713 **Engineering Approach to Imaging System Design** (Holst) Monday, 8:30 am to 5:30 pm
SC755 **Infrared Optics and Zoom Lenses** (Mann) Thursday, 8:30 am to 12:30 pm
SC789 **Introduction to Optical and Infrared Sensor Systems** (Shaw) Friday, 8:30 am to 5:30 pm
SC835 **Infrared Systems - Technology & Design** (Daniels) Monday-Tuesday, 8:30 am to 5:30 pm
SC838 **Laser Range Gated Imaging Techniques** (Duncan) Tuesday, 1:30 to 5:30 pm
SC892 **Infrared Search and Track Systems** (Schwering) Tuesday, 8:30 am to 5:30 pm
SC900 **Uncooled Thermal Imaging Detectors and Systems** (Hanson) Monday, 8:30 am to 5:30 pm
SC944 **The Radiometry Case Files** (Grant) Monday, 1:30 to 5:30 pm
SC947 **Cost-Conscious Tolerancing of Optical and IR Systems** (Youngworth, Contreras) Wednesday, 8:30 am to 5:30 pm
SC950 **Infrared Imaging Radiometry** (Richards) Tuesday, 8:30 am to 5:30 pm
SC1000 **Introduction to Infrared and Ultraviolet Imaging Technology** (Richards) Monday, 1:30 to 5:30 pm
SC1035 **Military Laser Safety** (Marshall) Wednesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Thermosense: Thermal Infrared Applications XXXIII

THERMOSENSE MISSION STATEMENT

The purpose of Thermosense is to promote the exchange of information pertaining to the use of infrared sensing and imaging instruments for diagnostics and controls. Presentations should address the solutions to problems and their reduction to practice.

THERMOSENSE BACKGROUND

Thermosense is the oldest and largest international technical meeting focused on scientific, industrial and general uses of Infrared Imaging and Infrared Temperature Measurements. Its regular printed proceedings are found in most scientific and engineering libraries, providing an unequaled depth and breadth of technical information and reference data. Further information regarding Thermosense can be found at: www.thermosense.org

Monday 25 April

Vendor Presentations and Reception

Mon. 5:00 to 8:30 pm

This event features brief presentations from hardware and software vendors on what is new this year in their product lines that impact thermal imaging applications and practices.

What's New in Hardware and Software at the 2011 SPIE Defense, Security, and Sensing Exhibition?

This Special Session was started six years ago and has been a very popular, well-attended success. Its intent is to bring together vendors and early arrival ThermoSense and DSS exhibitors to highlight the newest products and services being shown at the Exhibition. In this way, busy technical conference attendees can better prioritize their activities when visiting the exhibits. It is also a relaxed opportunity for getting to know one another better and to have informal discussions on matters of mutual interest. A program of approximately 10-minute vendor presentations starts the session, followed by a reception with snacks and soft drinks.

Any DSS exhibitor offering products or services related to infrared sensing or imaging can participate, but vendor time slots are limited and available on a first-come first-served basis. If you are interested in participating or have any questions, please contact:

Herb Kaplan, Vendors Session 2011 Moderator, hkaplan@earthlink.net
or
Andres Rozlosnik, aer@termografia.com

Confirmed Presentations:

STINGRAY OPTICS, LLC (Booth 411)
StingRay MWIR & LWIR Thermal Imaging Systems, Achromatically Corrected SWIR Lenses and Accessories
Presenters: **Jennifer Myers,** Sales and Marketing Manager and **Shannon Largig,** Sales Engineer

CI SYSTEMS, INC. (Booth 500)
Hyperspectral imaging, gas sensing, New SR 7000 spectroradiometer and new CVF (Circular Variable Filter) and other new CI products
Presenter: **Garrick Matheson**

BOULDER IMAGING, INC. (Booth 1130)
Making Multi Spectral Imagery Useful
Presenter: **Carlos Jorquera,** CEO & CTO

TELOPS INC. (Booth 1024)
Hyperspectral Imaging Applications in Defense & Security
Presenters: **Paul Chabot,** Vice-President Sales & Marketing

THERMOTEKNIX SYSTEMS LTD (Booth 1117)
Thermoteknix greatest hits
Presenter: **Alistair Brown,** Imaging Products Manager

XENICS INFRARED SOLUTIONS (Booth 3119)
Recent realizations in sensor fusion of Multiple wavelength products
Presenter: **Jan Vermeiren,** Technology Development Manager

NEW INFRARED TECHNOLOGIES (Booth 3305)
The MATRIX 1024 SERIES: Applications of High-Speed Uncooled MWIR Imaging Sensors
Presenter: **Rodrigo Linares,** Director of Marketing/Sales and Marketing Manager

SCD.USA (Booth 771)
SCD's New Products
Presenter: **Niels Jacksen,** VP of Technology

IRCAM GMBH (Booth 1231)
New IRCAM Products
Presenter: **Monica Lopez Saenz,** Managing Director of IRCAM

FLIR COMMERCIAL SYSTEMS INC. (Booth 700)
Quark Camera: A New Standard for SWaP
Presenter: **Dan Walker,** VP Product Development

JEOL USA, INC. (Booth 3706)
JEOL's Portable Scanning Electron Microscopes for Product Development to Final Inspection
Presenters: **Donna Guarrera,** Assistant Director, SM Division and **David Edwards**

Additional Vendors may join at the end of the session as time allows.

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 1 . . . . . Tues. 10:00 to 11:20 am

Pyrometry and Radiometry

Session Chairs: **Morteza Safai,** The Boeing Co.; **Herbert Kaplan,** Honeyhill Technical Co.

A polynomial regression approach to subpixel temperature extraction from a single-band thermal infrared image, Sarah Paul, Carl Salvaggio, Rochester Institute of Technology (USA) . . . . . [8013-01]

New developments in the NIST spectral radiance and radiance temperature metrology in the thermal and far infrared, Sergey N. Mekhontsev, Leonard M. Hanssen, Vladimir B. Khromchenko, Boris Wilthan, National Institute of Standards and Technology (USA). . . . . [8013-02]

Status of the NIST program for infrared emittance measurement, Leonard M. Hanssen, Boris Wilthan, Sergey N. Mekhontsev, National Institute of Standards and Technology (USA). . . . . [8013-03]

Measurement of true temperature fields by bicolor thermoreflectometry, Gilblas Remi, Thierry Sentenac, Ecole des Mines d'Albi (France); Daniel Hernandez, Procedes, Materiaux et Energie Solaire (France); Yannick Le Maoult, Ecole des Mines d'Albi (France) . . . . . [8013-04]

SESSION 2 . . . . . Tues. 11:20 am to 12:00 pm

Industrial Applications: Biological

Session Chairs: **Timo T. Kauppinen,** VTT Technical Research Ctr. of Finland (Finland); **Ralph B. Dinwiddie,** Oak Ridge National Lab.; **Andrés E. Rozlosnik,** SI Termografía Infrarroja (Argentina)

Use of infrared imaging for investigation of chicken embryo development, Ryan A. Frye, Vanderbilt Univ. (USA); Sheng-Jen Hsieh, José B. D. Girón Palomares, Texas A&M Univ. (USA) . . . . . [8013-05]

Dynamic infrared imaging for biological and medical applications in Boron neutron capture therapy, Gustavo A. Santa Cruz, Sara J. González, Alejandra Dagrosa, Amanda Schwint, Marina Carpano, Verónica Trivillin, Esteban F. Boggio, Comision Nacional de Energia Atomica (Argentina); José Bertotti, Univ. Favaloro (Argentina); Julio Marín, Andrea Monti Hughes, Ana Molinari, Comision Nacional de Energia Atomica (Argentina); Miguel Albero, INVAP S E (Argentina) . . [8013-06]

Lunch/Exhibition Break . . . . . 12:00 to 1:00 pm

SESSION 3 . . . . . Tues. 1:00 to 2:00 pm

Industrial Applications: Buildings

Session Chairs: **Timo T. Kauppinen,** VTT Technical Research Ctr. of Finland (Finland); **Ralph B. Dinwiddie,** Oak Ridge National Lab.; **Andrés E. Rozlosnik,** SI Termografía Infrarroja (Argentina)

Using a combination of aerial infrared and handheld infrared cameras for measuring, analyzing, and prioritizing the thermal performance of "big box" buildings, Gregory R. Stockton, Stockton Infrared Thermographic Services, Inc. (USA) . . . . . [8013-07]

Improvement of energy efficiency: the use of thermography and air-tightness test in verification of thermal performance of school buildings, Timo T. Kauppinen, VTT Technical Research Ctr. of Finland (Finland) . . . . . [8013-08]

A hybrid, infrared thermography: heat diffusion equation, method for the 3D air-temperature measurement, Frank B. D. Djupkep, Xavier P. V. Maldague, Abdel Hakim Bendada, Univ. Laval (Canada) . . . . . [8013-09]

SESSION 4 . . . . . Tues. 2:00 to 4:10 pm

Industrial Applications: Petrochemical and Pipeline Applications

Session Chairs: **Timo T. Kauppinen,** VTT Technical Research Ctr. of Finland (Finland); **Ralph B. Dinwiddie,** Oak Ridge National Lab.; **Andrés E. Rozlosnik,** SI Termografía Infrarroja (Argentina)

IR gas cloud imaging in oil and gas applications: immunity to false stimuli, Edward Naranjo, Shakar B. Baliga, John H. Park, General Monitors Inc. (USA); Philippe Bernascolle, Bertin Technologies (France) . . . . . [8013-10]

Development of a gas leak detection method based on infrared spectrum imaging utilizing microbolometer camera, Takahide Sakagami, Kobe Univ. (Japan); Hiroaki Anzai, Shiro Kubo, Osaka Univ. (Japan) . . . . . [8013-11]

Detectivity of gas leakage based on electromagnetic radiation transfer, Yunting Long, Jiakun Li, Changxing Zhang, Bei Zhang, Lingxue Wang, Beijing Institute of Technology (China) . . . . . [8013-12]

IR evaluation of insulated pipelines to detect trapped water that could cause corrosion under insulation (CUI), Douglas Burleigh, La Jolla Cove Consulting (USA) . . . . . [8013-13]

Corrosion detection on pipelines by IR thermography, Paolo Bison, Sergio Marinetti, Graziano P. Cuogo, Consiglio Nazionale delle Ricerche (Italy); Paolo Zonta, Venezia Tecnologie S.p.A (Italy); Ermanno G. Grinzato, Consiglio Nazionale delle Ricerche (Italy) . . . . . [8013-14]

SESSION 5 . . . . . Tues. 4:10 to 5:30 pm

Industrial Applications: Electronics

Session Chairs: **Timo T. Kauppinen,** VTT Technical Research Ctr. of Finland (Finland); **Ralph B. Dinwiddie,** Oak Ridge National Lab.; **Andrés E. Rozlosnik,** SI Termografía Infrarroja (Argentina)

Enhancing time resolution of infrared cameras using a heterodyne approach: application to the mapping of fast temperature transients upon electronic micro-chips, Nabil Boutellis, Abdel Hakim Bendada, Univ. Laval (Canada); Jean-Christophe Batsale, Christophe Pradere, Ecole Nationale Supérieure d'Arts et Métiers (France). . . . . [8013-15]

Comparative analysis of pulse and active thermography for investigating solder joint geometry prediction, Becky M. Vela, Sheng-Jen Hsieh, José B. D. Girón Palomares, Texas A&M Univ. (USA) . . . . . [8013-16]

Using 3D infrared imaging to calibrate and refine computational fluid dynamic modeling for large computer and data centers, Gregory R. Stockton, Stockton Infrared Thermographic Services, Inc. (USA). . . . . [8013-17]

Infrared imaging of LED lighting tubes and fluorescent tubes, Sami Siikanen, VTT Technical Research Ctr. of Finland (Finland) . . . . . [8013-18]

Wednesday 27 April

SESSION 6 . . . . . Wed. 8:00 to 9:00 am

Industrial Applications: Solar Cells

Session Chairs: **Nicolas P. Avdelidis,** National Technical Univ. of Athens (Greece); **Ralph A. Rotolante,** MoviTherm

A thermographic survey for evaluating in situ the performance of photovoltaic panels, Nicolas P. Avdelidis, National Technical Univ. of Athens (Greece); Yiannis Markopoulos, Ioannis Katsis, Green Project S.A. (Greece); Maria Koui, National Technical Univ. of Athens (Greece) . . . . . [8013-19]

Infrared lock-in techniques for solar cell inspection, Ralph A. Rotolante, MoviTherm (USA) . . . . . [8013-20]

The use of infrared imaging with actual input and output power measurements to significantly change the weighted average power conversion efficiencies for photovoltaic solar plant inverters, Gregory R. Stockton, Stockton Infrared Thermographic Services, Inc. (USA) . . . . . [8013-21]

SESSION 7 . . . . . Wed. 9:00 to 11:10 am

Industrial Applications: Miscellaneous

Session Chairs: **Nicolas P. Avdelidis,** National Technical Univ. of Athens (Greece); **Ralph A. Rotolante,** MoviTherm

IR imaging for machine vision and process control, Jason Styron, FLIR Systems, Inc. (USA). . . . . [8013-22]

Experimental study of the detection of buried landmines in soils with increasing water content by infrared imaging, Danilo J. Dadamia, Univ. de Buenos Aires (Argentina); Eduardo H. Castro, Univ. de Buenos Aires (Argentina) and CITEDEF (Argentina). . . . . [8013-23]

High-speed IR monitoring of a turbojet engine gas flow using an uncooled MWIR imaging sensor, Rodrigo Linares-Herrero, María Teresa Montojo, Raúl Gutiérrez, Arturo Baldasano, New Infrared Technologies, Ltd. (Spain). . . [8013-24]

Measurement method based on directional contrast in infrared image for tracking filter, Wanjae Lee, Changhan Park, Samsung Thales Co., Ltd. (Korea, Republic of) . . . . . [8013-25]

Implementation of thermographers certification in Brazil, Laerte Santos, Furnas Centrais Elétricas S.A. (Brazil); Luiz M. Alves, ABENDI (Brazil); Edson C. Bortoni, Univ. Federal de Itajubá (Brazil) . . . . . [8013-26]

SESSION 8 . . . . . Wed. 11:10 am to 12:10 pm

IR NDT Theory I

Session Chairs: **Douglas Burleigh,** La Jolla Cove Consulting; **Jeff R. Brown,** Hope College; **K. Elliott Cramer,** NASA Langley Research Ctr.

Signal and image processing techniques for digitized frequency modulated thermal-wave imaging for characterization of fiber-reinforced plastics, Ravibabu Mulaveesala, Subbarao V. Ghali, Lokendra K. Balyan, Subir S. Lamba, Indian Institute of Information Technology (India) . . . . . [8013-27]

Automatic thermographic image defect detection in composites, Bin Luo, Bjorn Liebenberg, Jeffery Raymont, S. P. Santospirito, Kingston Computer Consultancy Ltd. (United Kingdom) . . . . . [8013-28]

Fixed eigenvector analysis of thermographic NDE data, K. Elliott Cramer, William P. Winfree, NASA Langley Research Ctr. (USA) . . . . . [8013-29]

Lunch/Exhibition Break. . . . . 12:10 to 1:20 pm

SESSION 9 . . . . . Wed. 1:20 to 2:20 pm

IR NDT Theory II

Session Chairs: **Douglas Burleigh,** La Jolla Cove Consulting; **Jeff R. Brown,** Hope College; **K. Elliott Cramer,** NASA Langley Research Ctr.

Improved flaw detection and characterization with difference thermography, William P. Winfree, Joseph N. Zalameda, Patricia A. Howell, NASA Langley Research Ctr. (USA) . . . . . [8013-30]

Defense and illustration of the pulse-stimulated IR thermography for NDE *(Invited Paper)*, Daniel L. Balageas, ONERA (France) . . . . . [8013-31]

SESSION 10 . . . . . Wed. 2:20 to 5:30 pm

IR NDT Methods and Applications

Session Chairs: **Douglas Burleigh,** La Jolla Cove Consulting; **Jeff R. Brown,** Hope College; **K. Elliott Cramer,** NASA Langley Research Ctr.

Automated transient thermography for the inspection of CFRP structures: experimental results and developed procedures, Panagiotis Theodorakeas, Nicolas P. Avdelidis, Kostas Chryssagis, National Technical Univ. of Athens (Greece); Clemente Ibarra-Castanedo, Univ. Laval (Canada); Maria Koui, National Technical Univ. of Athens (Greece); Xavier P. V. Maldague, Univ. Laval (Canada) . . . . . [8013-32]

Issues in on-aircraft application of thermographic NDT, Steven M. Shepard, Thermal Wave Imaging, Inc. (USA) . . . . . [8013-33]

Thinning identification technique using stainless steel film heater and response surface method, Nagahisa Ogasawara, Hiroyuki Yamada, National Defense Academy (Japan). . . . . [8013-34]

Real-time principle component analysis for thermograms processing and fusion, Mohammed A. Omar, Yi Zhou, Qin Shen, Clemson Univ. (USA) . [8013-35]

Detection of subsurface defects in metallic materials with thermo-inductive inspection, Beate Oswald-Tranta, Mario Sorger, Montan Univ. Leoben (Austria) . . . . . [8013-36]

Thermography based inspection of turbine airfoils, Steven M. Shepard, Thermal Wave Imaging, Inc. (USA) . . . . . [8013-37]

Pulse and lock-in IR NDT in complex structures, Markus Tarin, moviMED (USA) . . . . . [8013-38]

Infrared thermography as a nondestructive tool for materials characterisation and assessment, Tat-Hean Gan, TWI Ltd. (United Kingdom); Nicolas P. Avdelidis, National Technical Univ. of Athens (Greece). . . . . [8013-39]

Thursday 28 April

SESSION 11 . . . . . Thurs. 8:00 to 10:20 am

Materials Evaluation and Detection

Session Chairs: **Takahide Sakagami,** Kobe Univ. (Japan); **Morteza Safai,** The Boeing Co.

Fiber optic thermal detection of composite delaminations, Meng-Chou Wu, William P. Winfree, NASA Langley Research Ctr. (USA). . . . . [8013-40]

Thermoelastic stress analysis of overlap shear splices constructed from wet lay-up FRP composites, Jeff R. Brown, Benjamin Fineout, Hope College (USA) . . . . . [8013-41]

Preliminary investigation of polarization effects during metal cutting, Eric Whitenton, National Institute of Standards and Technology (USA) . . . . . [8013-42]

Infrared imaging during ballistic testing of self-healing materials, K. Elliott Cramer, Sidney G. Allison, Eric R. Burke, Patricia A. Howell, William T. Yost, NASA Langley Research Ctr. (USA) . . . . . [8013-43]

Modeling of laser-analyte-substrate interaction in photo-thermal infrared imaging and laser trace vaporization, Robert Furstenberg, Jakob Grosser, Christopher A. Kendziora, Michael R. Papantonakis, R. Andrew McGill, U.S. Naval Research Lab. (USA). . . . . [8013-44]

Application of micro-scale thermography to the thermal analysis of polymeric and organic materials, Junko Morikawa, Tokyo Institute of Technology (Japan); Eita Hayakawa, ai-Phase Co., Ltd. (Japan); Toshimasa Hashimoto, Tokyo Institute of Technology (Japan). . . . . [8013-45]

Infrared imaging for process control of laser glass tube, Monica Lopez Saenz, Oliver Schreer, IRCAM GmbH (Germany) . . . . . [8013-46]

Courses of Related Interest

SC152 **Infrared Focal Plane Arrays** (Dereniak, Hubbs) Monday, 1:30 to 5:30 pm
SC278 **Infrared Detectors** (Dereniak) Monday, 8:30 am to 12:30 pm
SC835 **Infrared Systems - Technology & Design** (Daniels) Monday-Tuesday, 8:30 am to 5:30 pm
SC900 **Uncooled Thermal Imaging Detectors and Systems** (Hanson) Monday, 8:30 am to 5:30 pm
SC950 **Infrared Imaging Radiometry** (Richards) Tuesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Tuesday-Thursday 26-28 April 2011 • Proceedings of SPIE Vol. 8014

Infrared Imaging Systems: Design, Analysis, Modeling, and Testing XXII

Conference Chairs: **Gerald C. Holst,** JCD Publishing; **Keith A. Krapels,** U.S. Army Night Vision & Electronic Sensors Directorate

Program Committee: **Piet Bijl,** TNO Defence, Security and Safety (Netherlands); **Ronald G. Driggers,** U.S. Naval Research Lab.; **Richard L. Espinola,** U.S. Army Night Vision & Electronic Sensors Directorate; **David P. Forrai,** L-3 Communications Cincinnati Electronics; **Terrence S. Lomheim,** The Aerospace Corp.; **Alan Irwin,** Santa Barbara Infrared, Inc.; **Hector Reyes,** Raytheon Co.; **Endre Repasi,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Joseph P. Reynolds,** U.S. Army Night Vision & Electronic Sensors Directorate; **Bernard M. Rosier,** ONERA (France); **Ronald B. Sartain,** U.S. Army Research Lab.; **Michael A. Soel,** FLIR Systems, Inc.; **Curtis M. Webb,** Northrop Grumman Corp.

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan
Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

Introduction and Review of 22 Conference Years. . . . . Tues. 1:00 to 1:20 pm

Session Chair: **Gerald C. Holst,** JCD Publishing

SESSION 1 . . . . . Tues. 1:20 to 3:00 pm

Modeling Non-Thermal Imaging Systems

Session Chairs: **Ronald G. Driggers,** U.S. Naval Research Lab.; **Keith A. Krapels,** U.S. Army Night Vision & Electronic Sensors Directorate; **Terrence S. Lomheim,** The Aerospace Corp.

Modeling of pixel edge effects in a novel micro-filter array for the visible spectrum, Frida E. Strömqvist Vetelino, Ali A. Abtahi, Aerospace Missions Corp. (USA); Peter B. Griffin, Stanford Univ. (USA); Ricky J. Morgan, Usha Raghuram, Aerospace Missions Corp. (USA) . . . . . [8014-01]

Conspicuity of moving soldiers in the field, Jaap A. Beintema, Alexander Toet, Sjoerd C. de Vries, TNO Defence, Security and Safety (Netherlands) . . . [8014-02]

Modeling human performance with low-light sparse color imagers, David P. Haefner, Jae H. Cha, Joseph P. Reynolds, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8014-03]

Visibility of F-16's with the naked eye, NVG's, and thermal sensor, Frank L. Kooi, TNO Defence, Security and Safety (Netherlands) . . . . . [8014-04]

Passive SWIR sky-glow illuminated imaging compared with NIR-visible for low-light nighttime observations, David C. Dayton, Jeffery G. Allen, John D. Gonglewski, Applied Technology Associates (USA) . . . . . [8014-05]

SESSION 2 . . . . . Tues. 3:40 to 4:40 pm

Modeling Thermal Imaging Systems I

Session Chairs: **Ronald G. Driggers,** U.S. Naval Research Lab.; **Keith A. Krapels,** U.S. Army Night Vision & Electronic Sensors Directorate; **Terrence S. Lomheim,** The Aerospace Corp.

Modeling MRT for well characterized thermal imagers, Stephen D. Burks, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8014-06]

Performance evaluation of panoramic electro-optic imagers using the TOD method, Pierre Desaulniers, Simon Thibault, Univ. Laval (Canada) . . . . . [8014-07]

Thermal imager non-uniformity sources modeling, Emanuele Guadagnoli, Claudio Giunti, SELEX Galileo S.p.A. (Italy); Paolo Mariani, ALTRAN Italy S.p.A. (Italy); Monica Olivieri, Antonio Porta, Barbara Sozzi, Stefano Zatti, SELEX Galileo S.p.A. (Italy) . . . . . [8014-08]

WORKSHOP. . . . . Tues. 4:50 to 6:00 pm

New NVESD Performance

Speakers: **Brian Teaney, Joseph Reynolds,** U.S. Army Night Vision & Electronic Sensors Directorate

The US Army Night Vision and Electronic Sensors Directorate (NVESD) recently released a beta version of the next generation Integrated Performance Model (NV-IPM). Details concerning the changes to the model interface along with a discussion of model capabilities and a demonstration of existing model functionality will be the focus of this presentation. A discussion of updates to the model theory including revisions to the noise model, aliasing as noise, and the development of a fully 2D model will also be included.

Wednesday 27 April

SESSION 3 . . . . . Wed. 8:40 to 10:00 am

Modeling Thermal Imaging Systems II

Session Chairs: **Hector Reyes,** Raytheon Co.; **Joseph P. Reynolds,** U.S. Army Night Vision & Electronic Sensors Directorate; **Piet Bijl,** TNO Defence, Security and Safety (Netherlands)

Matched filtering determines human visual search in natural images, Alexander Toet, TNO Defence, Security and Safety (Netherlands) and Univ. van Amsterdam (Netherlands) . . . . . [8014-09]

Analytical calculation for probability of detection given time-dependent search parametes, Melvin H. Friedman, Joseph P. Reynolds, David L. Wilson, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Ronald G. Driggers, U.S. Naval Research Lab. (USA) . . . . . [8014-10]

Drift-insensitive dim-target detection using differential correlation, Alan Y. Hsu, Sandia National Labs. (USA). . . . . [8014-11]

Software toolkit for evaluating infrared imaging seeker, Marianne A. Degache, TNO Defence, Security and Safety (Netherlands). . . . . [8014-12]

SESSION 4 . . . . . Wed. 10:40 to 11:20 am

Modeling Thermal Imaging Systems III

Session Chairs: **Hector Reyes,** Raytheon Co.; **Joseph P. Reynolds,** U.S. Army Night Vision & Electronic Sensors Directorate; **Piet Bijl,** TNO Defence, Security and Safety (Netherlands)

Collaborative search with independent sensors, Melvin H. Friedman, Joseph P. Reynolds, Todd W. Du Bosq, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8014-13]

LWIR thermal imaging through dust obscuration, Forrest A. Smith, Eddie L. Jacobs, Srikant K. Chari, Jason M. Brooks, The Univ. of Memphis (USA) . . . . . [8014-14]

SESSION 5 . . . . . Wed. 11:30 am to 12:00 pm

Joint Keynote Session with Conference 8012

Session Chair: **Paul R. Norton,**
U.S. Army Night Vision & Electronic Sensors Directorate

Wide-area infrared surveillance: performance requirements and technology needs *(Keynote Presentation)*, Michael T. Eismann, Air Force Research Lab. (USA) . . . . . [8012-50]

Lunch/Exhibition Break . . . . . 12:00 to 1:20 pm

SESSION 6 . . . . . Wed. 1:20 to 3:00 pm

Modeling Thermal Imaging Systems IV

Session Chairs: **Ronald B. Sartain,** U.S. Army Research Lab.;
Michael A. Soel, FLIR Systems, Inc.

Performance assessment of treating aliased signal as target-dependent noise, Bradley L. Preece, David P. Haefner, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8014-15]

Identification of human activities in a thermal system with noise varied in temporal frequency, Jason M. Brooks, Eddie L. Jacobs, Forrest A. Smith, The Univ. of Memphis (USA) . . . . . [8014-16]

System considerations of aerial infrared imaging for wide-area persistent surveillance, Melvin R. Kruer, John N. Lee, Dale C. Linne von Berg, Grant Howard, U.S. Naval Research Lab. (USA); Jason A. Edelberg, V-Systems, Inc. (USA) . . . . . [8014-17]

Developing adequate definitions for detection, recognition, and identification of human targets, Patrick D. O'Shea, Jeffrey T. Meier, U.S. Army Redstone Technical Test Ctr. (USA) . . . . . [8014-18]

TOD to TTP calibration, Piet Bijl, TNO Defence, Security and Safety (Netherlands); Joseph P. Reynolds, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Wouter K. Vos, Maarten A. Hogervorst, Jonathan D. Fanning, TNO Defence, Security and Safety (Netherlands) . . . . . [8014-19]

SESSION 7 . . . . . Wed. 3:30 to 4:50 pm

Modeling Thermal Imaging Systems V

Session Chairs: **Ronald B. Sartain,** U.S. Army Research Lab.;
Michael A. Soel, FLIR Systems, Inc.

Dependence on target spatial frequency signatures in infrared performance modeling, Todd W. Du Bosq, Jeffrey T. Olson, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [8014-20]

Estimating the blur kernel for blurry IR imagery from edge profiles, Leslie N. Smith, James R. Waterman, U.S. Naval Research Lab. (USA) . [8014-21]

Development of a moving platform model from the ACQUIRE model using first principles, Steve K. Moyer, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8014-22]

Comparison of the performance of LWIR and MWIR thermal imagers for varying ambient temperature and humidity conditions, Vikram Dhar, Zafar Khan, Rajesh K. Sharma, Rangarajan Muralidharan, Solid State Physics Lab. (India) . . . . . [8014-23]

Thursday 28 April

SESSION 8 . . . . . Thurs. 8:00 to 10:00 am

Targets, Backgrounds, and Atmospherics I

Session Chairs: **Endre Repasi,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany);
Bernard M. Rosier, ONERA (France); **Richard L. Espinola,** U.S. Army Night Vision & Electronic Sensors Directorate

Improved signature prediction through coupling of ShipIR and CFD, David A. Vaitekunas, W. R. Davis Engineering, Ltd. (Canada). . . . . [8014-24]

Simulation of laser beam reflection at the sea surface, Frédéric Schwenger, Endre Repasi, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [8014-25]

SMART and SMARTI: visible and IR atmospheric radiative transfer libraries optimized for wide-band applications, Vincent Ross, AEREX avionique inc. (Canada); Denis Dion, Jr., Defence Research and Development Canada (Canada) . . . . . [8014-26]

Simulation of a laser range-gated SWIR imaging system in weak turbulence conditions, David E. Oxford, Defence Science and Technology Lab. (United Kingdom); Richard L. Espinola, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8014-27]

Computer simulation of image degradations by atmospheric turbulence for horizontal views, Endre Repasi, Robert Weiss, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [8014-28]

Spatial and temporal variability of SWIR air glow measurements, David C. Dayton, Jeffery Allan, Rudolf Nolasco, Applied Technology Associates (USA); John D. Gonglewski, Michael M. Myers, Air Force Research Lab. (USA). [8014-29]

SESSION 9 . . . . . Thurs. 10:30 to 11:50 am

Targets, Backgrounds, and Atmospherics II

Session Chairs: **Endre Repasi,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Bernard M. Rosier,** ONERA (France); **Richard L. Espinola,** U.S. Army Night Vision & Electronic Sensors Directorate

Statistics of the point spread function for imaging through turbulence, Mikhail I. Charnotskii, Zel Technologies, LLC (USA) . . . . . [8014-30]

CART V: recent advancements in computer-aided camouflage assessment, Thomas Müller, Markus Müller, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany). . . . . [8014-31]

A simple physical model for simulating turbulent imaging, Guy Potvin, J. Luc Forand, Denis Dion, Jr., Defence Research and Development Canada (Canada) . . . . . [8014-32]

MATISSE-v2.0: new functionalities and comparison with MODIS satellite images, Luc Labarre, ONERA (France); Karin Stein, Norbert Wendelstein, Caroline Schweitzer, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Karine Caillault, Sandrine Fauqueux, Claire Malherbe, Antoine Roblin, Bernard M. Rosier, Pierre Simoneau, ONERA (France). . . . . [8014-33]

Lunch/Exhibition Break . . . . . 11:50 am to 1:00 pm

SESSION 10 . . . . . Thurs. 1:00 to 3:00 pm

Testing I

Session Chairs: **Alan Irwin,** Santa Barbara Infrared, Inc.;
Curtis M. Webb, Northrop Grumman Electronic Systems

3D detector noise revisited, Astrid Lundmark, Autoliv Electronics AB (Sweden) . . . . . [8014-34]

MRi dual-band MWIR imaging FTS, Louis M. Moreau, Claude B. Roy, Stéphane Lantagne, Florent Prel, Christian A. Vallieres, ABB Analytical Measurement (Canada) . . . . . [8014-35]

Design and characterization of an integral uniform radiance source for integral veiling glare testing of optical systems, Joseph Jablonski, Greg A. McKee, Chris Durell, Labsphere, Inc. (USA) . . . . . [8014-36]

Confirming the performance of LWIR optical systems: an affordable high-accuracy lens measurement system, Stephen D. Fantone, Daniel Orband, Jian Zhang, Roger Kirschner, Optikos Corp. (USA) . . . . . [8014-37]

Blackbody source technology trends, Jason A. Mazzetta, Stephen D. Scoptaz, John E. Sgheiza, Miguel A. Medina, Electro Optical Industries, Inc. (USA)[8014-38]

Calibration and control of a large dynamic range visible source, Joseph D. LaVeigne, Nathan Radtke, Santa Barbara Infrared, Inc. (USA) . . . . . [8014-39]

SESSION 11 . . . . . Thurs. 3:30 to 5:10 pm

Testing II

Session Chairs: **Alan Irwin,** Santa Barbara Infrared, Inc.;
Curtis M. Webb, Northrop Grumman Electronic Systems

Removing ths statistical bias from three-dimensional noise measurements, Ze'ev Bomzon, CI Systems (Israel) Ltd. (Israel). . . . . [8014-40]

A common architecture for TPS development, Brian Nehring, Alan Irwin, Joseph D. LaVeigne, Santa Barbara Infrared, Inc. (USA) . . . . . [8014-41]

SR-5000N: spectroradiometer's new performance improvements in FOV flatness, scan speed, and other important features, Dario Cabib, Moshe Lavi, Amir Gil, Shmuel Shapira, CI Systems (Israel) Ltd. (Israel) . . . . . [8014-42]

Increased responsivity pyroelectric radiometer with dome input and temperature control, George P. Eppeldauer, Jinan Zeng, Leonard M. Hanssen, National Institute of Standards and Technology (USA). . . . . [8014-43]

Fast MTF and aberrations analysis of MWIR and LWIR imaging systems using quadri wave interferometry, Sabrina Velghe, Djamel Brahmi, William Boucher, Benoit F. Wattellier, PHASICS S.A. (France) . . . . . [8014-44]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Dual-wavelength transfer standard for laser peak-power measurement, Rodney Leonhardt, National Institute of Standards and Technology (USA); Daniel King, Naval Surface Warfare Ctr. Corona Div. (USA) . . . . . [8014-45]

Field performance evaluation for Heliborne FLIR systems by the devised conversion methodology, Kee Tae Han, Agency for Defense Development (Korea, Republic of). . . . . [8014-46]

SIFT-based localization and tracking in IR imaging system, Changhan Park, Samsung Thales Co., Ltd. (Korea, Republic of) . . . . . [8014-47]

Laboratory for testing electro-optical surveillance systems, Krzysztof Chrzanowski, Military Univ. of Technology (Poland). . . . . [8014-48]

Precision centering error measurement of assembled IR optics in the wavelength range from 3-5 and 8-12µm, Josef Heinisch, Helge Pannhoff, Trioptics GmbH (Germany) . . . . . [8014-49]

Feasibility analysis and demonstration of high-speed digital imaging using micro-arrays of vertical cavity surface-emitting lasers, Mark A. Mentzer, U.S. Army Aberdeen Test Ctr. (USA). . . . . [8014-50]

Courses of Related Interest

SC152 **Infrared Focal Plane Arrays** (Dereniak, Hubbs) Monday, 1:30 to 5:30 pm
SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Tuesday, 8:30 am to 5:30 pm
SC278 **Infrared Detectors** (Dereniak) Monday, 8:30 am to 12:30 pm
SC755 **Infrared Optics and Zoom Lenses** (Mann) Thursday, 8:30 am to 12:30 pm
SC835 **Infrared Systems - Technology & Design** (Daniels) Monday-Tuesday, 8:30 am to 5:30 pm
SC892 **Infrared Search and Track Systems** (Schwering) Tuesday, 8:30 am to 5:30 pm
SC900 **Uncooled Thermal Imaging Detectors and Systems** (Hanson) Monday, 8:30 am to 5:30 pm
SC1000 **Introduction to Infrared and Ultraviolet Imaging Technology** (Richards) Monday, 1:30 to 5:30 pm

See full course listing and descriptions on pp. 144-192.

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Wednesday-Thursday 27-28 April 2011 • Proceedings of SPIE Vol. 8015

Technologies for Synthetic Environments: Hardware-in-the-Loop XVI

Conference Chair: **Scott B. Mobley,** U.S. Army AMRDEC

Conference Co-Chair: **R. Lee Murrer, Jr.,** Millennium Engineering and Integration Co.

Program Committee: **James A. Annos,** U.S. Navy; **Gary H. Ballard,** U.S. Army AMRDEC; **David B. Beasley,** Optical Sciences Corp.; **James A. Buford, Jr.,** Missile Defense Agency; **Dennis H. Bunfield,** The AEgis Technologies Group, Inc.; **Raul Fainchtein,** The Johns Hopkins Univ.; **W. Larry Herald,** MacAulay Brown Inc.; **Hajin J. Kim,** U.S. Army AMRDEC; **John M. Lannon, Jr.,** RTI International; **Heard Lowry,** Aerospace Testing Alliance; **William M. Lowry,** U.S. Army Redstone Technical Test Ctr.; **Robert W. Mitchell,** Ideal Aerosmith, Inc.; **Ronald J. Rapp,** Air Force Research Lab.; **Richard M. Robinson,** The AEgis Technologies Group, Inc.; **Donald R. Snyder,** Air Force Research Lab.; **Florence C. Solomon,** U.S. Air Force; **Leszek Swierkowski,** Defence Science and Technology Organisation (Australia); **Brian K. Woode,** Naval Air Warfare Ctr.

Wednesday 27 April

Welcome and Announcements . . . . . Wed. 8:15 to 8:40 am

Session Chair: **Scott B. Mobley,**
U.S. Army Aviation and Missile Command

SESSION 1 . . . . . Wed. 8:40 to 11:40 am

Scene Simulation: Enabling Technologies

Session Chairs: **David B. Beasley,** Optical Sciences Corp.;
Donald R. Snyder, Air Force Research Lab.;
John M. Lannon, Jr., RTI International

IR emitter non-uniformity correction (NUC): making sense of the data, Jim Oleson, Oleson Convergent Solutions LLC. (USA); Breck A. Sieglinger, Ronald J. Rapp, Air Force Research Lab. (USA); Derek Greer, Naval Air Warfare Ctr. Aircraft Div. (USA) . . . . . [8015-01]

IR imaging bundles for HWIL testing, Brandon Shaw, Daniel J. Gibson, U.S. Naval Research Lab. (USA); Gabrielle Farrar, Univ. Research Foundation (USA); Rafael Gattass, Vinh Q. Nguyen, Jasbinder S. Sanghera, Ishwar D. Aggarwal, U.S. Naval Research Lab. (USA) . . . . . [8015-02]

MWIR LED performance enhancement by nano-plasmon layer, Naresh Das, Wayne Chang, U.S. Army Research Lab. (USA) . . . . . [8015-03]

Contrast analysis for DMD-based IR scene projector, Julia Rentz Dupuis, David J. Mansur, OPTRA, Inc. (USA). . . . . [8015-04]

Multispectral polarized scene projector (MPSP), Le Li, Kent Optronics, Inc. (USA) . . . . . [8015-05]

System for driving 2D infrared emitter arrays at cryogenic temperatures, Corey Lange, Rodney McGee, Fouad E. Kiamilev, Univ. of Delaware (USA) . . . . . [8015-06]

Lunch/Exhibition Break . . . . . 11:40 am to 1:20 pm

SESSION 2 . . . . . Wed. 1:20 to 3:00 pm

HWIL in Systems Integration Testing

Session Chairs: **Brian K. Woode,** Naval Air Warfare Ctr. Aircraft Div.;
Richard M. Robinson, The AEgis Technologies Group, Inc.;
James A. Buford, Jr., Missile Defense Agency

Integrated optical payload simulator, Jun-Ho Lee, Seungyeol Ryoo, Kongju National Univ. (Korea, Republic of); Doo-Chun Seo, Ji-Yeon Yang, Korea Aerospace Research Institute (Korea, Republic of). . . . . [8015-07]

Allegany Ballistics Lab.: Sensor Test Target System, Deran Eaton, Naval Surface Warfare Ctr. Indian Head Div. (USA) . . . . . [8015-08]

Missile airframe simulation testbed: MANPADS (MAST-M) for test and evaluation of aircraft survivability equipment, James L. Clements III, U.S. Army Aviation and Missile Command (USA); Richard M. Robinson, Joseph Robinson, The AEgis Technologies Group, Inc. (USA). . . . . [8015-09]

Rapid common hardware-in-the-loop development, Hajin J. Kim, U.S. Army Research, Development and Engineering Command (USA); Stephen Moss, The AEgis Technologies Group, Inc. (USA) . . . . . [8015-10]

SESSION 3 . . . . . Wed. 3:30 to 4:45 pm

HWIL Enabling Technologies

Session Chairs: **Heard Lowry,** Aerospace Testing Alliance;
Ronald J. Rapp, Air Force Research Lab.; **Hajin J. Kim,** U.S. Army Research, Development and Engineering Command

Calibration and deployment of a new NIST transfer radiometer for broadband and spectral calibration of space chambers (MDXR), Timothy M. Jung, Jung Research and Development Corp. (USA); Adriaan C. Carter, Booz Allen Hamilton Inc. (USA); Solomon I. Woods, Simon G. Kaplan, National Institute of Standards and Technology (USA). . . . . [8015-11]

Development of technologies for imaging sensor testing at AEDC, Heard Lowry, Aerospace Testing Alliance (USA) . . . . . [8015-12]

Fine range-motion simulation for hardware-in-the-loop testing of monostatic-pulsed LFM radars, Richard F. Olson, Jr., U.S. Army Aviation and Missile Command (USA) . . . . . [8015-13]

Thursday 28 April

Welcome and Announcements . . . . . Thurs. 8:15 to 8:40 am

Session Chair: **Scott B. Mobley,**
U.S. Army Aviation and Missile Command

SESSION 4 . . . . . Thurs. 8:40 to 11:15 am

Scene Generation Technologies

Session Chairs: **James A. Annos,** U.S. Navy;
Dennis H. Bunfield, The AEgis Technologies Group, Inc.

DRDC's approach to IR scene generation for IRCM simulation, Jean-François Lepage, Defence Research and Development Canada (Canada); Marc-André Labrie, Éric Rouleau, Jonathan Richard, LTI Informatique et Génie (Canada); Vincent Ross, AEREX avionique inc. (Canada); Denis Dion, Jr., Nathalie Harrison, Defence Research and Development Canada (Canada). . . . . [8015-14]

Real-time maritime scene simulation for LADAR sensors, Chad L. Christie, Efthimios T. Gouthas, Leszek Swierkowski, Defence Science and Technology Organisation (Australia) . . . . . [8015-15]

High-fidelity real-time maritime scene rendering, Thomas M. Taczak, Applied Technology Inc. (USA); Haw-Jye S. Shyu, U.S. Naval Research Lab. (USA); Kevin Cox, Space/Ground System Solutions, Inc. (USA); Colin P. Cahill, Envisioneering, Inc. (USA); Carlos G. Maraviglia, Robert E. Gover, U.S. Naval Research Lab. (USA) . . . . . [8015-16]

EO/IR scene generation open source initiative for real-time hardware-in-the-loop and all-digital simulation, Darian E. Trimble, The AEgis Technologies Group, Inc. (USA); William M. Lowry, U.S. Army Redstone Technical Test Ctr. (USA); Joseph W. Morris, U.S. Army Research, Development and Engineering Command (USA); Brett A. Boren, U.S. Army Redstone Technical Test Ctr. (USA); Dennis H. Bunfield, James B. Towers, The AEgis Technologies Group, Inc. (USA) . . . . . [8015-17]

The multispectral advanced volumetric real-time imaging compositor for real-time distributed scene generation, Dennis H. Bunfield, Thomas E. Peddycoart, Darian E. Trimble, The AEgis Technologies Group, Inc. (USA); Joseph W. Morris, Gary H. Ballard, U.S. Army Aviation and Missile Research Development and Engineering Ctr. (USA) . . . . . [8015-18]

SESSION 5 . . . . . Thurs. 11:15 am to 12:30 pm

Flight Motion Simulation Technology

Session Chairs: **R. Lee Murrer, Jr.,** Millennium Engineering and Integration Co.; **Robert W. Mitchell,** Ideal Aerosmith, Inc.; **Gary H. Ballard,** U.S. Army Aviation and Missile Command

Analysis of a flight motion controller, Thanh L. Vu, Russell M. Thamm, Defence Science and Technology Organisation (Australia). . . . . [8015-19]

Novel distributed real-time control system for a target motion simulator, Robin Hauser, Martin Kägi, Dominik Gunsch, Walter Rindlisbacher, Peter Wälti, ACUTRONIC Switzerland Ltd. (Switzerland) . . . . . [8015-20]

GPS synchronization of a motion simulator for hardware-in-the-loop applications, Robert W. Mitchell, Jay D. Marchetti, Ideal Aerosmith, Inc. (USA) . . . . . [8015-21]

Courses of Related Interest

SC152 **Infrared Focal Plane Arrays** (Dereniak, Hubbs) Monday, 1:30 to 5:30 pm
SC278 **Infrared Detectors** (Dereniak) Monday, 8:30 am to 12:30 pm
SC835 **Infrared Systems - Technology & Design** (Daniels) Monday-Tuesday, 8:30 am to 5:30 pm
SC900 **Uncooled Thermal Imaging Detectors and Systems** (Hanson) Monday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Wednesday-Thursday 27-28 April 2011 • Proceedings of SPIE Vol. 8016

Window and Dome Technologies and Materials XII

Conference Chair: **Randal W. Tustison,** Raytheon Co.

Program Committee: **Ishwar D. Aggarwal,** U.S. Naval Research Lab.; **Joel Askinazi,** Goodrich Corp.; **Richard Gentilman,** Raytheon Co.; **Daniel C. Harris,** Naval Air Systems Command; **Brian K. Jones,** U.S. Army Research, Development and Engineering Command; **John S. McCloy,** Pacific Northwest National Lab.; **Robert J. Ondercin,** Air Force Research Lab.; **Adrienne E. Selz,** Air Force Research Lab.; **Michael E. Thomas,** The Johns Hopkins Univ.; **Brian J. Zelinski,** Raytheon Missile Systems

Wednesday 27 April

SESSION 1 . . . . . Wed. 8:00 to 10:00 am

Advances in Mid-Wavelength Infrared Window Technology I

Session Chair: **Daniel C. Harris,** Naval Air Systems Command

Effects and elimination of nanoporosity in transparent sintered spinel ($MgAl_2O_4$), Andreas Krell, Katja Waetzig, Thomas Hutzler, Jens Klimke, Fraunhofer-Institut für Keramische Technologien und Systeme (Germany) . . . . . [8016-01]

Manufacturing solutions for polycrystalline transparent spinel domes, Evans A. LaRoche, Jeffrey J. Kutsch, Larry Fehrenbacher, Technology Assessment and Transfer (USA) . . . . . [8016-02]

High-performance spinel ceramics for IR windows and domes, Juan L. Sepulveda, Raouf O. Loutfy, Sekyung Chang, Sharly Ibrahim, Materials and Electrochemical Research Corp. (USA). . . . . [8016-03]

Joining of transparent ceramics, Amir Shechter, Ehud Galun, Elbit Systems Electro-Optics El-Op Ltd. (Israel) . . . . . [8016-04]

Large-area electro-optic spinel windows: advances in manufacturing, Jeffrey J. Kutsch, Evans A. LaRoche, Lynda Renomeron, Larry Fehrenbacher, Technology Assessment and Transfer (USA); Larry Shaffer, ArmorLine Corp. (USA); Joseph A. Randi, The Pennsylvania State Univ. Electro-Optics Ctr. (USA) . . . . . [8016-05]

Large optical grade sapphire windows produced from a horizontal growth process, Jonathan B. Levine, Matthew Montgomery, Andrey Novoselov, Sergey Podlozhenov, Rubicon Technology Inc. (USA) . . . . . [8016-06]

SESSION 2 . . . . . Wed. 10:30 am to 12:30 pm

Advances in Mid-Wavelength Infrared Window Technology II

Session Chair: **Robert J. Ondercin,** Air Force Research Lab.

ALON optical ceramic transparencies for window, dome, and transparent armor applications, Lee M. Goldman, Richard Twedt, Sreeram Balasubramanian, Suri Sastri, Surmet Corp. (USA) . . . . . [8016-07]

High-impact resistance optical sensor windows, Joel Askinazi, Goodrich Corp. (USA); Lee M. Goldman, Surmet Corp. (USA). . . . . [8016-08]

Dual IR/RF windows for laser communications, Lee M. Goldman, Richard Twedt, Jayson Zigman, Surmet Corp. (USA); Robert J. Ondercin, Air Force Research Lab. (USA) . . . . . [8016-09]

Transparent ceramics for demanding optical applications, Mark V. Parish, Marina R. Pascucci, Brenda Boucher-Puputti, Normand Corbin, Guerlyne Chery, Jason Small, CeraNova Corp. (USA). . . . . [8016-10]

Colloidal processing and optical transmittance of submicron polycrystalline alumina, Tzu-Chien Wen, Dinesh K. Shetty, The Univ. of Utah (USA) . . . [8016-11]

Synthesis, characterization, and densification of $Al_{2-x}Sc_x(WO_4)_3$ ceramics for low-expansion infrared-transparent windows, Niladri Dasgupta, Bruce Butler, Erinn Sorge, Materials and Systems Research, Inc. (USA); Tzu-Chien Wen, Dinesh K. Shetty, The Univ. of Utah (USA) . . . . . [8016-12]

Lunch/Exhibition Break . . . . . 12:30 to 2:00 pm

SESSION 3 . . . . . Wed. 2:00 to 3:20 pm

Optical Properties: Measurement and Prediction

Session Chair: **Brian J. Zelinski,** Raytheon Missile Systems

Measurement of chalcogenide glass optical dispersion using a mid-infrared prism coupler, Amy H. Qiao, Norman C. Anheier, Jr., Pacific Northwest National Lab. (USA); J. David Musgrave, Kathleen Richardson, Clemson Univ. (USA); Daniel W. Hewak, Univ. of Southampton (United Kingdom) . . . . . [8016-13]

A mid-infrared prism coupler for bulk and thin film analysis, Norman C. Anheier, Jr., Amy H. Qiao, Pacific Northwest National Lab. (USA) . . . . . [8016-14]

Methods for prediction of refractive index in glasses for the infrared, John S. McCloy, Pacific Northwest National Lab. (USA) . . . . . [8016-15]

Multiphonon difference band absorption in diamond, Michael E. Thomas, The Johns Hopkins Univ. (USA) . . . . . [8016-16]

SESSION 4 . . . . . Wed. 3:50 to 5:30 pm

Advances in Long-Wavelength Infrared Window Technology

Session Chair: **Brian K. Jones,** U.S. Army Research, Development and Engineering Command

Anisotropy in structural and optical properties of chemical vapor deposited ZnS, John S. McCloy, Pacific Northwest National Lab. (USA) . . . . . [8016-17]

Describing the flexural strength of IR-transmitting materials: case of CVD zinc selenide and CVD zinc sulfide, Claude A. Klein, C.A.K. Analytics, Int'l. (USA) . . . . . [8016-18]

Microwave mediated synthesis of spherical ZnS nanoparticles, Duraiswamy Ravichandran, Texas Biochemicals, Inc. (USA); Brian K. Jones, U.S. Army Research, Development and Engineering Command (USA); Daniel C. Harris, Naval Air Warfare Ctr. Weapons Div. (USA); Timothy Wharton, Devan Balachari, Texas Biochemicals, Inc. (USA); Ralph Korenstein, Randal W. Tustison, Raytheon Co. (USA); Sridhar Komarneni, The Pennsylvania State Univ. (USA). . . . . [8016-19]

Single crystal and polycrystalline CVD diamond for demanding optical applications, Joseph M. Dodson, John R. Brandon, Ian Friel, Sarah L. Geoghegan, Tim P. Mollart, Element Six (UK) Ltd. (United Kingdom); Peter J. Santini, Element Six (USA); Geoffrey A. Scarsbrook, Andrew J. Whitehead, Jonathan J. Wilman, Element Six (UK) Ltd. (United Kingdom); Henk G. M. de Wit, Element Six N.V. (Netherlands) . . . . . [8016-20]

Depositing high-quality single-crystal-like diamond for optical window applications, Chao Liu, Wei Qiu, Valdosta Optics Lab., Inc. (USA) . . . . . [8016-21]

Thursday 28 April

SESSION 5 . . . . . Thurs. 8:40 to 10:00 am

State-of-the Art in Optical Finishing

Session Chair: **Joel Askinazi,** Goodrich Corp.

History of magnetorheological finishing *(Invited Paper)*, Daniel C. Harris, Naval Air Systems Command (USA); William I. Kordonski, Donald Golini, QED Technologies, Inc. (USA) . . . . . [8016-22]

Rapid optical manufacturing of hard ceramic conformal windows and domes, Jessica D. Nelson, Alan Gould, Daniel Dworzanski, Charles Klinger, Michael Mandina, Optimax Systems, Inc. (USA). . . . . [8016-23]

Ogive and free-form polishing with ultraform finishing, Scott Bambrick, Michael J. Bechtold, Scott DeFisher, David E. Mohring, OptiPro Systems (USA) . . . . . [8016-24]

SESSION 6 . . . . . Thurs. 10:30 am to 12:10 pm

Optical Surface Treatments and Microstructures

Session Chair: **Michael E. Thomas,**
The Johns Hopkins Univ. Applied Physics Lab.

Moldable AR microstructures for improved laser transmission and damage resistance in IRCM fiber optic beam delivery systems, Douglas S. Hobbs, Bruce D. MacLeod, TelAztec LLC (USA). . . . . [8016-25]

Hyperspectral antireflective coatings for infrared windows, Donald E. Patterson, Byron G. Zollars, Steve M. Savoy, Nanohmics (USA) . . . . . [8016-26]

Application of nanostructured protective "sight glasses" for IR gas sensors, René Bergmann, Zachary J. Davis, Michael S. Schmidt, Technical Univ. of Denmark (Denmark); Sonnik Clausen, Risø National Lab. (Denmark); Anja Boisen, Mogens H. Jakobsen, Technical Univ. of Denmark (Denmark). . . . . [8016-27]

High laser damage threshold optical microstructures in Raytheon ceramic YAG, Douglas S. Hobbs, Bruce D. MacLeod, TelAztec LLC (USA); Thomas M. Hartnett, Richard Gentilman, Raytheon Co. (USA) . . . . . [8016-28]

Numerical comparison of grid pattern diffraction effects through modeling with OptiScan software, Ian B. Murray, Matthew W. Pieratt, Douglas L. Hibbard, Exotic Electro-Optics, Inc. (USA); Tom D. Milster, Victor E. Densmore III, College of Optical Sciences, The Univ. of Arizona (USA). . . . . [8016-29]

Lunch/Exhibition Break . . . . . 12:10 to 1:40 pm

SESSION 7 . . . . . Thurs. 1:40 to 2:40 pm

Metrology of Free-Form and Conformal Optics

Session Chair: **John S. McCloy,** Pacific Northwest National Lab.

Advances in freeform optical metrology using a multibeam low-coherence optical probe (Quad-Probe), Damon W. Diehl, Christopher J. Ditchman, Christopher T. Cotton, Nathan E. Burdick, ASE Optics, Inc. (USA) . . . . . [8016-30]

A non-contact surface measurement system for freeform and conformal optics, Scott DeFisher, Michael J. Bechtold, David E. Mohring, OptiPro Systems (USA) . . . . . [8016-31]

Interferometric tomography: a new tool for metrology on conformal optics, Mikhail A. Gutin, Olga N. Gutin, Xu-Ming Wang, Dennis Ehlinger, Applied Science Innovations, Inc. (USA) . . . . . [8016-32]

SESSION 8 . . . . . Thurs. 3:20 to 5:00 pm

Thin Film Optical Coatings and Analysis

Session Chair: **Adrienne E. Selz,** Air Force Research Lab.

Low-loss dual-wavelength laser optics coatings at 1060nm and 530nm, Jue Wang, Horst Schreiber, Corning Tropel Corp. (USA) . . . . . [8016-33]

Optical properties of zinc nitride thin films, Ahalapitiya H. Jayatissa, The Univ. of Toledo (USA) . . . . . [8016-34]

Highly abrasion resistant ultra-nanocrystalline diamond (UNCD) coatings for ZnS, Ralph Korenstein, Raytheon Co. (USA) . . . . . [8016-35]

Flexible transparent electrode, Hulya Demiryont, Kenneth C. Shannon III, Eclipse Energy Systems, Inc. (USA); Matthew S. Bratcher, U.S. Army Research Lab. (USA) . . . . . [8016-36]

Light weight, highly flexible, micro-patternable, electrically conducting polymeric nanocomposites, Ajit Khosla, Simon Fraser Univ. (Canada) . [8016-37]

Courses of Related Interest

SC214 **Infrared Window and Dome Materials** (Harris) Tuesday, 8:30 am to 5:30 pm

SC755 **Infrared Optics and Zoom Lenses** (Mann) Thursday, 8:30 am to 12:30 pm

SC835 **Infrared Systems - Technology & Design** (Daniels) Monday-Tuesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

Monday-Friday 25-29 April 2011 • Proceedings of SPIE Vol. 8017

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XVI

Conference Chairs: **Russell S. Harmon,** U.S. Army Research Office; **John H. Holloway, Jr.,** Naval Surface Warfare Ctr. Panama City Div.; **J. Thomas Broach,** U.S. Army Night Vision & Electronic Sensors Directorate

Program Committee: **Benjamin E. Barrowes,** U.S. Army Engineer Research and Development Ctr.; **Leslie M. Collins,** Duke Univ.; **Gerald J. Dobeck,** Naval Surface Warfare Ctr. Panama City Div.; **Paul Gader,** Univ. of Florida; **John E. McFee,** Defence Research and Development Canada (Canada); **Andrzej W. Miziolek,** U.S. Army Research Lab.; **Henric Oestmark,** Swedish Defence Research Agency (Sweden); **James M. Sabatier,** The Univ. of Mississippi; **Motoyuki Sato IV,** Tohoku Univ. (Japan); **Mehmet Sezgin,** TÜBITAK Marmara Research Ctr. (Turkey); **Waymond R. Scott, Jr.,** Georgia Institute of Technology; **Miranda A. Silvious,** U.S. Army Night Vision & Electronic Sensors Directorate; **Richard C. Weaver,** U.S. Army Night Vision & Electronic Sensors Directorate

Monday 25 April

SESSION 1 . . . . . Mon. 9:00 to 11:50 am

Electromagnetic Induction I

Session Chairs: **Jay A. Marble,** U.S. Army Night Vision & Electronic Sensors Directorate; **Gregory Schultz,** Sky Research Inc.

Open area concealed weapon detection system, Prasanta K. Pati, Univ. of Huddersfield (United Kingdom) . . . . . [8017-01]

Magnetic sensing techniques for humanitarian ordnance detection and discrimination, Joe G. Keranen, Sky Research, Inc. (USA); Stephen Billings, Sky Research, Inc. (Australia); Jon Miller, Gregory Schultz, Sky Research, Inc. (USA) . . . . . [8017-02]

Incorporating advanced EMI technologies in operational munitions characterization surveys, Jonathan Miller, Fridon Shubiditze, Leonard R. Pasion, Joe G. Keranen, Gregory Schultz, Sky Research, Inc. (USA) . . . . . [8017-03]

Fast inversion of single target dynamic MetalMapper data, Tomasz M. Grzegorczyk, Delpsi, LLC (USA); Benjamin E. Barrowes, U.S. Army Engineer Research and Development Ctr. (USA); David George, G&G Sciences Inc. (USA); Fridon Shubitidze, Juan Pablo Fernandez, Dartmouth College (USA); Kevin O'Neill, U.S. Army Engineer Research and Development Ctr. (USA) . . . . [8017-04]

Comparison of support vector machines and neural networks for UXO classification using EMI data, Alex Bijamov, Dartmouth College (USA); Fridon Shubitidze, Dartmouth College (USA) and Sky Research, Inc. (USA); Juan Pablo Fernandez, Dartmouth College (USA); Irma Shamatava, Sky Research, Inc. (USA) and Thayer School of Engineering (USA); Benjamin E. Barrowes, U.S. Army Engineer Research and Development Ctr. (USA) and ERDC-CRREL (USA); Kevin O'Neill, Dartmouth College (USA) and ERDC-CRREL (USA) . . . . . [8017-05]

MPVII: an enhanced vector man-portable EMI sensor for UXO identification, Juan Pablo Fernandez, Dartmouth College (USA); Benjamin E. Barrowes, U.S. Army Engineer Research and Development Ctr. (USA); Nicolas Lhomme, Sky Research, Inc. (Canada); Alex Bijamov, Dartmouth College (USA); Tomasz M. Grzegorczyk, Delpsi, LLC (USA); Kevin O'Neill, U.S. Army Engineer Research and Development Ctr. (USA); Irma Shamatava, Fridon Shubitidze, Dartmouth College (USA) . . . . . [8017-06]

Inversion of dynamically repositioned multi-axis electromagnetic data for ordnance characterization, Joe G. Keranen, Gregory Schultz, Fridon Shubiditze, Jonathan Miller, Lance Besaw, Sky Research, Inc. (USA) . . . . . [8017-07]

Lunch Break . . . . . 11:50 am to 1:40 pm

Courses of Related Interest

SC952 **Applications of Detection Theory** (Carrano) Thursday, 8:30 am to 5:30 pm

SC1035 **Military Laser Safety** (Marshall) Wednesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

SESSION 2 . . . . . Mon. 1:40 to 3:00 pm

Electromagnetic Induction II

Session Chairs: **Jay A. Marble,** U.S. Army Night Vision & Electronic Sensors Directorate; **Gregory Schultz,** Sky Research Inc.

Live-site UXO classification studies via advanced EMI models, Irma Shamatava, Sky Research, Inc. (USA); Fridon Shubitidze, Dartmouth College (USA); Benjamin E. Barrowes, U.S. Army Engineer Research and Development Ctr. (USA); Juan Pablo Fernandez, Alex Bijamov, Dartmouth College (USA) . . . . . [8017-08]

Advanced UXO discrimination: resolving multiple targets and overlapping EMI signals, Fridon Shubitidze, Dartmouth College (USA); Benjamin E. Barrowes, U.S. Army Engineer Research and Development Ctr. (USA); Irma Shamatava, Juan Pablo Fernandez, Dartmouth College (USA); Tomasz M. Grzegorczyk, Delpsi, LLC (USA); Kevin O'Neill, U.S. Army Engineer Research and Development Ctr. (USA); Alex Bijamov, Dartmouth College (USA) . . . . . [8017-09]

Frequency domain electromagnetic induction sensor data feature extraction and processing for improved landmine detection, Stacy L. Tantum, Kenneth D. Morton, Jr., Peter A. Torrione, Leslie M. Collins, Duke Univ. (USA) . . . . . [8017-10]

EMI sensor positioning using a beacon approach, Nicolas Lhomme, Sky Research, Inc. (Canada); Benjamin E. Barrowes, U.S. Army Engineer Research and Development Ctr. (USA); David George, G&G Sciences Inc. (USA). . [8017-11]

SESSION 3 . . . . . Mon. 3:30 to 5:30 pm

A Melange of Techniques

Session Chairs: **Steven S. Bishop,** U.S. Army Night Vision & Electronic Sensors Directorate; **J. Thomas Broach,** U.S. Army Night Vision & Electronic Sensors Directorate

Synthetic aperture acoustic imaging of canonical targets with a 2-15 kHz LFM chirp, Steven S. Bishop, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Joseph F. Vignola, The Catholic Univ. of America (USA); Mehrdad Soumekh, Soumekh Consultant (USA); John A. Judge, The Catholic Univ. of America (USA); Peter M. Gugino, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8017-12]

Detection of unintended electromagnetic emissions from super-regenerative receivers, Jake Hertenstein, DRS Sustainment Systems, Inc. (USA); Jagannathan Sarangapani, Missouri Univ. of Science and Technology (USA). . . . . [8017-13]

Ground target stimulaiton using a moving high-power microwave (HPM) source, David C. Heberlein, Institute for Defense Analyses (USA); Benjamin Grady, Naval Surface Warfare Ctr. Dahlgren Div. (USA); Bohdan Balko, Ira Kohlberg, John Biddle, John Franklin, Institute for Defense Analyses (USA) . . . . . [8017-14]

DS Sentry™: an acquisition ASIC for smart, micro-power sensing applications, John C. Liobe, ADVIS, Inc. (USA) and Univ. of Rochester (USA); Zeljko Ignjatovic, Univ. of Rochester (USA); Eric Moule, Mark Balon, ADVIS, Inc. (USA); Mark Bocko, Univ. of Rochester (USA); Mark Fiscella, ADVIS, Inc. (USA) . . . . . [8017-15]

Threat detection in desert environment with passive millimeter-wave sensor, John P. Wilson, Univ. of Delaware (USA); Christopher A. Schuetz, Richard D. Martin, Thomas E. Dillon III, Phase Sensitive Innovations, Inc. (USA); Maciej Murakowski, Dennis W. Prather, Univ. of Delaware (USA) . . . . . [8017-16]

Laser neutralization of buried munitions, James D. Habersat, Bradley Schilling, Joe Alexander III, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Thomas Lehecka, Penn State E-O Center (USA); Mathew Nixon, Boeing-SVS Inc (USA); Russell McElhaney, Cobham Analytic Solutions (USA) . . . . . [8017-17]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 4 . . . . . Tues. 10:00 am to 12:00 pm

Sensing and Detecting in the Marine Environment I

Session Chairs: **Gerald J. Dobeck,** Naval Surface Warfare Ctr. Panama City Div.; **James Tory Cobb,** Naval Surface Warfare Ctr. Panama City Div.

Automation for underwater mine recognition: current trends and future strategy, Jason R. Stack, Office of Naval Research (USA) . . . . . [8017-18]

Adaptive clutter removal from imagery and its impact on ATR with application to high-resolution sonar, Gerald J. Dobeck, Naval Surface Warfare Ctr. Panama City Div. (USA) . . . . . [8017-19]

SAS image segmentation using parameterized autocorrelation function models, James T. Cobb, Naval Surface Warfare Ctr. Panama City Div. (USA) . . . . . [8017-20]

Optimal frames for pattern recognition applications, Jason C. Isaacs, Naval Surface Warfare Ctr. Panama City Div. (USA). . . . . [8017-21]

Generalized likelihood ratio test for finite mixture model of k-distributed random variables, James D. Tucker, James T. Cobb, Naval Surface Warfare Ctr. Panama City Div. (USA). . . . . [8017-22]

Seabed change detection through time invariant saliency (TIS), Cameron Matthews, Dan Sternlicht, Naval Surface Warfare Ctr. Panama City Div. (USA) . . . . . [8017-23]

Lunch/Exhibition Break . . . . . 12:00 to 1:10 pm

SESSION 5 . . . . . Tues. 1:10 to 3:10 pm

Sensing and Detecting in the Marine Environment II

Session Chairs: **Gerald J. Dobeck,** Naval Surface Warfare Ctr. Panama City Div.; **James Tory Cobb,** Naval Surface Warfare Ctr. Panama City Div.

Metrics of the eigenfunctions of the graph Laplacian for 3D shape matching, Jason C. Isaacs, Naval Surface Warfare Ctr. Panama City Div. (USA) . . . [8017-24]

Data clustering and fusion using deformable structure Bayesian networks (DSBN), Kittipat Kampa, James T. Cobb, Jose C. Principe, Anand Rangarajan, Univ. of Florida (USA) . . . . . [8017-25]

Bayesian surprise metric for outlier detection in on-line learning, Erion Hasanbelliu, Kittipat Kampa, Jose C. Principe, Univ. of Florida (USA); James T. Cobb, Naval Surface Warfare Ctr. Panama City Div. (USA) . . . [8017-26]

Low-noise magnetic sensing for marine munitions characterization, Gregory Schultz, Sky Research, Inc. (USA); Stephen Billings, Sky Research, Inc. (Australia); Chet Bassani, John Foley, Raul Fonda, Sky Research, Inc. (USA) . . . . . [8017-27]

Active source electromagnetic methods for marine munitions, Gregory Schultz, Fridon Shubiditze, Jonathan Miller, Sky Research, Inc. (USA) . . [8017-28]

Investigating magnetic-field sensor configurations for underwater geo-location, Fridon Shubitidze, Dartmouth College (USA); Gregory Schultz, Jon Miller, Irma Shamatava, Sky Research, Inc. (USA) . . . . . [8017-29]

SESSION 6 . . . . . Tues. 3:40 to 5:20 pm

Soils and Soil Effects

Session Chairs: **Russell S. Harmon,** U.S. Army Research Office; **Jan M. H. Hendrickx,** New Mexico Institute of Mining and Technology

Coaxial line measurement and analysis of electromagnetic properties of soils for sensor applications, William R. Folks, Ryan North, Julie R. Kelley, Amy Cunningham, Jason McKenna, U.S. Army Engineer Research and Development Ctr. (USA) . . . . . [8017-30]

Performance of demining sensors and soil properties, Kazunori Takahashi, Holger Preetz, Jan Igel, Leibniz Institute for Applied Geosciences (Germany) . . . . . [8017-31]

Effects of different soil types on strip-map SAR images using real-time impulse GPR system data, Hakkı Nazli, Mehmet Sezgin, TÜBITAK Marmara Research Ctr. (Turkey . . . . . [8017-32]

Simultaneous inversion of electromagnetic induction data for target and soil parameters, Leonard R. Pasion, Kevin Kingdon, Jon Jacobson, Sky Research, Inc. (Canada); Stephen Billings, Sky Research, Inc. (Australia); Douglas W. Oldenburg, The Univ. of British Columbia (Canada) . . . . . [8017-33]

High-resolution soil moisture mapping in Afghanistan, Jan M. H. Hendrickx, J. Bruce Harrison, Brian Borchers, New Mexico Institute of Mining and Technology (USA); Julie R. Kelley, Stacy Howington, Jerrell R. Ballard, Jr., U.S. Army Engineer Research and Development Ctr. (USA) . . . . . [8017-34]

Wednesday 27 April

SESSION 7 . . . . . Wed. 8:30 to 10:10 am

Detection of Bulk Explosive Threats I

Session Chair: **John E. McFee,** Defence Research and Development Canada (Canada)

Principles and status of neutron-based inspection technologies *(Invited Paper)*, Tsahi Gozani, Rapiscan Systems Labs. (USA). . . . . [8017-35]

ESCALAD: a scanning landmine detector based on neutron backscattering, Victor R. Bom, Technische Univ. Delft (Netherlands); Ahmed M. Osman, Riad M. Megahid, Egyptian Atomic Energy Authority (Egypt) . . . . . [8017-36]

Portable and autonomous x-ray equipment for in-situ threatening materials identification by atomic effective number high-accuracy measurement, Mihai Iovea, Marian Neagu, Gabriela Mateiasi, Octavian Duliu, Alexandru Caescu, Madalina SIMA, ACCENT PRO 2000 s.r.l. (Romania) . . . . . [8017-37]

Defence R&D Canada-Suffield research on nuclear methods for detection of buried bulk explosives *(Invited Paper)*, John E. McFee, Anthony A. Faust, Defence Research and Development Canada (Canada). . . . . [8017-38]

SESSION 8 . . . . . Wed. 10:40 am to 12:00 pm

Detection of Bulk Explosive Threats II

Session Chair: **John E. McFee,** Defence Research and Development Canada (Canada)

Nuclear quadrupole resonance detection of explosives: an overview, Joel B. Miller, U.S. Naval Research Lab. (USA). . . . . [8017-39]

Observations on military exploitation of explosives detection technologies, Anthony A. Faust, Defence Research and Development Canada (Canada); Cornelis J. de Ruiter, TNO Defence, Security and Safety (Netherlands); Anneli Ehlerding, Swedish Defence Research Agency (Sweden); John E. McFee, Defence Research and Development Canada (Canada); Eirik Svinsås, Arthur D. van Rheenen, Norwegian Defence Research Establishment (Norway) . . . . . [8017-40]

Explosives (and other threats) detection using pulsed neutron interrogation and optimized detectors, Dan A. Strellis, Tsahi Gozani, Mashal Elsalim, Rapiscan Systems Labs. (USA). . . . . [8017-41]

A non-imaging polarized terahertz passive system for detecting and identifying concealed explosives, Mostafa A. Karam, Douglas Meyer, Northrop Grumman Navigation Systems (USA) . . . . . [8017-42]

Lunch/Exhibition Break . . . . . 12:00 to 1:40 pm

SESSION 9 . . . . . Wed. 1:40 to 3:00 pm

Standoff Detection of Explosives

Session Chair: **John E. McFee,** Defence Research and Development Canada (Canada)

Detection and identification of explosives hidden under barrier materials: What are the THz-technology challenges?, Arthur D. van Rheenen, Magnus W. Haakestad, Norwegian Defence Research Establishment (Norway). . . . . [8017-43]

Improved real-time processing of hyperspectral imaging data, Robert Schweitzer, Matthew P. Nelson, Robert J. D'Agostino, Patrick J. Treado, ChemImage Corp. (USA). . . . . [8017-44]

Stand-off detection of explosive particles by imaging Raman spectroscopy, Markus Nordberg, Hanna Ellis, Anneli Ehlerding, Henric Oestmark, Swedish Defence Research Agency (Sweden) . . . . . [8017-45]

Picosecond laser pulses improves sensitivity in standoff explosive detection, Madeleine Akeson, Lars-Erik Nilsson, Pierre Strömbeck, Portendo AB (Sweden) . . . . . [8017-46]

SESSION 10 . . . . . Wed. 3:30 to 5:30 pm

Advances in Ground Penetrating Radar Subsurface Object Detection

Session Chairs: **Jeremy Bolton,** Univ. of Florida; **Alina Zare,** Univ. of Missouri-Columbia

ALIS deployment in Cambodia, Motoyuki Sato IV, Tohoku Univ. (Japan) . . . . . [8017-47]

Landmine detection by 3DGPR system, Motoyuki Sato IV, Yuya Yokota, Tohoku Univ. (Japan); Mark Grasmueck, Univ. of Miami (USA) . . . . . [8017-48]

Random GPR antennae height variations and mine detection performance, G. Martin Milner, AARD, LLC (USA); Michael Younger, BAE Systems (USA) . . . . . [8017-49]

Detection of explosive hazards using spectrum features from forward-looking ground-penetrating radar imagery, Justin W. Farrell, Timothy C. Havens, Dominic K. Ho, James M. Keller, Univ. of Missouri-Columbia (USA); Taun T. Ton, David C. Wong, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Mehrdad Soumekh, Univ. at Buffalo (USA) . . . . . [8017-50]

Context-aware detection of explosive hazards using frequency subband processing of forward-looking ground-penetrating radar, Timothy C. Havens, James M. Keller, Dominic K. Ho, Univ. of Missouri-Columbia (USA); Taun T. Ton, David C. Wong, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Mehrdad Soumekh, Univ. at Buffalo (USA) . . . . . [8017-51]

Layer segmentation of GPR images using relaxation labeling for landmine detection, Matthew A. Laffin, Magdi A. Mohamed, NIITEK, Inc. (USA) . . [8017-52]

Thursday 28 April

SESSION 11 . . . . . Thurs. 8:30 to 10:10 am

Tracking Rough Ground in Ground-Penetrating Radar Data

Session Chairs: **Jeremy Bolton,** Univ. of Florida; **Peter A. Torrione,** Duke Univ.

The Viterbi algorithm as an approach for incorporating spatial information into air/ground interface inference, Peter A. Torrione, Leslie M. Collins, Duke Univ. (USA) . . . . . [8017-53]

DynAlign ground-tracking algorithm, Brandon Smock, Paul Gader, Joseph N. Wilson, Univ. of Florida (USA) . . . . . [8017-54]

Support vector data description for detecting the air-ground interface in ground-penetrating radar signals, Joshua J. Wood, Joseph N. Wilson, Univ. of Florida (USA) . . . . . [8017-55]

Ground tracking in ground-penetrating radar using Gaussian process and Bayesian inference, Jeffrey Ho, Jeremy Bolton, Brandon Smock, Univ. of Florida (USA) . . . . . [8017-56]

Comparison of algorithms for finding the air-ground interface in ground-penetrating radar signals, Joshua J. Wood, Jeremy Bolton, George Casella, Univ. of Florida (USA); Leslie M. Collins, Duke Univ. (USA); Paul Gader, Taylor C. Glenn, Univ. of Florida (USA); Wen Lee, Richard Mueller, NIITEK, Inc. (USA); Brandon Smock, Univ. of Florida (USA); Peter A. Torrione, Duke Univ. (USA); Joseph N. Wilson, Univ. of Florida (USA) . . . . . [8017-57]

SESSION 12 . . . . . Thurs. 10:40 am to 12:20 pm

Signal Processing Ground-Penetrating Radar Data I

Session Chairs: **Richard C. Weaver,** U.S. Army Night Vision & Electronic Sensors Directorate; **Paul Gader,** Univ. of Florida

Observations on syntactic landmine detection using impulse ground-penetrating radar, Ahmed O. Nasif, Kenneth J. Hintz, George Mason Univ. (USA) . . . . . [8017-58]

Characterization of binary string statistics for syntactic landmine detection, Ahmed O. Nasif, Brian Mark, Kenneth J. Hintz, George Mason Univ. (USA) . . . . . [8017-59]

Ground-penetrating radar signal processing for the detection of buried objects, Mitchell Walters, Ephrahim Garcia, Cornell Univ. (USA). . . . . [8017-60]

Adaptive Gaussian mixture models for pre-screening in GPR data, Peter A. Torrione, Kenneth D. Morton, Jr., New Folder Consulting, LLC (USA); Lance Besaw, Applied Research Associates, Inc. (USA). . . . . [8017-61]

Physics-based features for contextual factors affecting landmine detection with ground-penetrating radar, Christopher R. Ratto, Kenneth D. Morton, Jr., Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) . . . . . [8017-62]

Lunch/Exhibition Break . . . . . 12:20 to 1:40 pm

SESSION 13 . . . . . Thurs. 1:40 to 3:00 pm

Signal Processing Ground-Penetrating Radar Data II

Session Chairs: **Richard L. Weaver,** Univ. of Illinois at Urbana-Champaign; **Paul Gader,** Univ. of Florida

Multiple instance learning for landmine detection using ground-penetrating radar data, Achut Manandhar, Kenneth D. Morton, Jr., Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) . . . . . [8017-63]

Contextual learning in ground-penetrating radar data using Dirichlet process priors, Christopher R. Ratto, Kenneth D. Morton, Jr., Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) . . . . . [8017-64]

Exploiting spectral content for image segmentation in GPR data, Patrick Wang, Kenneth D. Morton, Jr., Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) . . . . . [8017-65]

GPR-based change detection for false alarm rejection and threat identification, Peter A. Torrione, Kenneth D. Morton, Jr., Leslie M. Collins, Duke Univ. (USA) . . . . . [8017-66]

SESSION 14 . . . . . Thurs. 3:30 to 5:30 pm

Infrared

Session Chairs: **Jason J. Lepley,** SELEX Galileo Ltd. (United Kingdom); **James J. Staszewski,** Carnegie Mellon Univ.

Detection of buried mines and explosive objects using dual-band thermal imagery, Jason J. Lepley, Michael T. Averill, SELEX Galileo Ltd. (United Kingdom) . . . . . [8017-67]

Image processing for enhanced situational awareness, Jason J. Lepley, Jason J. Hay III, SELEX Galileo Ltd. (United Kingdom) . . . . . [8017-68]

Investigation of the potential use of hyperspectral imaging for stand-off detection of person-borne IEDs, Catherine C. Cooksey, David W. Allen, National Institute of Standards and Technology (USA) . . . . . [8017-69]

Comparative study between serial and parallel algorithms for unsupervised unmixing of hyperspectral images, Yahya M. Masalmah, Univ. del Turabo (USA) . . . . . [8017-70]

Characterizing optical properties of IED surface signatures, James J. Staszewski, Carnegie Mellon Univ. (USA); Charles A. Hibbitts, Gregory O'Marr, Arnold C. Goldberg, The Johns Hopkins Univ. (USA) . . . . . [8017-71]

Automatic detection of targets in medium-wave infrared imagery using adaptive background mixture models, Christopher J. Spain, James M. Keller, Mihail Popescu, Kevin E. Stone, Univ. of Missouri-Columbia (USA) . . . . [8017-72]

Friday 29 April

SESSION 15 . . . . . Fri. 8:00 to 10:20 am

Signal Processing and Sensor Fusion

Session Chairs: **Pete Howard,** U.S. Army Night Vision & Electronic Sensors Directorate; **Robert H. Luke,** U.S. Army Night Vision & Electronic Sensors Directorate

Detection of targets in forward-looking infrared imaging using a multiple instance learning framework, Mihail Popescu, Kevin E. Stone, James M. Keller, Univ. of Missouri-Columbia (USA). . . . . [8017-73]

Sensor fusion approaches for EMI and GPR-based subsurface threat identification, Peter A. Torrione, Kenneth D. Morton, Jr., New Folder Consulting, LLC (USA); Lance Besaw, Applied Research Associates, Inc. (USA) . . . . [8017-74]

Vehicle mounted video-based change detection for novel anomaly detection, Peter A. Torrione, Kenneth D. Morton, Jr., Christopher R. Ratto, Leslie M. Collins, Duke Univ. (USA). . . . . [8017-75]

Fuzzy integral-based fusion of confidence maps in an infrared and forward looking ground-penetrating radar system for explosive hazard detection, Derek T. Anderson, James M. Keller, David Lewis, Univ. of Missouri-Columbia (USA) . . . . . [8017-76]

Validating spectral-spatial detection based on MMPP formulation, Anh H. Trang, Sanjeev Agarwal, J. Thomas Broach, Thomas E. Smith, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [8017-77]

Using predictive distributions to estimate uncertainty in classifying landmine targets, Ryan Close, Ken Watford, Taylor C. Glenn, Paul Gader, Joseph N. Wilson, Univ. of Florida (USA) . . . . . [8017-78]

Buried explosive hazard detection using forward-looking long-wave infrared imagery, Kevin E. Stone, James M. Keller, Mihail Popescu, Christopher J. Spain, Univ. of Missouri-Columbia (USA). . . . . [8017-79]

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Tuesday-Thursday 26-28 April 2011 • Proceedings of SPIE Vol. 8018

Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing XII

Conference Chairs: **Augustus W. Fountain III,** U.S. Army Edgewood Chemical Biological Ctr.; **Patrick J. Gardner,** The Charles Stark Draper Lab., Inc.

Program Committee: **Jerome J. Braun,** MIT Lincoln Lab.; **John C. Carrano,** Carrano Consulting; **Christopher C. Carter,** The Johns Hopkins Univ.; **Matthew T. Griffin,** General Dynamics Armament and Technical Products; **Eric J. Houser,** U.S. Dept. of Homeland Security; **Harry Ing,** Bubble Technology Industries, Inc. (Canada); **Harold R. McHugh,** U.S. Dept. of Energy Special Technologies Lab.; **Carter D. Hull,** Y-12 National Security Complex; **Aaron LaPointe,** U.S. Army Night Vision & Electronic Sensors Directorate; **Paul M. Pellegrino,** U.S. Army Research Lab.; **Michael W. Petryk,** Defence Research and Development Canada (Canada); **James G. Placke, Jr.,** Y-12 National Security Complex; **Cynthia R. Swim,** U.S. Army Edgewood Chemical Biological Ctr.; **Anna Tedeschi,** Strategic Analysis, Inc. and U.S. Dept. of Homeland Security; **Steven W. Waugh,** Defense Threat Reduction Agency

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 1 . . . . . Tues. 10:00 am to 12:00 pm

Biological Aerosol Background Characterization

Session Chair: **Augustus W. Fountain III,** U.S. Army Edgewood Chemical Biological Ctr.

Biological aerosol background characterization, Janet M. Blatny, Norwegian Defence Research Establishment (Norway); Augustus W. Fountain III, U.S. Army Edgewood Chemical Biological Ctr. (USA) . . . . . [8018-01]

Characterization of laser-induced fluorescence from background aerosols in a maritime environment, Sylvie Buteau, Jean-Robert Simard, Denis Nadeau, Defence Research and Development Canada (Canada). . . . . [8018-02]

Changes in fluorescence spectra of bioaerosols measured in a laboratory reaction chamber to simulate atmospheric transport, Yongle Pan, Steven C. Hill, Ronald G. Pinnick, U.S. Army Research Lab. (USA); Joshua L. Santarpia, Neal Baker, Shanna Ratnesar-Shumate, Brian Cottrell, Laura McKee, The Johns Hopkins Univ. (USA) . . . . . [8018-03]

Ground truth methods for optical cross-section modeling of biological aerosols, Jeffrey Kalter, Evan P. Thrush, Joshua L. Santarpia, Zahra Chaudhry, Jerome Gilberry, David M. Brown, Andrea M. Brown, Christopher C. Carter, The Johns Hopkins Univ. (USA) . . . . . [8018-04]

Optimal classification of standoff bioaerosol measurements using evolutionary algorithms, Ragnhild Nyhavn, Hans J. F. Moen, Øystein Farsund, Gunnar Rustad, Norwegian Defence Research Establishment (Norway) . [8018-05]

On the information content of linear and circular depolarization signatures of bioaerosols, Gilles A. Roy, Defence Research and Development Canada (Canada); Xiaoying Cao, Royal Military College of Canada (Canada); Robert Bernier, Les Instruments Optiques du St-Laurent Inc. (Canada) . . . . . [8018-06]

Lunch/Exhibition Break . . . . . 12:00 to 1:30 pm

SESSION 2 . . . . . Tues. 1:30 to 3:10 pm

Biological Detection

Session Chair: **Jerome J. Braun,** MIT Lincoln Lab.

Tracking legionella in air generated from a biological treatment plant: a case study of the outbreak of legionellosis in Norway, Janet M. Blatny, Norwegian Defence Research Establishment (Norway) . . . . . [8018-07]

Characterizing phylogenetic diversity in airborne bacterial populations in China, Zahra Chaudhry, Joshua L. Santarpia, The Johns Hopkins Univ. Applied Physics Lab. (USA); Jose V. Martins, Univ. of Maryland-Baltimore County (USA) . . . . . [8018-08]

Bacterial identification using kinetics of fluorescence staining, Vicente Nunez, Srigokul Upadhyayula, Kenny Chau, Adam Y. Lin, Valentine I. Vullev, Univ. of California, Riverside (USA) . . . . . [8018-09]

Selective biomarker detection in saliva and serum using peptide functionalized field-effect transistors, Joshua A. Hagen, Wanda J. Lyon, Sang Nyon Kim, Yaroslav G. Chushak, Nancy Kelley-Loughnane, Rajesh R. Naik, Morley O. Stone, Air Force Research Lab. (USA) . . . . . [8018-10]

A distributed national network for label-free rapid identification of emerging pathogens, J. Paul Robinson, Bartek P. Rajwa, Purdue Univ. (USA); M. Murat Dundar, Indiana Univ.-Purdue Univ. Indianapolis (USA); Valery Patsekin, Purdue Univ. (USA); E. Daniel Hirleman, Univ. of California, Merced (USA); Arun K. Bhunia, Ctr. for Food Safety Engineering (USA); J. Eric Dietz, Purdue Univ. (USA)[8018-11]

SESSION 3 . . . . . Tues. 3:40 to 6:20 pm

Radiological and Nuclear Detection

Session Chair: **Patrick J. Gardner,** Draper Lab.

Gamma/neutron analysis for SNM signatures at high-data rates (greater than 10^7 cps) for single-pulse active interrogation, Istvan Dioszegi, Cynthia Salwen, Brookhaven National Lab. (USA); Leon Forman, Ion Focus Technology Inc. (USA). . . . . [8018-12]

Over-water testing of the neutron imaging camera, Stanley D. Hunter, NASA Goddard Space Flight Ctr. (USA) . . . . . [8018-13]

Detection of thermal neutrons using gadolinium-oxide-based nanocrystals, Antonio C. Rivera, Natasha N. Glazener, Nathaniel C. Cook, Brian A. Akins, John B. Plumley, Nathan J. Withers, Eric Sunde, Jose M. Vargas, Gennady A. Smolyakov, Ken Carpenter, Robert D. Busch, Marek Osinski, The Univ. of New Mexico (USA). . . . . [8018-14]

An air fluorescence imaging system for the detection of radiological contamination, Vernon Koslowsky, Bubble Technology Industries, Inc. (Canada); Elizabeth L. Inrig, Lorne S. Erhardt, Defence Research and Development Canada (Canada); Bob Andrews, Harry Ing, Michael J. Dick, Patrick Forget, Bubble Technology Industries, Inc. (Canada) . . . . . [8018-15]

TI-based wide-gap semiconductor materials for x-ray and gamma-ray detection, Zhifu Liu, John A. Peters, Chunyu Zang, Nam Ki Cho, Bruce W. Wessels, Simon Johnsen, Sebastian Peter, John Androulakis, Mercouri G. Kanatzidis, Jung-Hwan Song, Hosub Jin, Northwestern Univ. (USA). . . . [8018-16]

Portable high-speed data acquisition system for x-ray and gamma radiation detection, Mark Wade, Adam P. Hellmers, Christopher Barber, Heath A. Berry, Radiance Technologies, Inc. (USA) and Louisiana Tech Univ. (USA) . . . . [8018-17]

Compton imaging with a planar semiconductor system using pulse shape analysis, Anthony Sweeney, Andrew J. Boston, Helen C. Boston, John P. Cresswell, Jamie Dormand, Univ. of Liverpool (United Kingdom); Mark S. Ellis, Atomic Weapons Establishment (United Kingdom); Laura J. Harkness, Martin Jones, Daniel S. Judson, Paul J. Nolan, David C. Oxley, David P. Scraggs, Mike J. Slee, Univ. of Liverpool (United Kingdom); Amandeep Thandi, Atomic Weapons Establishment (United Kingdom). . . . . [8018-18]

Plutinium rock-like oxide fuel (ROXF) system: their once-through burning and usage, Ashraf Elsayed El Mohamed, Brno Univ. of Technology (Egypt) . . . . . [8018-19]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

The ChemSight: an open-path, multichemical detector for security applications, Stephen K. Holland, James Madison Univ. (USA); Gabriel Laufer, Univ. of Virginia (USA) . . . . . [8018-63]

Threat representative droplet generation and surface interaction analysis, Steven M. Simpson, Thomas H. Chyba, Robert M. Jones, Gordon Harper, Diane Haslam, ITT Advanced Engineering & Sciences (USA) . . . . . [8018-64]

Investigation of standoff explosives detection via photothermal/ photoacoustic interferometry, Pak S. Cho, Celight, Inc. (USA); Robert M. Jones, ITT Advanced Engineering & Sciences (USA); Geof Harston, Celight, Inc. (USA) . . . . . [8018-65]

Explosives detection in the marine environment using UUV-modified immunosensor, Paul T. Charles, U.S. Naval Research Lab. (USA); Andre Adams, National Research Council (USA); Jeffrey Deschamps, Anne W. Kusterbeck, U.S. Naval Research Lab. (USA) . . . . . [8018-66]

Detection of TATP precursor acetone at trace levels using rf sputtered SnO_2 thin film-based sensors, Vinay Gupta, Kondepudy Sreenivas, Anjali Sharma, Arijit Chowdhuri, Univ. of Delhi (India) . . . . . [8018-67]

Specific detection of urea and ammonium nitrate explosives, Chloe de Perre, Inge Corbin, Bruce R. McCord, Florida International Univ. (USA). . . . . [8018-68]

Fluorescence/scattering lidar for short-range standoff detection of biological agents, Zygmunt Mierczyk, Krzysztof Kopczyński, Marek Zygmunt, Jaroslaw Mlynczak, Jacek Wojtanowski, Miroslaw Kwasny, Miron Z. Kaliszewski, Andrzej Mlodzianko, Maksymilian Wlodarski, Andrzej Gietka, Piotr Knysak, Tadeusz Drozd, Michal Muzal, Monika Mularczyk-Oliwa, Aneta Bombalska, Jadwiga Mierczyk, Military Univ. of Technology (Poland) . . . . . [8018-69]

Gas image enhancement based on morphology and adaptive time-domain filtering, Changxing Zhang, Jiakun Li, Yunting Long, Bei Zhang, Lingxue Wang, Beijing Institute of Technology (China) . . . . . [8018-70]

Smart radiation monitor for airport baggage screening, Alon Osovizky, Dimitry Ginzburg, Rotem Industries Ltd. (Israel); Eliezer Marcus, Nuclear Research Ctr. Negev (Israel); Baruch Ashkenzi, Rotem Industries Ltd. (Israel); Yaacov Yehuda-Zada, Nuclear Research Ctr. Negev (Israel); Vladislav Bronfenmacher, Rotem Industries Ltd. (Israel); Max Ghelman, Eran Vax, Tzachi Mazor, Yosef Cohen, Nuclear Research Ctr. Negev (Israel) . . . . . [8018-71]

Wednesday 27 April

SESSION 4 . . . . . Wed. 8:00 to 10:00 am

Fundamentals Concepts in Chemical Sensing

Session Chair: **Paul M. Pellegrino,** U.S. Army Research Lab.

Visible/near-infrared hyperspectral sensing of solids under controlled environmental conditions, Bruce E. Bernacki, Norman C. Anheier, Jr., Albert Mendoza, Bradley G. Fritz, Timothy J. Johnson, Pacific Northwest National Lab. (USA) . . . . . [8018-20]

Fluorescence lifetime imaging system for the remote sensing of hazardous materials, Edgar A. Mendoza, Redondo Optics, Inc. (USA). . . . . [8018-21]

Optical constants of neat liquid-chemical warfare agents and related materials measured by infrared spectroscopic ellipsometry, Clayton S. Yang, Battelle East Science and Technology Ctr. (USA); Barry R. Williams, Melissa S. Hulet, SAIC (USA); Thomas E. Tiwald, J.A. Woollam Co. (USA); Ronald W. Miles, Jr., Alan C. Samuels, U.S. Army Edgewood Chemical Biological Ctr. (USA) . . . . . [8018-22]

Active infrared multispectral imaging of chemicals on surfaces, Anish K. Goyal, Melissa Spencer, Michael W. Kelly, Joseph Costa, Michael DiLiberto, Emily Meyer, Thomas H. Jeys, MIT Lincoln Lab. (USA) . . . . . [8018-23]

Polarimetry and infrared spectroscopy in the detection of low-volatility chemical threats, Michael W. Petryk, Armando J. Marenco, Defence Research and Development Canada (Canada) . . . . . [8018-24]

Characterization of next-generation commercial surface-enhanced Raman scattering (SERS) substrates, Mikella E. Hankus, Paul M. Pellegrino, Dimitra N. Stratis-Cullum, U.S. Army Research Lab. (USA). . . . . [8018-25]

SESSION 5 . . . . . Wed. 10:30 to 11:50 am

Laser-based Chemical Detection

Session Chair: **Cynthia R. Swim,** U.S. Army Edgewood Chemical Biological Ctr.

A two-pulse, pump probe method for short-range, remote standoff detection of chemical warfare agents, Scott E. Bisson, Thomas A. Reichardt, Thomas J. Kulp, Sandia National Labs., California (USA). . . . . [8018-26]

Standoff chemical detection using quantum cascade lasers and photoacoustic sensing, Xing Chen, Univ. of Maryland, Baltimore County (USA); Douglas Janssen, Greater Grace Christian Academy (USA); Fow-Sen Choa, Univ. of Maryland, Baltimore County (USA) . . . . . [8018-27]

LIBS spectroscopic classification relative to compressive sensing, Steven T. Griffin, Eddie Jacobs, Orges Furxhi, The Univ. of Memphis (USA) . . . . . [8018-28]

Standoff detection applying laser-induced breakdown spectroscopy at the DLR laser test range, Jürgen Handke, Frank Duschek, Karin M. Gruenewald, Carsten Pargmann, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [8018-29]

Lunch/Exhibition Break . . . . . 11:50 am to 1:20 pm

SESSION 6 . . . . . Wed. 1:20 to 2:40 pm

Novel Devices for Chemical Detection

Session Chair: **Steven W. Waugh,** Defense Threat Reduction Agency

Mid-infrared optical fiber Fourier transform infrared spectrometer, Kenneth J. Ewing, Jasbinder S. Sanghera, Brandon Shaw, Rafael Gattass, Ishwar Aggarwal, U.S. Naval Research Lab. (USA) . . . . . [8018-30]

Hollow-core fiber optics for mid-wave and long-wave infrared spectroscopy, Jason M. Kriesel, Nahum Gat, Opto Knowledge Systems, Inc. (USA); Bruce E. Bernacki, Rebecca L. Erikson, Bret D. Cannon, Tanya L. Myers, Pacific Northwest National Lab. (USA); Carlos M. Bledt, James A. Harrington, Rutgers, The State Univ. of New Jersey (USA) . . . . . [8018-31]

Design, synthesis, and processing of novel infrared chalcogenide glasses for ultra-sensitive nanocavity photothermal chem-bio detection, Juejun Hu, Univ. of Delaware (USA); J. David Musgrave, Nathan Carlie, Clemson Univ. (USA); Anuradha M. Agarwal, Massachusetts Institute of Technology (USA); Kathleen Richardson, Clemson Univ. (USA); Lionel C. Kimerling, Massachusetts Institute of Technology (USA) . . . . . [8018-32]

Demonstration of microcantilever-based sensor array with integrated microfluidics, Gregory P. Nordin, Ryan R. Anderson, Stanley J. Ness, Weisheng Hu, Timothy M. Gustafson, Danny C. Richards, Jong W. Noh, Seunghyun Kim, Brigham Young Univ. (USA) . . . . . [8018-33]

SESSION 7 . . . . . Wed. 2:40 to 4:30 pm

Standoff Chemical Detection Modeling and Algorithms

Session Chair: **Christopher C. Carter,** The Johns Hopkins Univ. Applied Physics Lab.

Coordinated sensor cueing for chemical plume detection and tracking, Chad Hawthorne, Adam S. Watkins, Steven J. Marshall, Nathan Abraham, Andrea Jensenius, The Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [8018-34]

Enhanced chemical weapon warning via sensor data fusion, Michael Flaherty, Torch Technologies (USA). . . . . [8018-35]

Sensor fusion for chemical plume detection, classification, and tracking, Adam S. Watkins, Jeffrey D. Barton, Chad Hawthorne, The Johns Hopkins Univ. Applied Physics Lab. (USA). . . . . [8018-36]

Modeling of photoacoustic vapor sensors using a multiphysics approach, Ellen L. Holthoff, Paul M. Pellegrino, U.S. Army Research Lab. (USA) . . . [8018-37]

SESSION 8 . . . . . Wed. 4:30 to 6:10 pm

Applications of Standoff Chemical Detection

Session Chair: **Michael W. Petryk,**
Defence Research and Development Canada (Canada)

Dynamic sensor deployment for the monitoring of chemical releases in urban environments (DYCE), Jason J. Lepley, SELEX Galileo Ltd. (United Kingdom) . . . . . [8018-38]

Remote quantification of smokestack total effluent mass flow rates using imaging Fourier-transform spectroscopy, Jacob L. Harley, Kevin C. Gross, Air Force Institute of Technology (USA) . . . . . [8018-39]

iCATSI: a multi-pixel imaging differential standoff chemical detection sensor, Louis M. Moreau, Florent Prel, ABB Analytical Measurement (Canada); Hugo Lavoie, Defence Research and Development Canada (Canada); Claude B. Roy, Christian A. Vallieres, ABB Analytical Measurement (Canada); Jean-Marc Theriault, Defence Research and Development Canada (Canada) . . . . . [8018-40]

Chemical agent detection with low-resolution scanning FTIR sensors, Eric R. Larrieux, Dimitris Manolakis, MIT Lincoln Lab. (USA); Francis M. D'Amico, U.S. Army Edgewood Chemical Biological Ctr. (USA) . . . . . [8018-41]

Characterization of aerosol-containing chemical simulant clouds using a sensitive, thermal infrared imaging spectrometer, Jeffrey L. Hall, Jun Qian, Mark L. Polak, Clement S. Chang, The Aerospace Corp. (USA); Francis M. D'Amico, U.S. Army Edgewood Chemical Biological Ctr. (USA); Steven J. Kolodzey, U.S. Army Research, Development and Engineering Command (USA) . . . . . [8018-42]

Thursday 28 April

SESSION 9 . . . . . Thurs. 8:00 am to 12:10 pm

Laser and Raman-based Explosives Detection

Session Chair: **Aaron LaPointe,**
U.S. Army Night Vision & Electronic Sensors Directorate

Signal processing for the detection of explosive residues on varying substrates using laser-induced breakdown spectroscopy, Kenneth D. Morton, Jr., Peter A. Torrione, Leslie M. Collins, Duke Univ. (USA) . . . . . [8018-43]

Fabrication and testing of a standoff trace explosives detection system, Robert D. Waterbury, Jeremy B. Rose, Darius Vunck, Thomas B. Blank, Frank Vilardi, Kenneth R. Pohl, Alan Ford, Troy McVay, Edwin L. Dottery, Alakai Defense Systems, Inc. (USA). . . . . [8018-44]

Multiple-excitation-wavelength resonance-Raman explosives detection, Balakishore Yellampelle, Mikhail Sluch, West Virginia High Technology Consortium Foundation (USA); Sanford A. Asher, Univ. of Pittsburgh (USA); Brian E. Lemoff, West Virginia High Technology Consortium Foundation (USA)[8018-45]

Remote detection of explosives using Raman spectroscopy, Jack E. Fulton, Jr., Naval Surface Warfare Ctr. Crane Div. (USA) . . . . . [8018-46]

Deep-UV Raman measurements of energetic materials, Sanford A. Asher, David Tuschel, Luling Wang, Univ. of Pittsburgh (USA) . . . . . [8018-47]

Ultraviolet resonance Raman spectroscopy of nitroaromatic compounds for standoff detection applications, Erik D. Emmons, Steven D. Christesen, Augustus W. Fountain III, Jason A. Guicheteau, U.S. Army Edgewood Chemical Biological Ctr. (USA) . . . . . [8018-48]

Optimal dynamic detection of explosives, David S. Moore, Los Alamos National Lab. (USA); Herschel A. Rabitz, Princeton Univ. (USA). . . . . [8018-49]

Chemical and explosives point detection through opaque containers using spatially offset Raman spectroscopy (SORS), Paul W. Loeffen, Craig Tombling, Matthew Bloomfield, Cobalt Light Systems Ltd. (United Kingdom); Pavel Matousek, Cobalt Light Systems Ltd. (United Kingdom) and Rutherford Appleton Lab. (United Kingdom). . . . . [8018-50]

Investigating a drop-on-demand microdispenser for standardized sample preparation, Ellen L. Holthoff, Mikella E. Hankus, Paul M. Pellegrino, U.S. Army Research Lab. (USA) . . . . . [8018-51]

A mass spectrometer-based explosives trace detector, Jack A. Syage, Karl A. Hanold, Andrey Vilkov, Syagen Technology, Inc. (USA) . . . . . [8018-52]

Multi-colorimetric sensor array for detection of explosives in gas and liquid phases, Natalie Kostesha, Tommy S. Alstrøm, Technical Univ. of Denmark (Denmark); Carsten Johnsen, Kent A. Nielsen, Jan O. Jeppesen, Univ. of Southern Denmark (Denmark); Jan Larsen, Anja Boisen, Mogens H. Jakobsen, Technical Univ. of Denmark (Denmark) . . . . . [8018-53]

Lunch/Exhibition Break . . . . . 12:10 to 1:40 pm

SESSION 10 . . . . . Thurs. 1:40 to 5:10 pm

NIR, IR, and Photothermal Detection of Explosives

Session Chair: **Anna Tedeschi,** Strategic Analysis, Inc.

NIR spectroscopy with multivariate calibration and lock-in amplification to detect chemicals concealed behind fabrics, Aamer Saleem, Celine Canal, David Hutchins, The Univ. of Warwick (United Kingdom) . . . . . [8018-54]

Development of standoff detection of trace explosives by infrared photothermal imaging, Christopher A. Kendziora, Robert Furstenberg, Michael R. Papantonakis, Viet Q. Nguyen, U.S. Naval Research Lab. (USA); Jennifer L. Stepnowski, Nova Research, Inc. (USA); R. Andrew McGill, U.S. Naval Research Lab. (USA) . . . . . [8018-55]

Enhanced vapor signature of explosive materials using infrared laser excitation, Michael R. Papantonakis, Robert Furstenberg, Christopher A. Kendziora, R. Andrew McGill, Jakob Grosser, U.S. Naval Research Lab. (USA) . . . . . [8018-56]

The limit of detection for explosives in spectroscopic differential reflectometry, Thierry A. Dubroca, Karthik Vishwanathan, Michael Friedman, Rolf E. Hummel, Univ. of Florida (USA) . . . . . [8018-57]

Empirical model for the temporally resolved temperatures of post-detonation fireballs for aluminized high explosives, Joe M. Gordon, Kevin C. Gross, Glen P. Perram, Air Force Institute of Technology (USA) . . . . . [8018-58]

A novel infrared hyperspectral imager for passive standoff detection of explosives and explosive precursors, Jean-Marc Theriault, Eldon Puckrin, Hugo Lavoie, Francois Bouffard, Defence Research and Development Canada (Canada); Paul Lacasse, AEREX avionique inc. (Canada); Alexandre Vallières, Vincent Farley, Martin Chamberland, Telops (Canada). . . . . [8018-59]

Compact, wide-field photoacoustic explosive detector, Elizabeth C. Schundler, David L. Carlson, Robert M. Vaillancourt, Julia Rentz Dupuis, Craig R. Schwarze, OPTRA, Inc. (USA). . . . . [8018-60]

Explosive and pharmaceutical mid-and long-wave IR spectra by laser-induced breakdown spectroscopy, A. Peter Snyder, U.S. Army Edgewood Chemical Biological Ctr. (USA); Clayton S. Yang, Battelle Memorial Institute (USA); Alan C. Samuels, U.S. Army Edgewood Chemical Biological Ctr. (USA); Sudhir B. Trivedi, Brimrose Corp. of America (USA); Ei-Ei Brown, Uwe H. Hommerich, Hampton Univ. (USA) . . . . . [8018-61]

Liquid explosive detection in bottle by near infrared, Hideo Itozaki, Dai Shirotani, Hideo Akaba, Osaka Univ. (Japan); Susumu Morimoto, Kubota Corp. (Japan). . . . . [8018-62]

Courses of Related Interest

SC1034 **Lab-on-a-Chip Technology - Towards Portable Detection Systems** (Gärtner) Friday, 8:30 am to 12:30 pm

SC719 **Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies** (Gardner) Monday, 8:30 am to 12:30 pm

SC952 **Applications of Detection Theory** (Carrano) Thursday, 8:30 am to 5:30 pm

SC1035 **Military Laser Safety** (Marshall) Wednesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Monday-Thursday 25-28 April 2011 • Proceedings of SPIE Vol. 8019

Sensors, and Command, Control, Communications, and Intelligence (C3I) Technologies for Homeland Security and Homeland Defense X

Conference Chair: **Edward M. Carapezza,** Univ. of Connecticut and DARPA

Program Committee: **Zoraida P. Aguilar,** Ocean NanoTech; **John G. Blitch,** ARACAR: Alliance for Robot Assisted Crisis Assessment and Response; **George Cybenko,** Dartmouth College; **Michael J. DeWeert,** BAE Systems; **Mildred A. Donlon,** Defense Advanced Research Projects Agency; **Susan F Hallowell,** Dept of Homeland Security; **Todd M. Hintz,** Space and Naval Warfare Systems Command; **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr.; **Ivan Kadar,** Interlink Systems Sciences, Inc.; **Pradeep K. Khosla,** Carnegie Mellon Univ.; **Han Q. Le,** Univ. of Houston; **Daniel Lehrfeld,** Blue Marble Group LLC; **Tariq Manzur,** Naval Undersea Warfare Ctr.; **Paul F. Morgan,** U.S. Special Operations Command; **Dennis J. Reimer,** National Memorial Institute for the Prevention of Terrorism; **Nino Srour,** U.S. Army Research Lab.

Monday 25 April

PANEL DISCUSSION. . . . . Mon. 9:30 to 11:30 am

Less-than-Lethal Technologies to Minimize Civilian Casualties

Panel Moderator: **David B. Law,** Joint Non-Lethal Weapons Directorate

SESSION 1 . . . . . Mon. 11:30 am to 12:10 pm

Keynote Session I

Session Chair: **Edward M. Carapezza,** Univ. of Connecticut and DARPA

Situational awareness and informed decision-making for law enforcement responders *(Keynote Presentation),* G. Chris Tillery, National Institute of Justice (USA) . . . . . [8019-01]

Lunch Break . . . . . 12:10 to 1:30 pm

SESSION 2 . . . . . Mon. 1:30 to 2:10 pm

Keynote Session II

Session Chair: **Edward M. Carapezza,** Univ. of Connecticut and DARPA

Cyber security state-of-the-art and challenges and opportunities for the future *(Keynote Presentation),* Pradeep K. Khosla, Carnegie Mellon Univ. (USA) . . . . . [8019-05]

SESSION 3 . . . . . Mon. 2:10 to 6:00 pm

Cyber Security and Visual Analytics

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr.; **Todd M. Hintz,** Space and Naval Warfare Systems Command

Immune security network model based on multi-agents coevolution, Jie Su, Harbin Univ. of Science and Technology (China) . . . . . [8019-06]

Visualization techniques for malware behavior analysis, André R. A. Gregio, Univ. Estadual de Campinas (Brazil); Rafael D. Coelho dos Santos, Instituto Nacional de Pesquisas Espaciais (Brazil) . . . . . [8019-07]

Visual analytics for computer network defense, Justin M. Beaver, Robert M. Patton, Xiaohui Cui, Chad A. Steed, Oak Ridge National Lab. (USA); Matthew Schultz, Univ. of Maryland, Baltimore County (USA) . . . . . [8019-08]

Comparative evaluation of anomaly detection algorithms for local maritime video surveillance, Bryan L. Auslander, Kalyan M. Gupta, Knexus Research (USA); David W. Aha, U.S. Naval Research Lab. (USA) . . . . . [8019-09]

Image quality assessment using color appearance model, Mariofanna G. Milanova, Travis A. Bennett, John R. Talburt, Univ. of Arkansas at Little Rock (USA); Brian H. Tsou, Air Force Research Lab. (USA); Sertan Kaya, Hongyan Xu, Univ. of Arkansas at Little Rock (USA) . . . . . [8019-10]

TERRA efficient video mark-up and analytics, Scott F. Page, Darren R. Myatt, Waterfall Solutions Ltd. (United Kingdom) . . . . . [8019-11]

Toward intelligent decision support for security staff: evaluation of an interactive resource management system based on a CMDP model, Jutta Hild, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Jonathan Ott, Karlsruher Institut für Technologie (Germany); Elisabeth Peinsipp-Byma, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [8019-12]

Entropy based heavy tailed distribution transformation and visual analytics for monitoring massive network traffic, Keesook J. Han, Air Force Research Lab. (USA) . . . . . [8019-13]

Increasing the security at vital infrastructures: automated detection of deviant human behavior, Gertjan Burghouts, Richard den Hollander, Klamer Schutte, Sander Landsmeer, Eric den Breejen, Jan-Willem Marck, TNO Defence, Security and Safety (Netherlands). . . . . [8019-14]

Joint situation awareness frameworks and informed decision making for federal and civil authorities, Andrew Lenz, U.S. Army Armament Research, Development and Engineering Ctr. (USA) . . . . . [8019-15]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 4 . . . . . Tues. 10:00 to 10:40 am

Keynote Session III

Session Chairs: **Daniel Lehrfeld,** Blue Marble Group LLC; **Edward M. Carapezza,** Univ. of Connecticut and DARPA

Fast track, fast tech: challenges and opportunities for homeland security *(Keynote Presentation),* Susan F. Hallowell, Transportation Security Lab. (USA) . . . . . [8019-16]

SESSION 5 . . . . . Tues. 10:40 am to 12:40 pm

Transporation Security Panel

Session Chairs: **Susan F. Hallowell,** Transportation Security Lab.; **Daniel Lehrfeld,** Blue Marble Group LLC

Measurement of the reflectivity and absorptivity of liquids, powders, and solids at millimeter wavelengths using dielectric detection by a resonator-post fixture between parallel conducting plates, James C. Weatherall, SRA International, Inc. (USA); Jeffrey Barber, Battelle Ventures, L.P. (USA); Carolyn S. Brauer, Barry T. Smith, Transportation Security Lab. (USA). . . . . [8019-17]

Development of a contrast phantom for active millimeter-wave imaging systems, Jeffrey Barber, Battelle Ventures, L.P. (USA); James C. Weatherall, SRA International, Inc. (USA); Carolyn S. Brauer, Barry T. Smith, Transportation Security Lab. (USA) . . . . . [8019-18]

Characterization of peroxide-based explosives using Raman spectroscopy, Carolyn S. Brauer, Transportation Security Lab. (USA); Jeffrey Barber, Battelle Ventures, L.P. (USA); James C. Weatherall, SRA International, Inc. (USA); Barry T. Smith, Transportation Security Lab. (USA) . . . . . [8019-19]

Explosive detection technologies for aviation checkpoints, Ted Grant, Transportation Security Lab. (USA). . . . . [8019-20]

Optimization of dynamic sampling of trace explosives off of shoes, Stefan R. Lukow, Transportation Security Lab. (USA); Matthew Staymates, Jessica Grandner, National Institute of Standards and Technology (USA); Inho Cho, Nova Research, Inc. (USA) . . . . . [8019-21]

Opportunities with DHS Science & Technology: Research and Development (R&D) Partnerships Group, Thomas Cellucci, U.S. Dept. of Homeland Security (USA) . . . . . [8019-22]

Lunch/Exhibition Break . . . . . 12:40 to 1:40 pm

SESSION 6 . . . . . Tues. 1:40 to 3:00 pm

Human/Motion Detection

Session Chairs: **Sachi V. Desai,** U.S. Army Armament Research, Development and Engineering Ctr.; **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr.

Human motion analysis and modeling, Brian Kocher, J. Michael Cathcart, Alan M. Thomas, Georgia Tech Research Institute (USA). . . . . [8019-23]

Human motion analysis and characterization, J. Michael Cathcart, Alan M. Thomas, Brian Kocher, Georgia Tech Research Institute (USA). . . . . [8019-24]

Classification of people walking and jogging/running using multimodal sensor signatures, Thyagaraju Damarla, James M. Sabatier, U.S. Army Research Lab. (USA) . . . . . [8019-25]

Magnetometer-enhanced personal locator for tunnels and GPS-denied outdoor environments, Surat Kwanmuang, Johann Borenstein, Lauro V. Ojeda, Univ. of Michigan (USA) . . . . . [8019-26]

SESSION 7 . . . . . Tues. 3:30 to 4:30 pm

Bio-inspired Surveillance and Sensing

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr.; **Todd M. Hintz,** Space and Naval Warfare Systems Command

Validation of Escherichia coli capture on portable microchips for point-of-care applications, Utkan Demirci, Harvard Medical School (USA) . . . . . [8019-27]

Monitoring wildlife behavior for the detection of imminent threats, Charles S. Bendall, Space and Naval Warfare Systems Ctr. Pacific (USA) . . . . . [8019-28]

Bioinspired flow and acoustic sensor, Junliang Tao, Xiong Yu, Jim Berrilla, Case Western Reserve Univ. (USA). . . . . [8019-29]

SESSION 8 . . . . . Tues. 4:30 to 6:10 pm

Gunshot/Counter Sniper

Session Chairs: **Sachi V. Desai,** U.S. Army Armament Research, Development and Engineering Ctr.; **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr.

Photonics sensor-based rifle mini-fire control system, Slobodan Rajic, Oak Ridge National Lab. (USA). . . . . [8019-30]

Classification of acoustic gunshot signatures using a nonparametric Bayesian signal model, Kenneth D. Morton, Jr., Peter A. Torrione, Leslie M. Collins, New Folder Consulting, LLC (USA) . . . . . [8019-31]

Delay-and-sum beamforming for direction of arrival estimation applied to gunshot acoustics, Antonio L. L. Ramos, Buskerud Univ. College (Norway) and Univ. of Oslo (Norway); Sverre Holm, Univ. of Oslo (Norway); Sigmund Gudvangen, Buskerud Univ. College (Norway); Ragnvald Otterlei, Posicom AS (Norway) . . . . . [8019-32]

Analysis of multispectral signatures of shot, Mariusz Kastek, Rafal Dulski, Tadeusz Piatkowski, Henryk Madura, Jaroslaw Barela, Henryk Polakowski, Military Univ. of Technology (Poland) . . . . . [8019-33]

Fast uncooled module 32×32 array of polycrystalline PbSe used for muzzle flash detection, Mariusz Kastek, Rafal Dulski, Tomasz Sosnowski, Henryk Madura, Grzegorz Bieszczad, Piotr Trzaskawka, Military Univ. of Technology (Poland) . . . . . [8019-34]

Wednesday 27 April

SESSION 9 . . . . . Wed. 8:00 to 10:00 am

Surveillance and Border Safety

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr.; **Todd M. Hintz,** Space and Naval Warfare Systems Command

Concept of data processing in multisensor system for perimeter protection, Rafal Dulski, Mariusz Kastek, Piotr Trzaskawka, Mieczyslaw Szustakowski, Marek Zyczkowski, Military Univ. of Technology (Poland) . . . . . [8019-35]

Localisation of threat substances in urban society - LOTUS: a viable tool for finding illegal bomb factories in cities, Hans G. Önnerud, Henric Oestmark, Sara Wallin, Swedish Defence Research Agency (Sweden) . . . . . [8019-36]

Smart border: ad-hoc wireless sensor networks for border surveillance, Jun He, Robert A. Norwood, Mahmoud Fallahi, Nasser Peyghambarian, College of Optical Sciences, The Univ. of Arizona (USA). . . . . [8019-37]

Detection of person borne IEDs using multiple cooperative sensors, Scott MacIntosh, Ling Tang, Reveal Imaging Technologies, Inc. (USA). . . . . [8019-38]

Bayesian paradox in homeland security and homeland defense, Tomasz P. Jannson, Thomas C. Forrester, Wenjian Wang, Physical Optics Corp. (USA) . . . . . [8019-39]

Pervasive awareness and guidance for military training, Hunfuko A. Abeykoon, National Univ. of Singapore (Singapore); Sun Ying, Real Space Pte Ltd. (Singapore); Kasun Karunanayaka, Owen N. Newton Fernando, Adrian D. Cheok, National Univ. of Singapore (Singapore). . . . . [8019-40]

CROSS-CONFERENCE HOT TOPIC PANEL
Wed. 10:30 am to 12:30 pm

Data to Decisions: "Sensors are No Longer King"

Moderator: **John. M. Pellegrino,** Director, Army Research Lab., Computational and Information Sciences Directorate (CISD)

This cross-conference hot topic provides a unique forum for senior leaders from different organizational perspectives to discuss the shifting paradigm of what is needed to achieve the required situational understanding to make the best actionable battlefield decisions. We need to get away from the "autistic" view of sensing and learn to integrate other non-traditional information sources including HUMINT, cultural understanding, social networks, policies and behavior modeling.

Identifying the Technology Needs from a Holistic Perspective

Lunch/Exhibition Break . . . . . 12:30 to 1:30 pm

SESSION 10 . . . . . Wed. 1:30 to 2:10 pm

EO, Imaging and Communications Technologies

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr.; **Tariq Manzur,** Naval Undersea Warfare Ctr.

The all-optical warship: design and integration considerations for a future electro-optical sensor suite, Krispijn A. Scholte, Koen P. A. Ten Holter, Koninklijke Marine (Netherlands). . . . . [8019-02]

Nanostructure based EO/IR sensor development for homeland security applications, Ashok K. Sood, Magnolia Optical Technologies, Inc. (USA); Tariq Manzur, Naval Undersea Warfare Ctr. (USA); A. F. Mehdi Anwar, Univ. of Connecticut (USA); Nibir K. Dhar, Dennis L. Polla, Defense Advanced Research Projects Agency (USA) . . . . . [8019-03]

Courses of Related Interest

SC952 **Applications of Detection Theory** (Carrano) Thursday, 8:30 am to 5:30 pm

SC1035 **Military Laser Safety** (Marshall) Wednesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Airborne Intelligence, Surveillance, Reconnaissance (ISR) Systems and Applications VIII

Conference Chair: **Daniel J. Henry,** Goodrich ISR Systems

Conference Co-Chairs: **Beato T. Cheng,** Goodrich ISR; **Dale C. Linne von Berg,** Naval Research Lab.; **Darrell L. Young,** Raytheon Intelligence & Information Systems

Wednesday 27 April

SESSION 1 . . . . . Wed. 8:00 to 10:00 am

ISR Sensors and Systems I

Session Chair: **Daniel J. Henry,** Goodrich ISR Systems

Miniaturization of a SWIR hyperspectral imager, Christopher P. Warren, William R. Pfister, Detlev M. Even, Arleen Velasco, Joseph Naungayan, Selwyn M. Yee, David S. Breitwieser, NovaSol (USA) . . . . . [8020-01]

Small unmanned aerial system high performance payload, Ricky J. Morgan, Ali A. Abtahi, Usha Raghuram, Frida E. Strömqvist Vetelino, Aerospace Missions Corp. (USA) . . . . . [8020-02]

Real-world noise in hyperspectral imaging systems, Richard L. Wiggins, Lovell E. Comstock, Jeffry J. Santman, Corning NetOptix (USA) . . . . . [8020-03]

Flight test of an imaging O2(X-b) monocular passive ranging instrument, Joel R. Anderson, Michael R. Hawks, Kevin C. Gross, Glen P. Perram, Air Force Institute of Technology (USA) . . . . . [8020-04]

A novel SAL detector giving enhanced spatial and temporal resolution, Mark S. Robbins, Cliff Weatherup, e2v Technologies plc (United Kingdom) . . . [8020-05]

Orbit efficiency for persistent wide area ground surveillance, John J. SantaPietro, MITRE Corp. (USA) . . . . . [8020-06]

CROSS-CONFERENCE HOT TOPIC PANEL
Wed. 10:30 am to 12:30 pm

Data to Decisions: "Sensors are No Longer King"

Moderator: **John. M. Pellegrino,** Director, Army Research Lab., Computational and Information Sciences Directorate (CISD)

This cross-conference hot topic provides a unique forum for senior leaders from different organizational perspectives to discuss the shifting paradigm of what is needed to achieve the required situational understanding to make the best actionable battlefield decisions. We need to get away from the "autistic" view of sensing and learn to integrate other non-traditional information sources including HUMINT, cultural understanding, social networks, policies and behavior modeling.

Identifying the Technology Needs from a Holistic Perspective

Lunch/Exhibition Break . . . . . 12:30 to 1:30 pm

SESSION 2 . . . . . Wed. 1:30 to 3:10 pm

ISR Sensors and Systems II

Session Chair: **Dale C. Linne von Berg,** U.S. Naval Research Lab.

Modular multispectral imaging system for multiple missions and applications, Jon Schoonmaker, Yuliya Podobna, James Sofianos, Steve Saggese, Cynthia Boucher, Daniel Oakley, Dustin Medeiros, Advanced Coherent Technologies LLC (USA) . . . . . [8020-07]

Imaging EO/IR optical system for Long Range Oblique Photography, Jeong-Yeol Han, Sergey Marchuk, Samsung Thales Co., Ltd. (Korea, Republic of); Hooshik Kim, Vieworks Co., Ltd. (Korea, Republic of); Changwoo Kim, Kwang-Woo Park, Agency for Defense Development (Korea, Republic of) . . . . . [8020-08]

Autonomous collection of dynamically cued multisensor imagery, Scott A. Anderson, Mark D. Jensen, Space Dynamics Lab. (USA); Thomas J. Walls, Dale C. Linne von Berg, Michael L. Wilson, U.S. Naval Research Lab. (USA) . [8020-09]

High-speed laser communications in UAV scenarios, Wolfgang Griethe, Frank F. Heine, Hartmut Kaempfner, Tesat-Spacecom GmbH & Co. KG (Germany) . . . . . [8020-10]

On-flight correction algorithm of alignment errors in an optical system, Satoshi Imaizumi, Mitsubishi Electric Corp. (Japan) . . . . . [8020-12]

SESSION 3 . . . . . Wed. 3:40 to 5:00 pm

ISR Sensors and Systems III

Session Chair: **Dale C. Linne von Berg,** U.S. Naval Research Lab.

Optical characterization of artillery blast waves and muzzle flash, Bryan J. Steward, Kevin C. Gross, Glen P. Perram, Air Force Institute of Technology (USA) . . . . . [8020-13]

The building block approach to airborne pod structures, Jan D. Johansson, Terma A/S (Denmark) . . . . . [8020-14]

Search Metric Adaptive Resource Tasking (SMART), William J. Rudnisky, Raytheon Space & Airborne Systems (USA) . . . . . [8020-15]

Boron carbide and silicon carbide reinforced aluminum composites, Edgar E. Vidal, Brush Wellman, Inc. (USA); Jonathan Silk, Aerospace Metal Composites Ltd. (United Kingdom); Ai L. Wood III, Brush Wellman, Inc. (USA) . . . . . [8020-16]

Thursday 28 April

SESSION 4 . . . . . Thurs. 8:20 to 10:00 am

ISR Detection and Tracking I

Session Chair: **Beato T. Cheng,** Goodrich Corp.

Feature-based image registration for multispectral imagery, Beato T. Cheng, Goodrich Corp. (USA) . . . . . [8020-17]

Ocean modeling at multiple resolutions for ISR applications, J. Michael Cathcart, Brian Kocher, J. Ralph Teague, Sarah E. Lane, Edward Burdette, Georgia Institute of Technology (USA) . . . . . [8020-18]

Experimental analysis of adaptive clutter removal techniques in IR target detection systems, Alessandro Rossi, Nicola Acito, Marco Diani, Giovanni Corsini, Univ. di Pisa (Italy) . . . . . [8020-19]

The effect of minimum target size and other factors on the performance envelope of Automated Moving Target Indication Systems for airborne surveillance with EO sensors, Paul A. Boxer, Tom Loveard, Sentient Vision Systems (Australia) . . . . . [8020-21]

Robust vehicle detection in aerial images based on salient region selection and superpixel classification, Samir Sahli, Pierre-Luc Duval, Yunlong Sheng, Univ. Laval (Canada); Daniel A. Lavigne, Defence Research and Development Canada (Canada). . . . . [8020-22]

SESSION 5 . . . . . Thurs. 10:30 am to 12:30 pm

ISR Detection and Tracking II

Session Chair: **Beato T. Cheng,** Goodrich Corp.

Robust component-based car detection in aerial images with new segmentation techniques, Yueh Ouyang, Pierre-Luc Duval, Yunlong Sheng, Univ. Laval (Canada); Daniel A. Lavigne, Defence Research and Development Canada (Canada). . . . . [8020-23]

Layer-based object detection and tracking with graph matching, Qiang He, Mississippi Valley State Univ. (USA); Aldo Camargo, The Univ. of North Dakota (USA) . . . . . [8020-25]

Software-based robust global motion estimation for real-time video target tracking, Chenhui Yang, Hongwei Mao, Arizona State Univ. (USA); Glen P. Abousleman, General Dynamics C4 Systems, Inc. (USA); Jennie Si, Arizona State Univ. (USA) . . . . . [8020-26]

Tracking targets through occlusions in outdoor videos, Hongwei Mao, Chenhui Yang, Arizona State Univ. (USA); Glen P. Abousleman, General Dynamics C4 Systems, Inc. (USA); Jennie Si, Arizona State Univ. (USA) . . . . . [8020-27]

Target location from the estimated instantaneous received frequency, Douglas J. Nelson, National Security Agency (USA). . . . . [8020-28]

Vision-based drone flight control and crowd or riot analysis with efficient color histogram-based tracking, Thomas Müller, Markus Müller, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . [8020-24]

Lunch/Exhibition Break . . . . . 12:30 to 1:30 pm

SESSION 6 . . . . . Thurs. 1:30 to 3:10 pm

ISR Image Processing and Exploitation I

Session Chair: **Darrell L. Young,**
Raytheon Intelligence & Information Systems

Task-based video interpretability as a function of target motion, frame rate, and playback speed, Darrell L. Young, Raytheon Intelligence & Information Systems (USA). . . . . [8020-29]

Interactive video compression for remote sensing, Ray Maleh, Frank A. Boyle, Paul B. Deignan, Jerry W. Yancey, L-3 Communications Integrated Systems (USA) . . . . . [8020-30]

Efficient compression of sequences of multispectral images, Mariofanna G. Milanova, Univ. of Arkansas at Little Rock (USA); Roumen Kountchev, Technical Univ. of Sofia (Bulgaria); Roumiana Kountcheva, T&K Engineering Co. (Bulgaria) . . . . . [8020-31]

Scene-based blind deconvolution in the presence of anisoplanatism, David C. Dayton, Applied Technology Associates (USA); John D. Gonglewski, Air Force Research Lab. (USA) . . . . . [8020-32]

Video enhancement effectiveness for target detection, Michael C. Simon, Amber D. Fischer, Plamen V. Petrov, 21st Century Systems, Inc. (USA) . [8020-33]

SESSION 7 . . . . . Thurs. 3:40 to 5:00 pm

ISR Image Processing and Exploitation II

Session Chair: **Darrell L. Young,**
Raytheon Intelligence & Information Systems

Automatic registration and mosaicing algorithm for SAR images, Manikandan Samykannu, Chhabi Nigam, P. Vardhani, A. Vengadarajan, Defence Research and Development Organisation (India) . . . . . [8020-34]

Fast reconstruction of 3D terrain based on UAV sequential imagery, Xianwei Zhu, Yang Shang, Jianliang Ou, Qifeng Yu, Xiaohu Zhang, National Univ. of Defense Technology (China) . . . . . [8020-35]

Automated UAV-based video exploitation using service oriented architecture framework, Stephen Se, Christian Nadeau, Scott Wood, MacDonald, Dettwiler and Associates Ltd. (Canada) . . . . . [8020-36]

Techniques for inferring terrain parameters related to ground vehicle mobility using UAV born IFSAR and lidar data, Phillip J. Durst, Gary D. Cantrell, U.S. Army Engineer Research and Development Ctr. (USA) . . . . . [8020-37]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Mean-shift tracking for surveillance applications using thermal infrared and visible band data fusion, Cigdem Beyan, Middle East Technical Univ. (Turkey) and Baskent Univ. (Turkey); Alptekin Temizel, Middle East Technical Univ. (Turkey) . . . . . [8020-38]

Multi-field-of-view hyperspectral imager, Lovell E. Comstock, Richard L. Wiggins, Corning NetOptix (USA) . . . . . [8020-39]

Plenoptic processing methods for distributed camera arrays, Frank A. Boyle, Jerry W. Yancey, Ray Maleh, L-3 Communications Integrated Systems (USA) . . . . . [8020-40]

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Radar Sensor Technology XV

Conference Chairs: **Kenneth I. Ranney,** U.S. Army Research Lab.; **Armin W. Doerry,** Sandia National Labs.

Program Committee: **Fauzia Ahmad,** Villanova Univ.; **Sean M. Buckley,** Jet Propulsion Lab.; **Joseph C. Deroba,** U.S. Army CERDEC Intelligence and Information Warfare Directorate; **Doreen M. Dyck,** Defence Research and Development Canada (Canada); **Benjamin C. Flores,** The Univ. of Texas at El Paso; **John E. Gray,** Naval Surface Warfare Ctr. Dahlgren Div.; **Majeed M. Hayat,** The Univ. of New Mexico; **Todd A. Kastle,** Air Force Research Lab.; **Seong-Hwoon Kim,** Raytheon Space & Airborne Systems; **James L. Kurtz,** Univ. of Florida; **Changzhi Li,** Texas Tech Univ.; **Jenshan Lin,** Univ. of Florida; **David G. Long,** Brigham Young Univ.; **Jia-Jih Lu,** General Atomics Aeronautical Systems, Inc.; **Anthony F. Martone,** U.S. Army Research Lab.; **Atindra K. Mitra,** Air Force Research Lab.; **George J. Moussally,** Mirage Systems; **Lam H. Nguyen,** U.S. Army Research Lab.; **Hector A. Ochoa-Gutierrez,** The Univ. of Texas at Tyler; **Meppalli K. Shandas,** dB Control; **Jerry Silvious,** U.S. Army Research Lab.; **Brian Smith,** U.S. Army Armament Research, Development and Engineering Ctr.; **Helmut H. Suess,** Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **David Tahmoush,** U.S. Army Research Lab.; **Lars M. Wells,** Sandia National Labs.; **Steven J. Weiss,** U.S. Army Research Lab.

Monday 25 April

OPENING REMARKS. . . . . Mon. 8:30 to 8:40 am

SESSION 1 . . . . . Mon. 8:40 to 10:00 am

Systems and Applications

Session Chair: **James L. Kurtz,** Univ. of Florida

Ground penetration radar using free-electron maser, Alastair D. McAulay, Lehigh Univ. (USA) . . . . . [8021-01]

A computer simulation of a long-range CWFM radar showing trade-offs of performance as a function of range, Robert S. Gordy, Severyn Zoledziowski, Global Technical Systems (USA). . . . . [8021-02]

Augmented reality using ultra-wideband radar imagery, Lam H. Nguyen, Francois Koenig, Kelly D. Sherbondy, U.S. Army Research Lab. (USA). . [8021-03]

High-coherence track-while-scan low-cost radar for anti-piracy operations, Volodymyr Gouz, Valeriy Lipatov, Kvant Scientific Research Institute (Ukraine); Vasyl Molebny, National Taras Shevchenko Univ. of Kyiv (Ukraine). . . . . [8021-04]

SESSION 2 . . . . . Mon. 10:30 am to 12:10 pm

Phenomenology I

Session Chairs: **Meppalli K. Shandas,** dB Control; **Gregory J. Mazzaro,** U.S. Army Research Lab.

Human polarimetric micro-doppler, David Tahmoush, U.S. Army Research Lab. (USA) . . . . . [8021-10]

A survey of radar applications in medicine, Atindra K. Mitra, Air Force Research Lab. (USA) . . . . . [8021-06]

Polarization dynamics and interference analysis for wideband signals, Glafkos Stratis, Ghassan C. Maalouli, David G. Manzi, Rafael Ihly, Raytheon Missile Systems (USA). . . . . [8021-07]

Phenomenology of fully polarimetric imaging radars, Jorge V. Geaga, Consultant (USA). . . . . [8021-08]

Visualizing and displaying radar micro-doppler data, David Tahmoush, U.S. Army Research Lab. (USA) . . . . . [8021-11]

Lunch Break . . . . . 12:10 to 1:10 pm

SESSION 3 . . . . . Mon. 1:10 to 3:10 pm

Phenomenology II

Session Chairs: **Lam H. Nguyen,** U.S. Army Research Lab.; **Anthony F. Martone,** U.S. Army Research Lab.

A picosecond measuring technique to determine phase instability in a synthetic aperture radar system, Robert S. Gordy, David Markell, Mark Burns, Andy Anderson, Global Technical Systems (USA) . . . . . [8021-05]

Polarisation transform analysis for detection of shallow buried non-metallic landmines in microwave x-band region, Kailash C. Tiwari, Military Engineering Services (India) . . . . . [8021-09]

Radar cross section statistics of dismounts at Ku-band, Ann M. Raynal, Bryan L. Burns, Douglas L. Bickel, Armin W. Doerry, Sandia National Labs. (USA); Tobias J. Verge, Jeremy Stromsoe, Ralf Dunkel, General Atomics Aeronautical Systems, Inc. (USA). . . . . [8021-12]

Radar cross section statistics of ground vehicles at Ku-band, Ann M. Raynal, Douglas L. Bickel, Michael M. Denton, Wallace J. Bow, Jr., Armin W. Doerry, Sandia National Labs. (USA); Tobias J. Verge, Jeremy Stromsoe, Ralf Dunkel, General Atomics Aeronautical Systems, Inc. (USA) . . . . . [8021-13]

Human activity classification using Hilbert-Huang transform analysis of radar Doppler data, Ram M. Narayanan, Dustin P. Fairchild, The Pennsylvania State Univ. (USA) . . . . . [8021-14]

Multifrequency Doppler characteristics of human activities using biomechanical models, Ram M. Narayanan, Robert M. Sorbello, The Pennsylvania State Univ. (USA). . . . . [8021-15]

SESSION 4 . . . . . Mon. 3:40 to 5:40 pm

Through the Wall Radar

Session Chairs: **Atindra K. Mitra,** Air Force Research Lab.; **Jerry Silvious,** U.S. Army Research Lab.

Comparison of three radars for through-wall sensing, Junfei Li, Xiaohui Wang, The Univ. of Texas-Pan American (USA); Chiman Kwan, Signal Processing, Inc. (USA) . . . . . [8021-16]

A fast data acquisition and processing scheme for through-the-wall radar imaging, Fauzia Ahmad, Villanova Univ. (USA); Francesco Soldovieri, Instituto per il Rilevamento Elettromagnetico dell'Ambiente (Italy); Raffaele Solimene, Seconda Univ. degli Studi di Napoli (Italy) . . . . . [8021-17]

Target localization with a single-antenna monostatic radar via multipath exploitation, Pawan Setlur, Graeme E. Smith, Fauzia Ahmad, Moeness G. Amin, Villanova Univ. (USA). . . . . [8021-18]

Real-time subsurface imaging algorithm for intra-wall characterization, Wenji Zhang, Ahmad Hoorfar, Villanova Univ. (USA); Lianlin Li, Institute of Electronics (China); Fauzia Ahmad, Villanova Univ. (USA) . . . . . [8021-19]

UWB through complex scattering mechanisms, Ryan D. White, Blake J. Anderton, Eric Williams, Jonathan Hess, Steve Manson, Glafkos Stratis, Raytheon Missile Systems (USA); Chris Penney, Remcom, Inc. (USA). . . . . [8021-20]

Wave propagation through complex wall structures, Blake J. Anderton, Ryan D. White, Eric Williams, Jonathan Hess, Steve Manson, Glafkos Stratis, Raytheon Missile Systems (USA) . . . . . [8021-21]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

OPENING REMARKS. . . . . Tues. 10:00 to 10:10 am

SESSION 5 . . . . . Tues. 10:10 to 11:50 am

Metamaterials for Radar

Session Chair: **Steven J. Weiss,** U.S. Army Research Lab.

Novel antennas based upon extraordinary transmission metamaterial lenses, Mario Sorolla Ayza, Miguel Navarro-Cia, Miguel Beruete, Francisco Falcone, Univ. Pública de Navarra (Spain) . . . . . [8021-22]

Transformation optics compressed rotman lens implemented with complementary metamaterials, John D. Hunt, Duke Univ. (USA); Nathan Kundtz, Intellectual Ventures (USA); Bruce B. Sun, Duke Univ. (USA); Alper Genc, Anthony F. Starr, SensorMetrix (USA); David R. Smith, Duke Univ. (USA) . . . . . [8021-23]

Scalable smart antenna architectures using metamaterials, Atindra K. Mitra, Colin Hu, Air Force Research Lab. (USA); Connor Johnson, Louisiana Tech Univ. (USA) . . . . . [8021-24]

Considerations for dielectric breakdown of metamaterials, Jeffrey Boksiner, U.S. Army RDECOM CERDEC S&TCD (USA) . . . . . [8021-25]

Metamaterial-driven lens optics for new beam forming patterns, Amir I. Zaghloul, Steven J. Weiss, U.S. Army Research Lab. (USA) . . . . . [8021-26]

Lunch/Exhibition Break . . . . . 11:50 am to 1:00 pm

SESSION 6 . . . . . Tues. 1:00 to 3:00 pm

Applications and Techniques I

Session Chairs: **Seong-Hwoon Kim,** Raytheon Space & Airborne Systems; **David Tahmoush,** U.S. Army Research Lab.

Super-resolution technologies for all-weather sense and avoidance (SAA) radar, Yan Zhang, Hernan A. Montalvo Suarez, Zhengzheng Li, Shang Wang, The Univ. of Oklahoma (USA). . . . . [8021-27]

Using SAR back-projection for precise interferometric scene height measurement, Evan C. Zaugg, Matthew C. Edwards, ARTEMIS, Inc. (USA); David G. Long, Brigham Young Univ. (USA) . . . . . [8021-28]

SAR vibrometry using a pseudo-subspace approach based on the discrete fractional Fourier transform, Qi Wang, Balasubramaniam Santhanam, Matthew P. Pepin, Tom D. Atwood, Majeed M. Hayat, The Univ. of New Mexico (USA) . . . . . [8021-29]

Generation of FM signals with quasi-chirp behavior using three-dimensional chaotic flows, Chandra S. Pappu, Benjamin C. Flores, Berenice Verdin, The Univ. of Texas at El Paso (USA) . . . . . [8021-30]

PADF RF localization criteria for multimodel scattering environments, Miguel Gates, Christopher Barber, Louisiana Tech Univ. (USA); Huthaifa Alissa, Univ. of Dayton (USA); Atindra K. Mitra, Air Force Research Lab. (USA); Raul Ordonez, Univ. of Dayton (USA); Rastko R. Selmic, Louisiana Tech Univ. (USA) . . [8021-31]

A method for selecting radar waveforms based upon post-selection criteria, John E. Gray, Allen D. Parks, Naval Surface Warfare Ctr. Dahlgren Div. (USA) . . . . . [8021-32]

SESSION 7 . . . . . Tues. 3:30 to 5:30 pm

Applications and Techniques II

Session Chairs: **John E. Gray,** Naval Surface Warfare Ctr. Dahlgren Div.; **Fauzia Ahmad,** Villanova Univ.

Clutter locus equation for more general array orientation, Douglas L. Bickel, Sandia National Labs. (USA) . . . . . [8021-33]

Multisignal radar techniques using smartphone technologies, Atindra K. Mitra, Air Force Research Lab. (USA); Colin Hu, The Ohio State Univ. (USA); Kasandra Maxwell, Univ. of Dayton (USA) . . . . . [8021-34]

Determination of instantaneous frequency using MCMC bayesian model selection, Asif Mehmood, U.S. Army Research Lab. (USA); Paul M. Goggans, The Univ. of Mississippi (USA); James M. Sabatier, U.S. Army Research Lab. (USA) . . . . . [8021-35]

Quick signal detection and dynamic resource allocation scheme for ultra-wideband radar, Xiangming Kong, Mohin Ahmed, HRL Labs., LLC (USA) . . . . . [8021-36]

Exploitation of active electronically scanned array flexibility for improved GMTI and SAR functionality and performance, Martie M. Goulding, MacDonald, Dettwiler and Associates Ltd. (Canada); Andy Stonehouse, SELEX Galileo Ltd. (United Kingdom); Anthony Damini, Defence Research and Development Canada (Canada) . . . . . [8021-37]

Adaptive detection of range-spread targets by the generalized detector, Vyacheslav P. Tuzlukov, Kyungpook National Univ. (Korea, Republic of) [8021-38]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

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ECCM performance analysis of chaotic coded orthogonal frequency division multiplexing (COFDM) SAR, Xiangzhi Feng, Xiaojian Xu, BeiHang Univ. (China) . . . . . [8021-58]

Noise radar with broadband microwave ring correlator, Waldemar Susek, Bronislaw Stec, Military Univ. of Technology (Poland) . . . . . [8021-59]

Interference suppression in noise radar systems, Slobodan Djukanovic, Univ. of Montenegro (Montenegro); Thayananthan Thayaparan, Defence Research and Development Canada (Canada); Miloš Dakovic, Ljubiša Stankovic, Univ. of Montenegro (Montenegro) . . . . . [8021-60]

Detection and identification of concealed weapons using matrix pencil, Raviraj S. Adve, Univ. of Toronto (Canada); Thayananthan Thayaparan, Defence Research and Development Canada (Canada) . . . . . [8021-61]

Through-the-wall detection of human activity, Tommy Johansson, Jonas Rahm, Jan Gustavsson, Stefan L. Nilsson, Ain Sume, Anders Orbom, Swedish Defence Research Agency (Sweden) . . . . . [8021-62]

Some comments on GMTI false alarm rate, Armin W. Doerry, Sandia National Labs. (USA) . . . . . [8021-63]

Optimal antenna beamwidth for stripmap SAR, Armin W. Doerry, Sandia National Labs. (USA) . . . . . [8021-64]

Synthetic aperture radar for disaster monitoring, Ralf Dunkel, Randy Saddler, General Atomics Aeronautical Systems, Inc. (USA); Armin W. Doerry, Sandia National Labs. (USA) . . . . . [8021-65]

Design and implementation of a digital impulse generator for a 24GHz UWB radar, Sang-Dong Kim, Jonghun Lee, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of) . . . . . [8021-66]

Dc-offset effect cancelation method using mean-padding FFT for automotive UWB radar sensor, Yeonghwan Ju, Sang-Dong Kim, Jonghun Lee, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of) . . . . [8021-67]

Integrated radar-camera security system: experimental results, Marek Zyczkowski, Norbert Palka, Tomasz Trzcinski, Rafal Dulski, Mariusz Kastek, Piotr Trzaskawka, Military Univ. of Technology (Poland) . . . . . [8021-68]

Resolution analysis of bistatic SAR image, Zhijun Qiao, Guillermo Garza, Jaime Lopez, The Univ. of Texas-Pan American (USA) . . . . . [8021-69]

Side-looking image formation with a maneuvering vehicle-mounted antenna array, Kenneth I. Ranney, Lam H. Nguyen, Chi Tran, Roberto Innocenti, U.S. Army Research Lab. (USA) . . . . . [8021-70]

Wideband fiber optic vector modulator using 8-tap all-optical Hilbert transform, Ryand Tucker, Sergio C. Granieri, Azad Siahmakoun, Rose-Hulman Institute of Technology (USA) . . . . . [8021-71]

Coherent radar optimization using frequency-domain correlation function, Volodymyr Gouz, Kvant Scientific Research Institute (Ukraine) . . . . . [8021-72]

Far-field scattering of random electromagnetic fields from particulate media, Zhisong Tong, Olga Korotkova, Univ. of Miami (USA) . . . . . [8021-73]

Stereo matching: performance study of two global area-based algorithms, Sarala Arunagiri, The Univ. of Texas at El Paso (USA) . . . . . [8021-74]

On the use of the Shark antenna for radar detection techniques, Laurent Desrumaux, L'IUT du Limousin (France); Valérie Bertrand-Vincent, CISTEME (France); Joël Andrieu, Michèle Lalande, L'IUT du Limousin (France); Bernard Jecko, XLIM Institut de Recherche (France) . . . . . [8021-75]

Attenuation of front-end reflections in an impulse radar using high-speed switching, Gregory J. Mazzaro, Marc A. Ressler, Gregory D. Smith, U.S. Army Research Lab. (USA) . . . . . [8021-76]

Scannerless gain-modulated three-dimensional laser imaging radar, Chenfei Jin, Yuan Zhao, Xiudong Sun, Long Wu, Yu Zhang, Harbin Institute of Technology (China) . . . . . [8021-77]

Exploiting spatial diversity in MIMO radars with collocated antennas, Ghassan C. Maalouli, Daniel Rosser, Glafkos Stratis, Raytheon Missile Systems (USA) . . . . . [8021-78]

Wednesday 27 April

OPENING REMARKS. . . . . Wed. 8:10 to 8:20 am

SESSION 8 . . . . . Wed. 8:20 to 10:00 am

Signal Processing in Noise Radar

Session Chair: **Ram M. Narayanan,** The Pennsylvania State Univ.

Radar signature acquisition using indigenously designed noise radar system, Al Freundorfer, Queen's Univ. (Canada); Jawad Siddiqui, Yahia Antar, Royal Military College of Canada (Canada); Thayananthan Thayaparan, Defence Research and Development Canada (Canada) . . . . . [8021-39]

High-resolution noise radar using slow ADC, Konstantin A. Lukin, Pavlo L. Vyplavin, Oleg V. Zemlyanyi, Usikov Institute of Radiophysics and Electronics (Ukraine) . . . . . [8021-40]

Direct digitization of ultra-wideband (UWB) noise signals using frequency band folding, Russell Vela, The Pennsylvania State Univ. (USA); Gordon Woodington, Mark R. Deluca, Raytheon Co. (USA); Ram M. Narayanan, The Pennsylvania State Univ. (USA). . . . . [8021-41]

Cross-correlation analysis of noise radar signals propagating through lossy dispersive media, Ram M. Narayanan, Sonny Smith, The Pennsylvania State Univ. (USA) . . . . . [8021-42]

Super-resolution techniques for velocity estimation using UWB random noise radar signals, Muhammad Dawood, Nafish Quraishi, New Mexico State Univ. (USA) . . . . . [8021-43]

SESSION 9 . . . . . Wed. 10:30 am to 12:10 pm

Adaptive Generation of Noise and Noise-Like Waveforms

Session Chair: **Thayananthan Thayaparan,**
Defence Research and Development Canada (Canada)

Generation of noise-like radar waveforms, Gaspare Galati, Gabriele Pavan, Univ. degli Studi di Roma Tor Vergata (Italy). . . . . [8021-44]

A technique for the generation of customizable ultra-wideband pseudo-noise waveforms, Russell Vela, The Pennsylvania State Univ. (USA); David Erisman, X-COM Systems (USA); Ram M. Narayanan, The Pennsylvania State Univ. (USA) . . . . . [8021-45]

Brillouin precursor waveforms pertaining to UWB noise radar signals propagating through dispersive media, Muhammad Dawood, New Mexico State Univ. (USA); Anna V. Alejos, Univ. de Vigo (Spain) and New Mexico State Univ. (USA) . . . . . [8021-46]

Mitigation of RF spectrum co-channel interference through the application of noise radar technology, Mark Govoni, U.S. Army Research, Development and Engineering Command (USA) . . . . . [8021-47]

A technique for the extraction of ultra-wideband (UWB) signals concealed in frequency band folded responses, Russell Vela, Ram M. Narayanan, The Pennsylvania State Univ. (USA); David Erisman, X-COM Systems (USA) [8021-48]

Lunch/Exhibition Break . . . . . 12:10 to 1:40 pm

SESSION 10 . . . . . Wed. 1:40 to 3:20 pm

Imaging and Detection Using Noise Radar

Session Chair: **Mark Govoni,**
U.S. Army Research, Development and Engineering Command

SAR imagery using chaotic carrier frequency agility pulses, Xiaojian Xu, Xiangzhi Feng, BeiHang Univ. (China). . . . . [8021-49]

The constructive role of noise in tracing of targets behind wall using SAR, Robert Kozma, The Univ. of Memphis (USA); Robert Linnehan, Air Force Research Lab. (USA) . . . . . [8021-50]

Target discrimination technique utilizing noise waveforms, Mark R. DeLuca, Raytheon Co. (USA) . . . . . [8021-51]

Design and implementation of random noise radar with spectral-domain correlation for moving target detection, Jeong-Phill Kim, Chi-Hyeon Jeong, Ahn-Jian Bian, Cheol-Who Kim, Chung-Ang Univ. (Korea, Republic of) . [8021-52]

Passive radar imaging of moving targets using distributed apertures, Ling Wang, Nanjing Univ. of Aeronautics and Astronautics (China); Birsen Yazici, Rensselaer Polytechnic Institute (USA). . . . . [8021-53]

SESSION 11 . . . . . Wed. 3:50 to 5:10 pm

Chaotic and Noise-Like Radar Systems

Session Chair: **Russell Vela,** The Pennsylvania State Univ.

Microwave chaotic oscillator: a device based on three-wave interactions of spin waves in magnetic thin films, Mingzhong Wu, Aaron Hagerstrom, Richard Eykholt, Boris Kalinikos, Colorado State Univ. (USA) . . . . . [8021-54]

Concept for low-cost chaos radar using coherent reception, Jonathan N. Blakely, U.S. Army Research, Development and Engineering Command (USA); Ned J. Corron, U.S. Army Aviation and Missile Command (USA); Mark T. Stahl, U.S. Army Research, Development and Engineering Command (USA) . . [8021-55]

Nonlinear dynamics method for target identification, Thomas L. Carroll, Frederic J. Rachford, U.S. Naval Research Lab. (USA) . . . . . [8021-56]

Quantum radar versus noise radar, Konstantin A. Lukin, Usikov Institute of Radiophysics and Electronics (Ukraine) . . . . . [8021-57]

Course of Related Interest

SC1031 **Radar Micro-Doppler Signatures - Principles and Applications** (Chen, Tahmoush) Monday, 1:30 to 5:30 pm

See full course listing and descriptions on pp. 144-192.

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Passive Millimeter-Wave Imaging Technology XIV

Conference Chairs: **David A. Wikner,** U.S. Army Research Lab.; **Arttu R. Luukanen,** VTT Technical Research Ctr. of Finland (Finland)

Program Committee: **Roger Appleby,** Consultant (United Kingdom); **Erich N. Grossman,** National Institute of Standards and Technology; **Christopher A. Martin,** Trex Enterprises Corp.

Thursday 28 April

SESSION 1 . . . . . Thurs. 8:00 to 11:50 am

Imaging Systems

Session Chair: **David A. Wikner,** U.S. Army Research Lab.

Millimeter-wave interferometric radiometry for passive imaging and signal detection, David Dowgiallo, Elizabeth Twarog, Wendy Peters, Steve Rauen, Joseph Helmboldt, Peter Gaiser, U.S. Naval Research Lab. (USA) . . . . . [8022-01]

Progress toward a video-rate, passive millimeter-wave imager for brownout mitigation, Christopher A. Schuetz, Richard D. Martin, Thomas E. Dillon III, Daniel Mackrides, Peng Yao, Phase Sensitive Innovations, Inc. (USA); Dennis W. Prather, Univ. of Delaware (USA) . . . . . [8022-02]

Towards high-sensitivity and high-resolution submillimeter-wave video imaging, Erik Heinz, Torsten May, Detlef Born, Gabriel Zieger, Solveig Anders, Viatcheslav Zakosarenko, Institut für Photonische Technologien e.V. (Germany); Marco Schubert, Supracon AG (Germany); Torsten Krause, André Krüger, Hans-Georg Meyer, Institut für Photonische Technologien e.V. (Germany) . . . . [8022-03]

Improved reconstruction and sensing techniques for personnel screening in three-dimensional cylindrical millimeter-wave portal scanning, Justin L. Fernandes, Pacific Northwest National Lab. (USA); Carey M. Rappaport, Northeastern Univ. (USA); David M. Sheen, Pacific Northwest National Lab. (USA) . . . . . [8022-04]

High-resolution passive video-rate imaging at 350 GHz, Dan T. Becker, James A. Beall, Hsiao-Mei Cho, William D. Duncan, National Institute of Standards and Technology (USA); Cale M. Gentry, The Univ. of Oklahoma (USA); Gene C. Hilton, Kent D. Irwin, Peter Lowell, Michael D. Niemack, Carl D. Reintsema, Frank Schima, Robert E. Schwall, Ki Won Yoon, National Institute of Standards and Technology (USA); Peter A. Ade, Carole E. Tucker, Cardiff Univ. (United Kingdom). . . . . [8022-05]

Design and performance of a passive video-rate THz system demonstrator, Arttu R. Luukanen, Mika Aikio, Markus Grönholm, Mikko M. Leivo, Aki Mäyrä, Anssi Rautiainen, Hans Toivanen, VTT Technical Research Ctr. of Finland (Finland). . . . . [8022-06]

A new approach for fast security scanning with millimetre-waves: SARGATE, Stefan A. Lang, Manfred Hägelen, Sebastian Hantscher, Fraunhofer FHR (Germany) . . . . . [8022-07]

Multisensor millimeter-wave system for hidden objects detection by non-collaborative screening, Rhalem Zouaoui, Thierry Lamarque, Czarny Romain, Thales Research & Technology (France); Claude Checkroun, SART (France); Antoine Khy, Telecom ParisTech (France) . . . . . [8022-08]

300 GHz imaging with 8 meter stands-off distance and one-dimensional synthetic image reconstruction, Andreas Keil, Torsten Loeffler, Holger Quast, SynView GmbH (Germany); Viktor Krozer, Johann Wolfgang Goethe-Univ. Frankfurt am Main (Germany); Jørgen Dall, Anders Kusk, Vitaliy Zhurbenko, Technical Univ. of Denmark (Denmark); Peter J. I. de Maagt, European Space Research and Technology Ctr. (Netherlands) . . . . . [8022-09]

3D rendering of passive millimeter-wave scenes using modified open source software, Maciej Murakowski, John P. Wilson, Janusz Murakowski, Garrett Schneider, Univ. of Delaware (USA); Christopher A. Schuetz, Phase Sensitive Innovations, Inc. (USA); Dennis W. Prather, Univ. of Delaware (USA). . . . [8022-10]

Lunch/Exhibition Break . . . . . 11:50 am to 1:20 pm

SESSION 2 . . . . . Thurs. 1:20 to 3:00 pm

Phenomenology

Session Chair: **Arttu R. Luukanen,**
VTT Technical Research Ctr. of Finland (Finland)

Phenomenology studies using a scanning fully polarimetric passive W-band millimeter-wave imager, Bruce E. Bernacki, James F. Kelly, David M. Sheen, Douglas L. McMakin, Jonathan R. Tedeschi, Thomas E. Hall, Brian K. Hatchell, Patrick L. J. Valdez, Pacific Northwest National Lab. (USA). . . . . [8022-11]

Impact of polarization and frequency diversity on a terahertz radar's imaging performance, Ken B. Cooper, Jet Propulsion Lab. (USA); Nuria Llombart, Univ. Complutense de Madrid (Spain); Robert J. Dengler, Bertrand C. Thomas, Peter H. Siegel, Jet Propulsion Lab. (USA) . . . . . [8022-12]

Validation of a small-sample, bi-directional scattering measurement system from 200-500 GHz, David R. Novotny, Josh Gordon, Edwin J. Heilweil, Erich N. Grossman, Randy Direen, National Institute of Standards and Technology (USA); Brian Stillwell, Univ. of Colorado at Boulder (USA) . . . . . [8022-13]

Pulsed terahertz bi-directional reflection distribution function (BRDF) measurements of materials and obscurants, Edwin J. Heilweil, Alen Lo, David R. Novotny, Erich N. Grossman, National Institute of Standards and Technology (USA) . . . . . [8022-14]

Calibration, reconstruction, and rendering of cylindrical millimeter-wave image data, David M. Sheen, Thomas E. Hall, Pacific Northwest National Lab. (USA) . . . . . [8022-15]

SESSION 3 . . . . . Thurs. 3:30 to 6:10 pm

Devices and Intelligent Sensing

Session Chair: **David A. Wikner,** U.S. Army Research Lab.

Compressive sampling in passive millimeter-wave imaging, Nachappa Gopalsami, Thomas W. Elmer, Shaolin Liao, Ryan R. Ahern, Alexander Heifetz, Apostolos C. Raptis, Argonne National Lab. (USA); Martin Luessi, Derin Babacan, Aggelos Katsaggelos, Northwestern Univ. (USA) . . . . . [8022-16]

Two-dimensional, real-time, sub-millimeter-wave imaging using a spatially selective mask, Orges Furxhi, Eddie Jacobs, The Univ. of Memphis (USA) . . . . . [8022-17]

Compressive sensing for a sub-millimeter-wave single pixel imager, Imama Noor, Orges Furxhi, Eddie Jacobs, The Univ. of Memphis (USA). . . . . [8022-18]

A multicamera positioning system for steering of a THz stand-off scanner, Maria Axelsson, Mikael Karlsson, Staffan Rudner, Swedish Defence Research Agency (Sweden). . . . . [8022-19]

Rapid holographic beamsteering reflectarrays for millimeter-wave and sub-millimeter-wave imaging radars, Arttu R. Luukanen, VTT Technical Research Ctr. of Finland (Finland); Juha Ala-Laurinaho, Aalto Univ. School of Science and Technology (Finland); David Gomes-Martins, Janne Häkli, Päivi Koivisto, Pekka Pursula, Jussi Säily, VTT Technical Research Ctr. of Finland (Finland); Aleksi A. Tamminen, Aalto Univ. School of Science and Technology (Finland); Reijo Tuovinen, Markku Sipilä, VTT Technical Research Ctr. of Finland (Finland). . . . . [8022-20]

a 220 GHz reflection-type phased array concept study, Abigail Hedden, Charles C. Dietlein, Tony Ivanov, David A. Wikner, U.S. Army Research Lab. (USA) . . . . . [8022-21]

W-band direct detection radiometers using metamorphic HEMT technology, Ingmar Kallfass, Axel Huelsmann, Axel Tessmann, Arnulf Leuther, Ernst Weissbrodt, Michael Schlechtweg, Oliver Ambacher, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany) . . . . . [8022-22]

New semiconductor and packaging technologies for small receivers for W-band imaging, John W. McNicol, Paul Rice, MMIC Solutions Ltd. (United Kingdom) . . . . . [8022-23]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Monday-Tuesday 25-26 April 2011 • Proceedings of SPIE Vol. 8023

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Terahertz Physics, Devices, and Systems V: Advance Applications in Industry and Defense

Conference Chairs: **A. F. Mehdi Anwar,** Univ. of Connecticut; **Nibir K. Dhar,** U.S. Army Research Lab.; **Thomas W. Crowe,** Virginia Diodes, Inc.

Program Committee: **Alexander Giles Davies,** Univ. of Leeds (United Kingdom); **Gottfried H. Döhler,** Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); **Achyut K. Dutta,** Banpil Photonics, Inc.; **M. Saif Islam,** Univ. of California, Davis; **Hiroshi Ito,** NTT Photonics Labs. (Japan); **Peter Uhd Jepsen,** Technical Univ. of Denmark (Denmark); **James Kolodzey,** Univ. of Delaware; **Edmund H. Linfield,** Univ. of Leeds (United Kingdom); **A. Hamed Majedi,** Univ. of Waterloo (Canada); **Tariq Manzur,** Naval Undersea Warfare Ctr.; **Taiichi Otsuji,** Tohoku Univ. (Japan); **B. M. Azizur Rahman,** The City Univ. (United Kingdom); **Victor Ryzhii,** Univ. of Aizu (Japan); **Richard A. Soref,** Air Force Research Lab.; **Simon Verghese,** MIT Lincoln Lab.; **Richard T. Webster,** Air Force Research Lab.; **K. Sigfrid Yngvesson,** Univ. of Massachusetts Amherst; **Weili Zhang,** Oklahoma State Univ.

Monday 25 April

SESSION 1 . . . . . Mon. 10:30 to 11:50 am

Keynote Session

Session Chairs: **Tariq Manzur,** Naval Undersea Warfare Ctr.; **Nibir K. Dhar,** Defense Advanced Research Projects Agency

Toward realizing high-power semiconductor terahertz laser sources at room temperature *(Keynote Presentation)*, Manijeh Razeghi, Northwestern Univ. (USA) . . . . . [8023-01]

Large area THz emitters *(Invited Paper)*, Gottfried H. Döhler, Max Planck Institute for the Science of Light (Germany) and Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); Sascha Preu, Univ. of California, Santa Barbara (USA); Stefan Malzer, Max Planck Institute for the Science of Light (Germany); Luis E. García Muñoz, Belen Andres Garcia, Univ. Carlos III de Madrid (Spain) . . . . . [8023-02]

Lunch Break . . . . . 11:50 am to 1:30 pm

SESSION 2 . . . . . Mon. 1:30 to 3:10 pm

Advance Concepts in THz Technology

Session Chairs: **Gottfried H. Döhler,** Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany); **A. F. Mehdi Anwar,** Univ. of Connecticut

Terahertz light amplification by stimulated emission of radiation from optically pumped graphene *(Invited Paper)*, Taiichi Otsuji, Stephane Albon Boubanga Tombet, Akira Satou, Tohoku Univ. (Japan); Victor Ryzhii, Univ. of Aizu (Japan). . . . . [8023-03]

Modeling electron transport coherence in one- and two-well terahertz step well quantum cascade structures with diagonal optical transitions, Will Freeman, Naval Air Warfare Ctr. Weapons Div. (USA) . . . . . [8023-04]

Combining backwards wave oscillator and solid state frequency multipliers to extend spectral coverage of electronic sources to 2.2 THz, Walter C. Hurlbut, Vladimir G. Kozlov, Microtech Instruments, Inc. (USA). . . . . [8023-05]

Terahertz detection by field effect transistors (FETs) for THz imaging, Wojciech M. Knap, Univ. Montpellier 2 (France). . . . . [8023-06]

The effects of individual subband electron temperatures in terahertz quantum cascade laser predictions, Philip Slingerland, Christopher S. Baird, Robert H. Giles, Univ. of Massachusetts Lowell (USA). . . . . [8023-07]

Active layer design of GaN-based quantum cascade lasers, Hung Chi Chou, A. F. Mehdi Anwar, Univ. of Connecticut (USA); Tariq Manzur, Naval Undersea Warfare Ctr. (USA). . . . . [8023-08]

SESSION 3 . . . . . Mon. 3:40 to 6:30 pm

THz Imaging

Session Chairs: **Taiichi Otsuji,** Tohoku Univ. (Japan); **Gottfried H. Döhler,** Friedrich-Alexander-Univ. Erlangen-Nürnberg (Germany)

A real-time terahertz imaging system consisting of terahertz quantum cascade laser and uncooled microbolometer array detector *(Invited Paper)*, Iwao Hosako, Norihiko Sekine, National Institute of Information and Communications Technology (Japan); Naoki Oda, Masahiko Sano, Seiji Kurashina, Masaru Miyoshi, Ken'ichi Sonoda, Hajime Yoneyama, Tokuhito Sasaki, NEC Guidance and Electro-Optics Division (Japan) . . . . . [8023-09]

Defect engineering of photovoltaic substrates using THz imaging, Raimund Leitner, Thomas Arnold, Martin De Biasio, Carinthian Tech Research AG (Austria) . . . . . [8023-10]

Video-rate uncooled microbolometer-based THz imaging camera, Martin Bolduc, Linda Marchese, Marc Terroux, Bruno Tremblay, Hassane Oulachgar, Michel Doucet, Loïc Le Noc, Christine Alain, Hubert Jerominek, Alain Bergeron, INO (Canada). . . . . [8023-11]

Concealed object detection with multichannel passive millimeter-wave imaging and multivariate Gaussian mixture modeling, Dong-Su Lee, Seokwon Yeom, Jung-Young Son, Shin-Hwan Kim, Daegu Univ. (Korea, Republic of) . . . . . [8023-12]

Active THz imaging and explosive detection with uncooled antenna-coupled microbolometer arrays, François Simoens, Jérôme Meilhan, Stéphane Pocas, Valérie Goudon, Gilles Lasfargues, Jérémy Lalanne-Dera, Fabrice Guellec, Bertrand Dupont, Thierry Maillou, Commissariat à l'Énergie Atomique (France); Olivier Cathabard, Stefano Barbieri, Univ. Paris 7-Denis Diderot (France) . . . . . [8023-13]

Development of an 80 x 64 pixel, broadband, real-time THz imager., Don J. Burdette, Traycer Diagnostic Systems, Inc. (USA); Jorgen Alverbro, IRnova AB (Sweden); Patrick J. Fay, Univ. of Notre Dame (USA); Kubilay Sertel, Kagan Topalli, Gerogios Trichopoulos, John Volakis, The Ohio State Univ. (USA); Howard L. Mosbacker, Traycer Diagnostic Systems, Inc. (USA) . . . . . [8023-14]

Broadband sub-millimeter-wave amplifer module with 38dB gain and 8.3dB noise figure, Stephen Sarkozy, Richard Lai, William R. Deal, Northrop Grumman Aerospace Systems (USA) . . . . . [8023-15]

Sensitive water concentration mapping in thin fresh tissues using tunable THz-wave parametric oscillator, Yuye Wang, Ming Tang, Takashi Notake, Kouji Nawata, Hiromasa Ito, Hiroaki Minamide, RIKEN (Japan) . . . . . [8023-16]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 4 . . . . . Tues. 10:30 am to 12:00 pm

THz Generation

Session Chairs: **A. F. Mehdi Anwar,** Univ. of Connecticut; **Nibir K. Dhar,** Defense Advanced Research Projects Agency

Frequency-agile terahertz-wave sources and applications to sensitive diagnosis of semiconductor wafers *(Invited Paper)*, Hiroaki Minamide, Hiromasa Ito, RIKEN (Japan) . . . . . [8023-17]

Optimized THz emission from intrinsic Josephson junctions, Nathan A. Moody, Lev N. Boulaevskii, Vitaly Pavlenko, Quanxi Jia, David Devlin, Los Alamos National Lab. (USA) . . . . . [8023-18]

Intracavity terahertz generation from gallium arsenide in a fiber laser pumped type 0 doubly resonant optical parametric oscillator, Walter C. Hurlbut, Vladimir G. Kozlov, Microtech Instruments, Inc. (USA); Konstantin L. Vodopyanov, Stanford Univ. (USA); Patrick F. Tekavec, Microtech Instruments, Inc. (USA). . . . . [8023-19]

InP and InGaAs Schottky type terahertz emitter excited at a wavelength of 1560nm, Masayoshi Tonouchi, Masato Suzuki, Kazunori Serita, Iwao Kawayama, Hironaru Murakami, Osaka Univ. (Japan) . . . . . [8023-20]

Lunch/Exhibition Break . . . . . 12:00 to 1:30 pm

SESSION 5 . . . . . Tues. 1:30 to 3:10 pm

THz Detection

Session Chairs: **Tariq Manzur,** Naval Undersea Warfare Ctr.;
Taiichi Otsuji, Tohoku Univ. (Japan)

Terahertz spectroscopy of energetic materials, Ewelina Witko, Timothy Korter, Syracuse Univ. (USA); John Wilkinson, Wayne Ouellette, James Lightstone, Naval Surface Warfare Ctr., Indian Head Div. . . . . [8023-21]

Terahertz remote sensing, Alexander V. Kellarev, Dan Sheffer, IARD Sensing Solutions Ltd. (Israel) . . . . . [8023-22]

The method of the spectral dynamics analysis of reflected signal for problem of identification of substance, Vyacheslav A. Trofimov, Svetlana A. Varentsova, Lomonosov Moscow State Univ. (Russian Federation); Jian Chen, Portland State Univ. (USA) . . . . . [8023-23]

Spectroscopic terahertz imaging for food safety inspection, Thomas Arnold, Martin De Biasio, Raimund Leitner, Carinthian Tech Research AG (Austria) . . . . . [8023-24]

Terahertz imaging with InP high-electron-mobility transistors, Takayuki Watanabe, Keisuke Akagawa, Yudai Tanimoto, Tohoku Univ. (Japan); Dominique Coquillat, Wojciech M. Knap, Univ. Montpellier 2 (France); Taiichi Otsuji, Tohoku Univ. (Japan) . . . . . [8023-25]

SESSION 6 . . . . . Tues. 3:40 to 5:50 pm

THz Spectroscopy

Session Chairs: **A. F. Mehdi Anwar,** Univ. of Connecticut;
Tariq Manzur, Naval Undersea Warfare Ctr.

Laser terahertz emission microscope *(Invited Paper)*, Masayoshi Tonouchi, Sunmi Kim, Shogo Fujiwara, Iwao Kawayama, Hironaru Murakami, Osaka Univ. (Japan) . . . . . [8023-26]

Plasmon resonance response to millimeter-waves of grating-gated InGaAs/InP HEMT, Nima Nader Esfahani, Gautam Medhi, Univ. of Central Florida (USA); Himanshu Saxena, Zyberwear, Inc. (USA); Christopher J. Fredricksen, Robert E. Peale, Univ. of Central Florida (USA); Walter R. Buchwald, Air Force Research Lab. (USA); Oliver J. Edwards, Zyberwear, Inc. (USA) . . . . . [8023-27]

Absorption spectroscopy of energetic materials using a 0.075 cm^{-1} resolution Fourier transform spectrometer, Elizabeth J. Slingerland, Matthew K. Vallon, Edwin G. E. Jahngen, Thomas M. Goyette, Robert H. Giles, Univ. of Massachusetts Lowell (USA); William E. Nixon, National Ground Intelligence Ctr. (USA) . . . . . [8023-28]

Handheld terahertz spectrometry with the micro-Z, Thomas D. Tongue, Brian J. Schulkin, Zomega Terahertz Corp. (USA); Xi-Cheng Zhang, Rensselaer Polytechnic Institute (USA) . . . . . [8023-29]

Computing methods for THz materials characterization, Andre U. Sokolnikov, Visual Solutions and Applications (USA) . . . . . [8023-30]

Demonstration of sweep-and-zoom sensing of RNA and DNA in nanofluidic channels using a THz coherent photomixing transceiver, Elliott R. Brown, Physical Domains, LLC (USA); Edgar A. Mendoza, Redondo Optics, Inc. (USA); Steven R. J. Brueck, The Univ. of New Mexico (USA) . . . . . [8023-31]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Ground state resonance structure calculated by density functional theory for estimating the dielectric response of the high explosive PETN, Andrew Shabaev, George Mason Univ. (USA) and U.S. Naval Research Lab. (USA); Samuel G. Lambrakos, Noam Bernstein, Verne L. Jacobs, U.S. Naval Research Lab. (USA); Daniel Finkenstadt, U.S. Naval Academy (USA) . . . . . [8023-32]

Optimization of plasmonic resonances in the two-dimensional electron gas of an InGaAs/InP high electron mobility transistor, Justin W. Cleary, Solid State Scientific Corp. (USA); Robert E. Peale, Univ. of Central Florida (USA); Himanshu Saxena, Zyberwear, Inc. (USA); Walter R. Buchwald, Air Force Research Lab. (USA) . . . . . [8023-33]

Plasmonic parametric oscillator via coupling between optically and electrically induced plasmons, Jed Khoury, Bahareh Haji-saeed, Charles L. Woods, Air Force Research Lab. (USA); John Kierstead, Solid State Scientific Corp. (USA) . . . . . [8023-34]

Plasmon modulation using high-frequency current, Jed Khoury, Bahareh Haji-saeed, Charles L. Woods, Air Force Research Lab. (USA); John Kierstead, Solid State Scientific Corp. (USA) . . . . . [8023-35]

An investigation of parallel plate waveguide terahertz radiation input coupling, James A. Higgins, Forest A. Kernan, Christopher L. Cowen, Branimir Pejcinovic, Portland State Univ. (USA) . . . . . [8023-36]

Courses of Related Interest

SC719 **Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies** (Gardner) Monday, 8:30 am to 12:30 pm

SC952 **Applications of Detection Theory** (Carrano) Thursday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Advanced Environmental, Chemical, and Biological Sensing Technologies VIII

Conference Chairs: **Tuan Vo-Dinh,** Duke Univ.; **Robert A. Lieberman,** Intelligent Optical Systems, Inc.; **Günter Gauglitz,** Eberhard Karls Univ. Tübingen (Germany)

Program Committee: **Francesco Baldini,** Istituto di Fisica Applicata Nello Carrara (Italy); **Luigi Campanella,** Univ. degli Studi di Roma La Sapienza (Italy); **Franz Ludwig Dickert,** Univ. Wien (Austria); **Fabien J. Josse,** Marquette Univ.; **Vassili Karanassios,** Univ. of Waterloo (Canada); **Dennis K. Killinger,** Univ. of South Florida; **Heinz-Detlef Kronfeldt,** Technische Univ. Berlin (Germany); **Robert Lascola,** Savannah River National Lab.; **Anna Grazia Mignani,** Istituto di Fisica Applicata Nello Carrara (Italy); **Klaus Schäfer,** Forschungszentrum Karlsruhe (Germany)

Monday 25 April

SESSION 1 . . . . . Mon. 8:30 to 9:30 am

Biosensors

Session Chairs: **Robert A. Lieberman,** Intelligent Optical Systems, Inc.; **Tuan Vo-Dinh,** Duke Univ.

Enzyme detection by surface plasmon resonance using specially engineered spacers and plasmonic labelling, Alexandre Francois, Sabrina Heng, Roman Kostecki, Tanya Monro, The Univ. of Adelaide (Australia) . . . . . [8024-01]

An optical biosensor using MEMS-based V-grooves, Ye Tian, Xiaodong Ma, Nan Wu, Xiaotian Zou, Kai Sun, Xingwei Wang, Univ. of Massachusetts Lowell (USA) . . . . . [8024-10]

Optofluidic-nanoplasmonic sensors for biochemical detection, Hatice Altug, Ahmet A. Yanik, Min Huang, Arif E. Cetin, Boston Univ. (USA); Tsung-Yao Chang, Massachusetts Institute of Technology (USA); Alp Artar, Boston Univ. (USA) . . . . . [8024-04]

SESSION 2 . . . . . Mon. 9:30 to 10:30 am

Chemical Sensors

Session Chairs: **Robert A. Lieberman,** Intelligent Optical Systems, Inc.; **Tuan Vo-Dinh,** Duke Univ.

Interaction of stochastic electromagnetic beams with human eye, Serkan Sahin, Olga Korotkova, Univ. of Miami (USA) . . . . . [8024-03]

Distributed fiber optic chemical sensors for security safety, and environmental applications, Robert A. Lieberman, Manal Beshay, Intelligent Optical Systems, Inc. (USA) . . . . . [8024-05]

Plasmonics SERS nanochip sensing platforms for chemical and biological sensing, Anuj Dhawan, Hsin-Neng Wang, Tuan Vo-Dinh, Duke Univ. (USA) . . . . . [8024-38]

SESSION 3 . . . . . Mon. 11:00 am to 12:40 pm

Advanced Sensing Technologies

Session Chair: **Glenn O. Allgood,** Oak Ridge National Lab.

Steam distribution and energy delivery optimization using measurement and control over wireless sensors, Glenn O. Allgood, Mohammed M. Olama, Phani T. Kuruganti, Sreenivas R. Sukumar, Joe E. Lake, Oak Ridge National Lab. (USA) . . . . . [8024-07]

Lensfree sensing on a chip using plasmonic nano-apertures, Bahar Khademhosseinieh, Gabriel Biener, Ikbal Sencan, Ting-Wei Su, Ahmet F. Coskun, Aydogan Ozcan, Univ. of California, Los Angeles (USA). . . . . [8024-08]

Development of an optically interrogated chemical tag, Robert R. Boye, Cody M. Washburn, David A. Scrymgeour, Bradley G. Hance, Shawn M. Dirk, David R. Wheeler, W. Graham Yelton, Timothy N. Lambert, Sandia National Labs. (USA) . . . . . [8024-09]

Infrared surface waves on semimetals, semiconductors, and conducting polymers, Monas Shahzad, Gautam Medhi, Robert E. Peale, Univ. of Central Florida (USA); Walter R. Buchwald, Air Force Research Lab. (USA); Justin W. Cleary, Solid State Scientific Corp. (USA); Oliver J. Edwards, Zyberwear, Inc. (USA) . . . . . [8024-02]

Simultaneous ultra-high harmonic detection wavelength modulation spectroscopy for resolving congested spectra, Brett M. D. Sawyer, Karan D. Mohan, Amin N. Dharamsi, Old Dominion Univ. (USA). . . . . [8024-11]

Lunch Break . . . . . 12:40 to 2:00 pm

SESSION 4 . . . . . Mon. 2:00 to 3:40 pm

Spectrographic Trace Detection

Session Chair: **Heinz-Detlef Kronfeldt,** Technische Univ. Berlin (Germany)

671 nm microsystem diode laser based portable Raman sensor device for in-situ identification of meat spoilage, Kay Sowoidnich, Heinar Schmidt, Technische Univ. Berlin (Germany); Fredi Schwägele, Max Rubner-Institut (Germany); Heinz-Detlef Kronfeldt, Technische Univ. Berlin (Germany) . . [8024-12]

High sensitivity calixarene SERS substrates for the continuous in-situ detection of PAHs in seawater, Yong-Hyok Kwon, Anna Kolomijeca, Kay Sowoidnich, Heinz-Detlef Kronfeldt, Technische Univ. Berlin (Germany). [8024-13]

Remote mid-infrared sensing using chirped laser dispersion spectroscopy, Michal Nikodem, Clinton J. Smith, Princeton Univ. (USA); Damien Weidmann, Rutherford Appleton Lab. (United Kingdom); Gerard Wysocki, Princeton Univ. (USA) . . . . . [8024-14]

Long range trace detection by radar REMPI, Arthur Dogariu, Celine Stein, Alexander Glaser, Richard B. Miles, Princeton Univ. (USA) . . . . . [8024-15]

Remote air lasing for trace detection, Arthur Dogariu, James Michael, Richard B. Miles, Princeton Univ. (USA). . . . . [8024-16]

SESSION 5 . . . . . Mon. 4:00 to 6:20 pm

Environmental Sensing

Nanopillars array for surface enhanced Raman scattering, Allan Chang, Mihail Bora, Elaine M. Behymer, Hoang T. Nguyen, Cindy C. Larson, Jerald A. Britten, Lawrence Livermore National Lab. (USA); James Chan, Univ. of California, Davis (USA); Tiziana C. Bond, Lawrence Livermore National Lab. (USA). . . . . [8024-17]

Far-UV LIBS for biological and organic samples, Khan Lim, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Jason M. Eichenholz, Ocean Optics, Inc. (USA); Matthieu Baudelet, Martin C. Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8024-18]

Analyte focusing at self assembling hotspots for SERS by leaning silver coated silicon nanopillars, Michael S. Schmidt, Anja Boisen, Technical Univ. of Denmark (Denmark). . . . . [8024-19]

Battery-operated planar-geometry micro-plasmas on postage-stamp size chips: some fundamentals, Scott Weagant, Vassili Karanassios, Univ. of Waterloo (Canada). . . . . [8024-20]

Gallium nitride nanowire-nanocluster hybrids for environmental sensing, Geetha S. Aluri, George Mason Univ. (USA); Abhishek Motayed, Kris A. Bertness, Norman A. Sanford, Albert V. Davydov, National Institute of Standards and Technology (USA); Rao V. Mulpuri, George Mason Univ. (USA); John Melngailis, Univ. of Maryland, College Park (USA) . . . . . [8024-06]

Probabilistic evaluation and simulation of damageability of water infrastructure systems, Behrouz Shafei, Masanobu Shinozuka, Univ. of California, Irvine (USA). . . . . [8024-22]

Deforestation modeling for Zagros forests using RS and GIS techniques (case study: forests of Ilam), Djafar Oladi, Delavar Bozorgnia, Ali Akbar Jafarzadeh, Univ. of Mazandaran (Iran, Islamic Republic of) . . . . . [8024-23]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 6 . . . . . Tues. 10:00 am to 12:20 pm

Gas Sensing

Spectrally tailored pulsed thulium fiber laser system for broadband lidar CO_2 sensing, Timothy S. McComb, Northrop Grumman Aerospace Systems (USA); William S. Heaps, Elena M. Georgieva, NASA Goddard Space Flight Ctr. (USA); Eric C. Cheung, Brian K. Baldauf, Peter A. Thielen, James G. Ho, Frank R. Hassell, Northrop Grumman Aerospace Systems (USA) . . . . . [8024-24]

Characteristics of polar and nonpolar ZnO nanostructure based gas sensors, Sheng Chun Hung, Chung Wei Chen, Gou-Chung Chi, National Central Univ. (Taiwan) . . . . . [8024-25]

High sensitivity detection of NO_2 employing off-axis integrated cavity output spectroscopy coupled with multiple line integrated spectroscopy, Gottipaty N. Rao, Andreas Karpf, Adelphi Univ. (USA) . . . . . [8024-26]

A low-volume microstructured optical fiber hydrogen peroxide sensor, Erik P. Schartner, Dominic F. Murphy, Heike Ebendorff-Heidepriem, Tanya M. Monro, The Univ. of Adelaide (Australia) . . . . . [8024-27]

Tin oxide nanowire sensors for highly sensitive detection of the toxic gas H_2S, Anton Koeck, Elise Brunet, Austrian Institute of Technology (Austria); Giorgio Mutinati, Pirelli & C. S.p.A. (Austria); Stephan Steinhauer, Austrian Institute of Technology (Austria) . . . . . [8024-28]

Standoff identification and quantification of flare emissions using infrared hyperspectral imaging, Kevin C. Gross, Air Force Institute of Technology (USA); Simon Savary, Telops (Canada); Pierre Tremblay, Univ. Laval (Canada); Jean-Philippe Gagnon, Vincent Farley, Martin Chamberland, Telops (Canada) [8024-29]

Trace gas detection and monitoring with the digital array gas-correlation radiometer (DAGR), Martin J. McHugh, Larry L. Gordley, Mark E. Hervig, GATS, Inc. (USA). . . . . [8024-30]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Effects of design parameters of passive FTIR spectroscopy system using Michelson interferometer on the detection probability of stand-off hazardous compounds, Kang Sup Shim, Hong Jin Kong, Min Seok Oh, KAIST (Korea, Republic of) . . . . . [8024-31]

Noise and current-voltage characteristics of structures with porous silicon layer in different gas environments, Zara Mkhitaryan, Vladimir Aroutiounian, Shushanik Geghamyan, Yerevan State Univ. (Armenia) . . . . . [8024-32]

Strong room-temperature chemiresistive effect of TiO_2-B nanowires to nitro-aromatic compounds, Danling Wang, Antao Chen, Qifeng Zhang, Guozhong Cao, Univ. of Washington (USA) . . . . . [8024-33]

Gas cloud infrared image enhancement based on anisotropic diffusion, Jiakun Li, Changxing Zhang, Yunting Long, Bei Zhang, Lingxue Wang, Beijing Institute of Technology (China) . . . . . [8024-34]

Monitoring organic volatiles and flammable gases with a holographic sensor, Juan Leonardo Martinez-Hurtado, Christopher R. Lowe, Univ. of Cambridge (United Kingdom). . . . . [8024-35]

Compact mobile ELISA-based pathogen detection: design and implementation challenges, Dmitry S. Starodubov, Anya Asanbaeva, Ihor V. Berezhnyy, Chung-Yen Chao, Richard Koziol, David Miller, Edward Patton, Sushma Trehan, Chris Ulmer, Physical Optics Corp. (USA) . . . . . [8024-36]

Multifrequency electric field tomography for body cavity screening, Young K. Lee, Erik E. Magnuson, Lon Ficke, Quantum Magnetics, Inc. (USA); Yuri A. Plotnikov, Nilesh Tralshawala, GE Global Research (USA). . . . . [8024-37]

A comparison between deterministic and probabilistic approaches for detection of damage in corroded pipelines, Behrouz Shafei, Azadeh Alipour, Masanobu Shinozuka, Univ. of California, Irvine (USA). . . . . [8024-21]

Thursday 28 April 2011 • Proceedings of SPIE Vol. 8025

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Smart Biomedical and Physiological Sensor Technology VIII

Conference Chairs: **Brian M. Cullum,** Univ. of Maryland, Baltimore County; **Eric S. McLamore,** Univ. of Florida

Program Committee: **Karl S. Booksh,** Univ. of Delaware; **Marie-Christine F. Daniel,** Univ. of Maryland, Baltimore County; **Andre J. Gesquiere,** Univ. of Central Florida; **Ilko K. Ilev,** U.S. Food and Drug Administration; **T. Joshua Pfefer,** U.S. Food and Drug Administration; **Shiv K. Sharma,** Univ. of Hawai'i; **Brian S. Sorg,** Univ. of Florida; **Chang-Soo Kim,** Missouri Univ. of Science and Technology; **Anhong Zhou,** Utah State Univ.; **William Todd Monroe,** Louisiana State Univ.; **Majed Dweik,** Univ. of Missouri-Columbia; **Liju Yang,** North Carolina Central Univ.; **Mark R. Riley,** The Univ. of Arizona; **Liang Zhu,** Univ. of Maryland, Baltimore County

Thursday 28 April

SESSION 1 . . . . . Thurs. 8:20 to 10:00 am

Nano/Micro-sensors for Cellular Analyses

Session Chairs: **Liju Yang,** North Carolina Central Univ.; **Shiv K. Sharma,** Univ. of Hawai'i

Optimization of SAM-based multilayer SERS substrates for intracellular analyses: the effect of terminating functional groups, Charles K. Klutse, Brian M. Cullum, Univ. of Maryland, Baltimore County (USA) . . . . . [8025-01]

Nitrocellulose-based SERS based immuno-sensor for detection of biological molecules, Ava C. Dykes, Lori E. Kamemoto, Anupam K. Misra, Shiv K. Sharma, Univ. of Hawai'i (USA) . . . . . [8025-02]

Novel optical nanobiosensor encapsulated in erythrocytes, Majed Dweik, Lincoln Univ. (USA) . . . . . [8025-03]

Self-referencing luminescent optrodes for non-invasive, real time measurement of extracellular flux, Eric S. McLamore, Univ. of Florida (USA); D. Marshall Porterfield, Purdue Univ. (USA) . . . . . [8025-04]

Sensor for detection and classification of nano particles and biological agents in situ based on optical resonance in dielectric microspheres, Vladimir A. Saetchnikov, Elina A. Tcherniavskaia, Belarusian State Univ. (Belarus); Gustav Schweiger, Andreas Ostendorf, Ruhr-Univ. Bochum (Germany) . . . . . [8025-05]

SESSION 2 . . . . . Thurs. 10:20 am to 12:00 pm

Spectroscopic Tools for Tissue and Bacterial Analyses

Session Chairs: **Chang-Soo Kim,** Missouri Univ. of Science and Technology; **Liju Yang,** North Carolina Central Univ.

Electrical/electrochemical impedance biosensors/biochips for rapid detection of foodborne pathogenic bacteria, Liju Yang, North Carolina Central Univ. (USA) . . . . . [8025-06]

Micro-Raman discrimination of bacterial strains using multilayered microcavity substrates, Shiv K. Sharma, Ava C. Dykes, Anupam K. Misra, Lori E. Kamemoto, David E. Bates, Univ. of Hawai'i (USA) . . . . . [8025-07]

Fluorescence intensity measurements with display screen as excitation source, Sanghan Park, Satya Achanta, Chang-Soo Kim, Missouri Univ. of Science and Technology (USA). . . . . [8025-08]

Development of a depolarized Raman spectrometer for potential surface-enhanced Raman optical activity (SEROA) measurements, Honggang Li, Biotools Inc. (USA); Laurence A. Nafie, Syracuse Univ. (USA) . . . . . [8025-09]

Colorimetric phosphorescence measurements with a color camera for oxygen determination, Prajakta Bhagwat, Satya Achanta, Chang-Soo Kim, Missouri Univ. of Science and Technology (USA); David B. Henthorn, Saint Louis Univ. (USA) . . . . . [8025-10]

Lunch/Exhibition Break . . . . . 12:00 to 1:40 pm

SESSION 3 . . . . . Thurs. 1:40 to 3:00 pm

In-vitro and In-vivo Imaging and Diagnostics

Session Chairs: **Shiv K. Sharma,** Univ. of Hawai'i; **Marie-Christine F. Daniel,** Univ. of Maryland, Baltimore County

Micro-Raman spectroscopic study of ALVAC virus infected chicken embryo cells, Anupam K. Misra, Lori E. Kamemoto, Univ. of Hawai'i (USA); Ningjie Hu, Indiana Univ. School of Medicine (USA); Ava C. Dykes, Univ. of Hawai`i (USA); Qigui Yu, Indiana Univ. School of Medicine (USA); Shiv K. Sharma, Univ. of Hawai'i (USA). . . . . [8025-11]

UV Raman spectroscopy of HIV antigens, Pavel V. Zinin, Lori E. Kamemoto, Univ. of Hawai'i (USA); Qigui Yu, Ningjie Hu, Indiana Univ. School of Medicine (USA); Anupam K. Misra, Shiv K. Sharma, Univ. of Hawai'i (USA) . . . . . [8025-12]

Two-photon photoacoustic spectroscopy for noninvasive subsurface chemical diagnostics, Sudhir Dahal, Brian M. Cullum, John B. Kiser, Univ. of Maryland, Baltimore County (USA) . . . . . [8025-13]

Studies of MRI relaxivities of gadolinium-labeled dendronized gold nanoparticles, Hongmu Pan, Marie-Christine F. Daniel, Univ. of Maryland, Baltimore County (USA) . . . . . [8025-14]

SESSION 4 . . . . . Thurs. 3:30 to 4:50 pm

Toward the Clinic/Field

Session Chairs: **Marie-Christine F. Daniel,** Univ. of Maryland, Baltimore County; **Liang Zhu,** Univ. of Maryland, Baltimore County

Temperature elevations in prostatic tumors during laser photothermal therapy, Liang Zhu, Anilchandra Attaluri, Hong Cai, Raymond Edziah, Elaine Lalanne, Charles Bieberich, Ronghui Ma, Anthony M. Johnson, Univ. of Maryland, Baltimore County (USA) . . . . . [8025-15]

Synthesis and biological studies of highly concentrated lisinopril-capped gold nanoparticles for CT tracking of angiotensin converting enzyme (ACE), William E. Ghann, Univ. of Maryland, Baltimore County (USA); Omer Aras M.D., Thorsten Fleiter M.D., Univ. of Maryland Medical Ctr. (USA); Marie-Christine F. Daniel, Univ. of Maryland, Baltimore County (USA) . . . . . [8025-16]

Securing medical monitoring devices using advanced RFID technology, Daniel Engels, Massachusetts Institute of Technology (USA). . . . . [8025-17]

An innovative non-contact ECG sensor, Ye Sun, Xiong Yu, Jim Berrilla, Case Western Reserve Univ. (USA) . . . . . [8025-18]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Anti-sleepiness sensor systems for sober mental condition, Won Heum Han, Hyung Sik Jung, Hyo Gun Lee, Hana Academy Seoul (Korea, Republic of) . . . . . [8025-19]

Two-stage microfluidic device for acoustic particle manipulation, Myeong Chan Jo, Rasim O. Guldiken, Univ. of South Florida (USA) . . . . [8025-21]

Courses of Related Interest

SC952 **Applications of Detection Theory** (Carrano) Thursday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Monday-Tuesday 25-26 April 2011 • Proceedings of SPIE Vol. 8026

Photonic Applications for Aerospace, Transportation, and Harsh Environment II

Conference Chairs: **Alex A. Kazemi,** The Boeing Co.; **Bernard Kress,** USI Photonics Inc.; **Eric Y. Chan,** The Boeing Co.

Conference Co-Chairs: **Nabeel A. Riza,** CREOL, The College of Optics and Photonics, Univ. of Central Florida; **Lothar U. Kempen,** Intelligent Optical Systems, Inc.

Program Committee: **Frank Abdi,** AlphaSTAR Corp.; **Jacques Albert,** Carleton Univ. (Canada); **Christopher S. Baldwin,** Aither Engineering, Inc.; **Manal Beshay,** Intelligent Optical Systems, Inc.; **Ayoub Chakari,** Ecole Nationale Supérieure de Physique de Strasbourg (France); **Fu-Kuo Chang,** Stanford Univ.; **Dan Curticapean,** Hochschule Offenburg (Germany); **James E. Fesmire,** NASA Kennedy Space Ctr.; **Leo R. Gauthier, Jr.,** The Johns Hopkins Univ.; **Harold Hager,** The Boeing Co.; **Zuyuan He,** The Univ. of Tokyo (Japan); **Robert G. Johnson,** NASA Kennedy Space Ctr.; **Peter Kiesel,** Palo Alto Research Center, Inc.; **Dennis G. Koshinz,** The Boeing Co.; **Edgar A. Mendoza,** Redondo Optics, Inc.; **Patrick P. Meyrueis,** Ecole Nationale Supérieure de Physique de Strasbourg (France); **Jean-Pierre Moeglin,** Institut Franco-Allemand de Recherches de Saint-Louis (France); **Ayman S. Mosallam,** Univ. of California, Irvine; **Juock S. Namkung,** Naval Air Warfare Ctr. Aircraft Div.; **Allen S. Panahi,** Redondo Optics, Inc.; **Indu F. Saxena,** Intelligent Optical Systems, Inc.; **William St. Cyr,** NASA Stennis Space Ctr.; **Pierre St. Hilaire,** Holox Technologies, Inc.

Monday 25 April

SESSION 1 . . . . . Mon. 8:30 to 10:10 am

Sensors in Transportation/Aerospace Applications

Session Chair: **Alex A. Kazemi,** The Boeing Co.

PFO hydrogen detection sensor systems for space applications *(Invited Paper)*, Alex A. Kazemi, ARK International (USA) . . . . . [8026-01]

Viability of guided-wave ultrasound-based diagnostics for sharply curved composite structures, Indu F. Saxena, Intelligent Optical Systems, Inc. (USA); Vinay Dayal, Iowa State Univ. (USA); Lothar U. Kempen, Intelligent Optical Systems, Inc. (USA). . . . . [8026-02]

Advances towards the qualification of an aircraft fuel tank inert environment *(Invited Paper)*, Edgar A. Mendoza, Redondo Optics, Inc. (USA) . . . . . [8026-03]

Intrinsically safe oxygen and hydrogen optical leak detector, Manal Beshay, Simona Garon, David Ruiz, Lothar U. Kempen, Intelligent Optical Systems, Inc. (USA) . . . . . [8026-04]

SESSION 2 . . . . . Mon. 10:40 to 11:40 am

Micro, Nano and Laser Photonics in Transportation

Session Chair: **Eric Y. Chan,** The Boeing Co.

Miniaturized real-time monitor for fuel cell leak applications, Manal Beshay, Jai Ganesh Chandrasekhar, Jesus Delgado, Christopher Boehr, Robert A. Lieberman, Intelligent Optical Systems, Inc. (USA). . . . . [8026-05]

Online automatic measurement of deflection for automobile based on digital CCD sensors, Chanjun Chen, Wuhan Univ. (China) . . . . . [8026-06]

AUV-portable temperature-compensating fiber optic hydrophone, Indu F. Saxena, Narciso Guzman, Kaleo J. Hui, Steve Pflanze, Intelligent Optical Systems, Inc. (USA). . . . . [8026-07]

Lunch Break . . . . . 11:40 am to 1:10 pm

SESSION 3 . . . . . Mon. 1:10 to 2:30 pm

Photonics In Harsh Environment, Signal Processing

Session Chair: **Lothar U. Kempen,** Intelligent Optical Systems, Inc.

Incoherent light guide imager for harsh and complex environments, Leo R. Gauthier, Jr., The Johns Hopkins Univ. (USA). . . . . [8026-08]

Digital micromirror device-based robust object boundary mapping sensor, Philip J. Marraccini, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Cody Baxley, Univ. of Central Florida (USA); Nabeel A. Riza, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8026-09]

High resolution wide dynamic range distance sensor using spatial signal processing, Philip J. Marraccini, Nabeel A. Riza, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8026-10]

Multimode laser beam characterization using agile digital-analog photonics, Philip J. Marraccini, Nabeel A. Riza, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8026-11]

SESSION 4 . . . . . Mon. 3:20 to 5:10 pm

Environmental and Gas Monitoring

Session Chair: **Nabeel A. Riza,** CREOL, The College of Optics and Photonics, Univ. of Central Florida

Wireless/integrated strain monitoring and simulation system, Frank Abdi, AlphaSTAR Corp. (USA) . . . . . [8026-12]

All optical O_2 sensors using innovative phase fluorimetry for monitoring of headspace in ullage for FAA mandated inerting fuel tanks of commercial airlines, Allen S. Panahi, Accro USA, LLC (USA) . . . . . [8026-13]

Compact and fast read-out for wavelength-encoded sensors, Peter Kiesel, Palo Alto Research Center, Inc. (USA) . . . . . [8026-14]

Development of an ultrafast response fluorescence hydrogen sensor for leak detection in hazardous explosive environments *(Invited Paper)*, Edgar A. Mendoza, Redondo Optics, Inc. (USA) . . . . . [8026-15]

Battery outgassing sensor for electric drive vehicle energy storage systems, Manal Beshay, Jai Ganesh Chandrasekhar, Lothar U. Kempen, Intelligent Optical Systems, Inc. (USA). . . . . [8026-16]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 5 . . . . . Tues. 10:00 to 11:20 am

Wirless Optical Link, Optical Satellite Communication

Session Chair: **Bernard Kress,** USI Photonics Inc.

High speed laser communication network for satellite systems, Allen S. Panahi, Accro USA, LLC (USA); Alex A. Kazemi, ARK International (USA)[8026-17]

Wireless optical links for avionic applications *(Invited Paper)*, Eric Y. Chan, Dennis G. Koshinz, William Krug, Harold Hager, The Boeing Co. (USA) . [8026-18]

Towards development of a fiber optic-based transmission monitoring system, Christopher S. Baldwin, Jason S. Kiddy, Aither Engineering, Inc. (USA) . . . . . [8026-19]

A low cost disposable hydrogen sensor using guided optics: review for an optimal sensor, Alex A. Kazemi, Photonics Systems Laboratory (France) . . . . . [8026-20]

SESSION 6 . . . . . Tues. 11:20 am to 12:50 pm

Vision-Based and Imaging Sensors

Session Chair: **Indu F. Saxena,** Intelligent Optical Systems, Inc.

Speckle reduction technique for laser based automotive HUD projectors *(Invited Paper)*, Bernard Kress, USI Photonics Inc. (USA). . . . . [8026-21]

Diffractive elements manufactured by grey tone mask and global laser lighting for transportation applications, Patrick P. Meyrueis, Ecole Nationale Supérieure de Physique de Strasbourg (France) . . . . . [8026-22]

A low cost virtual reality system for automotive surrounding display using only one video beamer, Thierry Blandet, Ecole Nationale Supérieure de Physique de Strasbourg (France) . . . . . [8026-23]

Novel diffractive HUD combiner fabrication method, Pierre St. Hilaire, Holox Inc. (USA); Bernard Kress, USI Photonics Inc. (USA) . . . . . [8026-24]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

ARCADIS: IED detection and logistic infrastructure security, David Monnin, Etienne Bieber, Gwenaël Schmitt, Armin L. Schneider, Jean-Pierre Moeglin, Institut Franco-Allemand de Recherches de Saint-Louis (France) . . . . . [8026-25]

Tuesday-Wednesday 26-27 April 2011 • Proceedings of SPIE Vol. 8027

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Sensing for Agriculture and Food Quality and Safety III

Conference Chairs: **Moon S. Kim,** U.S.D.A. Agricultural Research Service; **Shu-I Tu,** U.S.D.A. Agricultural Research Service; **Kaunglin Chao,** USDA Agricultural Research Service

Program Committee: **Arun K. Bhunia,** Purdue Univ., Ctr. for Food Safety Engineering; **Suming Chen,** National Taiwan Univ. (Taiwan); **Bryan A. Chin,** Auburn Univ.; **Byoung-Kwan Cho,** Chungnam National Univ. (Korea, Republic of); **Stephen R. Delwiche,** U.S.D.A. Agricultural Research Service; **Ki-Bok Kim,** Korea Research Institute of Standards and Science (Korea, Republic of); **Naoshi Kondo,** Kyoto Univ. (Japan); **Kurt C. Lawrence,** U.S.D.A. Agricultural Research Service; **Kangjin Lee,** Rural Development Administration (Korea, Republic of); **Alan M. Lefcourt,** U.S.D.A. Agricultural Research Service; **Renfu Lu,** U.S.D.A. Agricultural Research Service; **Bosoon Park,** U.S.D.A. Agricultural Research Service; **Yankun Peng,** China Agricultural Univ. (China); **Yang Tao,** Univ. of Maryland, College Park; **Gang Yao,** Univ. of Missouri-Columbia; **Haibo Yao,** Mississippi State Univ.; **Yibin Ying,** Zhejiang Univ. (China); **Seung-Chul Yoon,** U.S.D.A. Agricultural Research Service

Tuesday 26 April

SESSION 1 . . . . . Tues. 1:00 to 2:40 pm

Raman and Terahertz Sensing

Session Chair: **Kuanglin Chao,** Agricultural Research Service

Combination of LIBS and Raman for food quality monitoring, Yuan Liu, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Lionel Gigant, Univ. Bordeaux 1 (France); Matthieu Baudelet, Martin C. Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8027-01]

Evaluating carotenoid changes in tomatoes during postharvest ripening using Raman chemical imaging, Jianwei Qin, Kuanglin Chao, Moon S. Kim, U.S.D.A. Agricultural Research Service (USA) . . . . . [8027-02]

Polarized Raman investigations of oriented animal muscle fibers affected by storage time applying a 671 nm diode laser, Halah Al Ebrahim, Kay Sowoidnich, Heinar Schmidt, Heinz-Detlef Kronfeldt, Technische Univ. Berlin (Germany) . . . . . [8027-03]

A quantitative study for determination of sugar concentration using attenuated total reflectance terahertz (ATR-THz) spectroscopy, Diding Suhandy, Tetsuhito Suzuki, Yuichi Ogawa, Naoshi Kondo, Kyoto Univ. Graduate School of Agriculture (Japan); Takeshi Ishihara, Yuichiro Takemoto, Panasonic Corp. (Japan) . . . . . [8027-04]

THz spectroscopy based high sensitivity measurement of protein using a metal mesh device, Tetsuhito Suzuki, Yuichi Ogawa, Naoshi Kondo, Kyoto Univ. Graduate School of Agriculture (Japan); Takashi Kondo, Kazuhiro Takigawa, Seiji Kamba, Murata Manufacturing Co., Ltd. (Japan) . . . . . [8027-05]

SESSION 2 . . . . . Tues. 2:40 to 4:40 pm

Pathogen Detection

Session Chair: **Bryan A. Chin,** Auburn Univ.

AOTF hyperspectral microscopic imaging for foodborne pathogenic bacteria detection, Bosoon Park, Jaya Sundaram, Gerald W. Heitschmidt, Seung Chul Yoon, Kurt C. Lawrence, William R. Windham, U.S.D.A. Agricultural Research Service (USA) . . . . . [8027-06]

The detection of Salmonella typhimurium on egg shell using a phage-based biosensor, Yating Chai, Shin Horikawa, Suiqiong Li, Wen Shen, Mi-Kyng Park, Vitaly J. Vodyanoy, Bryan A. Chin, Auburn Univ. (USA) . . . . . [8027-07]

Detection of Salmonella typhimurium on fresh spinach leaves using phage-coated magnetoelastic biosensors, Shin Horikawa, Suiqiong Li, Yating Chai, Vitaly J. Vodyanoy, Bryan A. Chin, Auburn Univ. (USA) . . . . . [8027-08]

Multiple phage-based magnetoelastic biosensors for the detection of Salmonella typhimurium on cantaloupe surfaces, Wen Shen, Suiqiong Li, Shin Horikawa, Bryan A. Chin, Auburn Univ. (USA) . . . . . [8027-09]

Rapid detection of salmonella using surface enhanced raman spectroscopy with silver nanosubstrate, Jaya Sundaram, Bosoon Park, U.S.D.A. Agricultural Research Service (USA); Yiping Zhao, The Univ. of Georgia (USA); Arthur Hinton, Jr., William R. Windham, Seung Chul Yoon, Kurt C. Lawrence, U.S.D.A. Agricultural Research Service (USA) . . . . . [8027-10]

SESSION 3 . . . . . Tues. 4:40 to 6:00 pm

Aflatoxin Detection

Session Chair: **Haibo Yao,** Mississippi State Univ.

Experimental characterization of bacterial microcolonies via the developed optical morphology analyzer, Nan Bai, Purdue Univ. (USA); Yanji Tang, Arun K. Bhunia, Ctr. for Food Safety Engineering (USA); E. Daniel Hirleman, Euiwon Bae, Purdue Univ. (USA) . . . . . [8027-11]

Development of narrow-band fluorescence indices for the detection of aflatoxin contaminated corn, Haibo Yao, Zuzana Hruska, Russell Kincaid, Ambrose E. Ononye, Mississippi State Univ. (USA); Robert L. Brown, Deepak Bhatnagar, Thomas E. Cleveland, U.S.D.A. Agricultural Research Service (USA) . . . . . [8027-12]

Cepstrum based feature extraction method for fungus detection, Onur Yorulmaz, Enis A. Cetin, Bilkent Univ. (Turkey); Tom C. Pearson, U.S.D.A. Agricultural Research Service (USA) . . . . . [8027-13]

Aflatoxin contaminated chili pepper detection by hyperspectral imaging and machine learning, Musa Atas, Yasemin Yardimci Cetin, Alptekin Temizel, Middle East Technical Univ. (Turkey) . . . . . [8027-14]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

High speed sorting of seeds with small blemishes, Tom C. Pearson, Ctr. for Grain and Animal Health Research (USA) . . . . . [8027-34]

Prediction of marked age of mature vinegar based on FT-NIRS, Huishan Lu, Zhengguang An, North Univ. of China (China); Yibin Ying, Zhejiang Univ. (China) . . . . . [8027-35]

Hyserspectral imaging for nondestructive quality and maturity evaluation in tomatoes, Sukwon Kang, National Academy of Agriculture Science (Korea, Republic of); Moon S. Kim, U.S.D.A. Agricultural Research Service (USA); Kangjin Lee, National Academy of Agriculture Science (Korea, Republic of) . . . . [8027-36]

A control system of mobile navigation robot for precise spraying based ultrasonic detecting and ARM embedded technologies, Xiuying Tang, Cuiling Li, China Agricultural Univ. (China); Xiu Wang, National Engineering Research Ctr. for Information Technology in Agriculture (China); Xinpeng Yue, Yankun Peng, China Agricultural Univ. (China) . . . . . [8027-37]

A Raman chemical imaging system for detection of contaminants in food, Kaunglin Chao, Jianwei Qin, Moon S. Kim, U.S.D.A. Agricultural Research Service (USA) . . . . . [8027-38]

Development of whole-surface imaging technique for online inspection of leafy green vegetables, Xiuying Tang, China Agricultural Univ. (China); Moon S. Kim, Jianwei Qin, Chun-Chieh Yang, U.S.D.A. Agricultural Research Service (USA); Yankun Peng, China Agricultural Univ. (China); Diane E. Chan, Kuanglin Chao, U.S.D.A. Agricultural Research Service (USA) . . . . . [8027-39]

Automatic eggshell crack detection system using acoustic response, Kangjin Lee, National Academy of Agriculture Science (Korea, Republic of); Wankyu Choi, Nongsim Engineering (Korea, Republic of); Hoyoung Lee, Seoul National Univ. (Korea, Republic of) . . . . . [8027-40]

Wednesday 27 April

SESSION 4 . . . . . Wed. 8:30 to 10:10 am

Hyperspectral Imaging I

Session Chair: **Seung Chul Yoon,** Agricultural Research Service

Fast and accurate image recognition algorithms for fresh produce food safety sensing, Chun-Chieh Yang, Moon S. Kim, Kuanglin Chao, U.S.D.A. Agricultural Research Service (USA) . . . . . [8027-15]

Hyperspectral imaging technique for determination of pork freshness, Yankun Peng, Leilei Zhang, China Agricultural Univ. (China) . . . . . [8027-16]

Infrared imaging technology for detection of bruising damages of 'Singo' pear, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of); Moon S. Kim, U.S.D.A. Agricultural Research Service (USA); Hoon-Soo Lee, Chungnam National Univ. (Korea, Republic of); Stephen R. Delwiche, U.S.D.A. Agricultural Research Service (USA) . . . . . [8027-17]

Hyperspectral near-infrared imaging for detection of cuticle cracks on tomatoes, Hoon-Soo Lee, Chungnam National Univ. (Korea, Republic of); Danhee Jeong, Moon S. Kim, Agricultural Research Service, USDA (USA); Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of); Stephen R. Delwiche, Kuanglin Chao, Agricultural Research Service, USDA (USA) . . . . . [8027-18]

Detection of fruit fly infestation in pickling cucumbers using hyperspectral imaging, Renfu Lu, Agricultural Research Service (USA); Diwan P. Ariana, Michigan State Univ. (USA) . . . . . [8027-19]

SESSION 5 . . . . . Wed. 10:40 am to 12:00 pm

Hyperspectral Imaging II

Session Chair: **Renfu Lu,** Agricultural Research Service

Peach maturity/quality assessment using hyperspectral imaging-based spatially resolved technique, Haiyan Cen, Renfu Lu, Fernando A. Mendoza, Diwan P. Ariana, Michigan State Univ. (USA) . . . . . [8027-20]

Multisensor data fusion for improved prediction of apple fruit firmness and soluble solids, Fernando A. Mendoza, Michigan State Univ. (USA); Renfu Lu, U.S.D.A. Agricultural Research Service (USA); Haiyan Cen, Michigan State Univ. (USA) . . . . . [8027-21]

LED induced fluorescence imaging technology for detection of cuticle cracking on cherry tomatoes, In-Suck Baek, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of); Moon S. Kim, U.S.D.A. Agricultural Research Service (USA); Young-Sik Kim, SangMyung Univ. (Korea, Republic of) . . [8027-22]

Dried fruits quality assessment by hyperspectral imaging, Silvia Serranti, Giuseppe Bonifazi, Univ. degli Studi di Roma La Sapienza (Italy) . . . . . [8027-23]

Lunch/Exhibition Break . . . . . 12:00 to 1:30 pm

SESSION 6 . . . . . Wed. 1:30 to 3:10 pm

Fluorescence Applications

Session Chair: **Byoung-Kwan Cho,**
Chungnam National Univ. (Korea, Republic of)

Dynamic flourescence-based method for measuring oxygen transmission rate of food packaging, Bruce Welt, Univ. of Florida (USA) . . . . . [8027-24]

Fluorescence lifetime monitor for the remote inspection of hermetic packaged food, Edgar A. Mendoza, Redondo Optics, Inc. (USA). . . . . [8027-25]

Fluorescence excitation and emission wavebands for evaluation of freshness of pork meats, Jae-Gon Kim, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of); Moon S. Kim, U.S.D.A. Agricultural Research Service (USA) . . . . . [8027-26]

Study on excitation and fluorescence spectrums of Japanese citruses to construct machine vision system for acquiring fluorescent images, Md. Abdul Momin, Naoshi Kondo, Kyoto Univ. Graduate School of Agriculture (Japan); Makoto Kuramoto, Ehime Univ. (Japan); Yuichi Ogawa, Tomoo Shigi, Kyoto Univ. Graduate School of Agriculture (Japan) . . . . . [8027-27]

Homgenization of a pulsed laser beam using a lightpipe, Alan M. Lefcourt, Payam Motabar, Moon S. Kim, U.S.D.A. Agricultural Research Service (USA); Uri Tasch, Univ. of Maryland, Baltimore County (USA); Mary Camp, U.S.D.A. Agricultural Research Service (USA) . . . . . [8027-28]

SESSION 7 . . . . . Wed. 3:40 to 5:20 pm

Vis/NIR and Optical Sensing

Session Chair: **Sukwon Kang,**
National Academy of Agriculture Science (Korea, Republic of)

Development of the pungency measuring system for red-pepper powder, Changyeun Mo, Kangjin Lee, Jongguk Lim, Sukwon Kang, Hyundong Lee, Rural Development Administration (Korea, Republic of) . . . . . [8027-29]

Improved egg crack detection algorithm for modified pressure imaging system, Seung-Chul Yoon, Kurt C. Lawrence, Deana R. Jones, Gerald W. Heitschmidt, Bosoon Park, U.S.D.A. Agricultural Research Service (USA)[8027-30]

Light reflection measurement on cattle pupil for serum vitamin A measurement, Chihiro Sugimoto, Tomoo Shigi, Kazuya Yamamoto, Yuichi Ogawa, Naoshi Kondo, Kyoto Univ. (Japan); Namiko Kohama, Moriyuki Fukushima, Hyogo Prefectural Hokubu Agricultural Institute (Japan); Shoichi Mano, Kazumi Yoshida, Kyoto Univ. (Japan) . . . . . [8027-31]

Quality measurement of Korean traditional rice beer 'Makgeolri' using VIS/NIR spectroscopy, Dae-Yong Kim, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of). . . . . [8027-32]

Potential of using satellite remote sensing data for estimation of Aus rice yield in Bangladesh, Mohammad Nizamuddin, Leonid Roytman, The City College of New York (USA); Felix Kogan, Mitchell D. Goldberg, National Environmental Satellite, Data, and Information Service (USA) . . . . . [8027-33]

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Fiber Optic Sensors and Applications VIII

Conference Chairs: **Stephen J. Mihailov,** Communications Research Ctr. Canada (Canada); **Henry H. Du,** Stevens Institute of Technology; **Gary Pickrell,** Virginia Polytechnic Institute and State Univ.

Conference Co-Chairs: **Anbo Wang,** Virginia Polytechnic Institute and State Univ.; **Alexis Mendez,** MCH Engineering LLC; **Eric Udd,** Columbia Gorge Research

Program Committee: **Christopher S. Baldwin,** Aither Engineering, Inc.; **Ole Bang,** Technical Univ. of Denmark (Denmark); **Eric A. Bergles,** BaySpec, Inc.; **Jeff Bush,** Optiphase, Inc.; **Kevin P. Chen,** Univ. of Pittsburgh; **Steven D. Christesen,** U.S. Army Edgewood Chemical Biological Ctr.; **Brian Culshaw,** Univ. of Strathclyde (United Kingdom); **Abdessama Elyamani,** Northrop Grumman Navigation Systems; **Yoel Fink,** Massachusetts Institute of Technology; **Eric Goldner,** US Sensor Systems Inc.; **Tom W. Graver,** Micron Optics, Inc.; **Ming Han,** Univ. of Nebraska-Lincoln; **Hajime Haneda,** National Institute for Materials Science (Japan); **Kazuo Hotate,** The Univ. of Tokyo (Japan); **Jiri Kanka,** Institute of Photonics and Electronics of the ASCR, v.v.i. (Czech Republic); **Victor I. Kopp,** Chiral Photonics, Inc.; **Katerina Krebber,** Bundesanstalt für Materialforschung und -prüfung (Germany); **Steven T. Kreger,** Luna Innovations Inc.; **David A. Krohn,** Light Wave Venture Consulting, LLC; **Paul Lefebvre,** LxDATA (Canada); **Thomas D. Monte,** KVH Industries, Inc.; **Glen A. Sanders,** Honeywell Technology; **Svetlana A. Sukhishvili,** Stevens Institute of Technology; **Dennis J. Trevor,** OFS Labs.; **Xingwei Wang,** Univ. of Massachusetts Lowell; **Reinhardt Willsch,** IPHT Jena (Germany); **Younan Xia,** Washington Univ. in St. Louis; **Hai Xiao,** Missouri Univ. of Science and Technology

Thursday 28 April

SESSION 1 . . . . . Thurs. 8:00 to 10:00 am

Evanescent Field Sensing, Long Period Gratings, Structured Fibers

Polarization properties of tilted fiber Bragg gratings for novel sensing modalities *(Invited Paper)*, Jacques Albert, Carleton Univ. (Canada) . . . [8028-01]

Chiral fiber sensors for harsh environments *(Invited Paper)*, Victor I. Kopp, Jonathan Singer, Daniel Neugroschl, Azriel Z. Genack, Chiral Photonics, Inc. (USA) . . . . . [8028-02]

Long period grating in photonic crystal fiber as opto-microfluidic label-free biosensor, Zonghu He, Fei Tian, Stevens Institute of Technology (USA); Jiri Kanka, Institute of Photonics and Electronics of the ASCR, v.v.i. (Czech Republic); Nina Lavlinskaia, High Tech High School (USA); Dennis J. Trevor, OFS Labs. (USA); Henry H. Du, Stevens Institute of Technology (USA) . . . . . [8028-03]

Sensitive fluorescence detection with microstructured optical fibers, Erik P. Schartner, Heike Ebendorff-Heidepriem, Tanya M. Monro, The Univ. of Adelaide (Australia) . . . . . [8028-04]

Fabrication and characterization of photonic crystal fiber for resonance laser absorption spectroscopy using long period gratings, Fei Tian, Zonghu He, Stevens Institute of Technology (USA); Jiri Kanka, Institute of Photonics and Electronics of the ASCR, v.v.i. (Czech Republic); Dennis J. Trevor, OFS Labs. (USA); Henry H. Du, Stevens Institute of Technology (USA) . . . . . [8028-05]

SESSION 2 . . . . . Thurs. 10:30 to 11:50 am

Fiber Optic Sensing in Harsh Environments

Thermally regenerated fiber Bragg gratings in air-hole microstructured fibers for high-temperature pressure sensing *(Invited Paper)*, Kevin P. Chen, Tong Chen, Jordan B. Negley, Univ. of Pittsburgh (USA); Dan Grobnic, Stephen J. Mihailov, Communications Research Ctr. Canada (Canada); John Canning, The Univ. of Sydney (Australia) . . . . . [8028-06]

High speed measurements using fiber-optic Bragg gratings *(Invited Paper)*, Jerry J. Benterou, Chadd M. May, Lawrence Livermore National Lab. (USA); Eric Udd, Columbia Gorge Research (USA) . . . . . [8028-07]

Study of blast event propagation in different materials using a novel ultrafast miniature optical pressure sensor, Xiaotian Zou, Nan Wu, Ye Tian, Jiacheng Li, Kai Sun, Xingwei Wang, Univ. of Massachusetts Lowell (USA) . . . . . [8028-08]

Lunch/Exhibition Break . . . . . 11:50 am to 1:20 pm

SESSION 3 . . . . . Thurs. 1:20 to 5:00 pm

Fiber Bragg Gratings for Sensing

Advanced spectral fiber optic sensor systems and their application in energy facilities and environmental monitoring *(Invited Paper)*, Reinhardt Willsch, Hartmut Bartelt, Wolfgang Ecke, Hartmut Lehmann, IPHT Jena (Germany); Thomas Bosselmann, Michael Willsch, Siemens AG (Germany) . . . . . [8028-09]

All-optical vibration and temperature monitoring systems for large scale power generators *(Invited Paper)*, Luís A. Ferreira, Francisco M. Araújo, FiberSensing (Portugal); Evangelos V. Diatzikis, Siemens Power Generation, Inc. (USA) . . . . . [8028-10]

Advanced draw-tower fiber Bragg gratings and their application in sensing, Eric Lindner, Institut für Photonische Technologien e.V. (Germany); Christoph Chojetzki, Julia Moerbitz, FBGS Technologies GmbH (Germany); Martin Becker, Sven Brückner, Reinhardt Willsch, Manfred Rothhardt, Hartmut Bartelt, Institut für Photonische Technologien e.V. (Germany) . . . . . [8028-11]

Automatic fiber Bragg grating fabrication system for mass production, Yunmiao Wang, Jianmin Gong, Dorothy Y. Wang, Bo Dong, Anbo Wang, Virginia Polytechnic Institute and State Univ. (USA) . . . . . [8028-12]

Innovative use of embedded FBG sensors in civil engineering and other applications *(Invited Paper)*, Giorgio Nosenzo, Monitor Optics Solutions (Australia) . . . . . [8028-13]

Next generation distributed fiber optic acoustic emission sensor (FAESense™) system for condition-based maintenance, Edgar A. Mendoza, Redondo Optics, Inc. (USA) . . . . . [8028-14]

A 40 ksamples/sec spectrometer based FBG interrogator, capable of simultaneously measuring more than 16 FBG sensors, J. P. Vermeiren, J. L. Bentell, D. De Gaspari, D. Uwaerts, P. Verbeke, Xenics NV (Belgium); J. Vlekken, OpticalFiberSensors.org BVBA (Belgium) . . . . . [8028-15]

A discrete liquid level sensor based on fiber Bragg grating, Dongcao Song, Jilin Zou, Jing Xie, Hong-liang cui, L.C. Pegasus Corp. (USA) . . . . . [8028-16]

SESSION 4 . . . . . Thurs. 5:00 to 5:50 pm

Novel Sensing Fiber Optic Sensing Techniques

Fiber laser sensors: enabling the next generation of miniaturized, wideband marine sensors *(Invited Paper)*, Geoffrey A. Cranch, Gary A. Miller, Clay K. Kirkendall, U.S. Naval Research Lab. (USA) . . . . . [8028-17]

Surface scattering plasmon resonance fibre sensors: demonstration of rapid influenza A virus detection, Alexandre Francois, Jonathan Boehm, The Univ. of Adelaide (Australia); Sawyin Oh, Tuckweng Kok, Institute of Medical and Veterinary Science (Australia); Tanya Monro, The Univ. of Adelaide (Australia) . . . . . [8028-18]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Computational analysis and considerations of an optical fiber sensor with multiple cladding, Jose A. Betancur Ramírez, Univ. EAFIT (Colombia) . [8028-25]

A research on polarization effects in an distributed optical fiber sensor disturbance location system, Haiyan Xu, Xiao Qian, Fudan Univ. (China) . . . . . [8028-26]

A novel frequency domain location method in distributed optic-fiber sensor based on PGC, Haiyan Xu, Hongyan Wu, Xiao Qian, Fudan Univ. (China); Zhong-De Qiao, Zhengben Water Purification Co., Ltd. (China). . . . . [8028-27]

All-fiber multimode interference micro-displacement sensor, Jose E. Antonio-López, Instituto Nacional de Astrofisica, Optica y Electronica (Mexico) and CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Jaime A. Arredondo-Lucio, Univ. Autónoma de Tamaulipas (Mexico); Patrick L. Likamwa, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Daniel A. May-Arrioja, Univ. Autónoma de Tamaulipas (Mexico). . [8028-28]

Phase-shifted Bragg gratings generated by CO_2 laser post-fabrication processing, Fawen Guo, Ming Han, Univ. of Nebraska-Lincoln (USA) . . [8028-29]

Multi-point fiber-optic recirculating voltage sensor, Alexandre V. Polyakov, Belarusian State Univ. (Belarus) . . . . . [8028-30]

Automated testing for the fast and accurate determination of detergent efficiency by optical fibre sensors, Maria Patitsa, Helge Pfeiffer, Martine Wevers, Katholieke Univ. Leuven (Belgium) . . . . . [8028-31]

Friday 29 April

SESSION 5 . . . . . Fri. 8:30 to 10:30 am

Novel Micro-optic Devices and Sensing Applications

Optical efficiency in metal-lined capillary waveguide Raman sensors, Stephen Biedrzycki, Michael P. Buric, National Energy Technology Lab. (USA) and Univ. of Pittsburgh (USA); Joel Falk, Steven D. Woodruff, National Energy Technology Lab. (USA) . . . . . [8028-19]

Position Determination and Monitoring of Disturbance along Distributed Fiber Optic Sensors, Hongyan Wu, Haiyan Xu, Tingting Bu, Dong Zhao, Fudan Univ. (China) . . . . . [8028-20]

Lithographic inscription of micro-optical devices on a multi-material optical fiber tip, Joshua Kaufman, Guangming Tao, Ayman F. Abouraddy, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8028-21]

Test of a novel miniature blood pressure sensor in the coronary arteries of a swine model, Nan Wu, Kai Sun, Xiaotian Zou, Univ. of Massachusetts Lowell (USA); Kurt Barringhaus, Univ. of Massachusetts Medical School (USA); Xingwei Wang, Univ. of Massachusetts Lowell (USA) . . . . . [8028-22]

Optoacoustic fiber optic interferometric sensors for biomedical applications, Daniel C. Gallego, Horacio Lamela, Univ. Carlos III de Madrid (Spain). . . [8028-23]

Continuous monitoring of plant stem diameter growth using fiber-optic interferometric sensing, Julius Chatterjee, Barry G. Grossman, Florida Institute of Technology (USA) . . . . . [8028-24]

Courses of Related Interest

SC719 **Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies** (Gardner) Monday, 8:30 am to 12:30 pm

SC952 **Applications of Detection Theory** (Carrano) Thursday, 8:30 am to 5:30 pm

SC1034 **Lab-on-a-Chip Technology - Towards Portable Detection Systems** (Gärtner) Friday, 8:30 am to 12:30 pm

See full course listing and descriptions on pp. 144-192.

Sensing Technologies for Global Health, Military Medicine, Disaster Response, and Environmental Monitoring

Conference Chairs: **Kevin N. Montgomery,** U.S. Army Telemedicine and Advanced Technology Research Ctr.; **Sárka O. Southern,** Gaia Medical Institute; **Carl W. Taylor,** Univ. of South Alabama; **Bernhard H. Weigl,** PATH

Program Committee: **Mark J. Buller,** U.S. Army Research Institute of Environmental Medicine; **John C. Carrano,** Carrano Consulting; **Samuel N. Cheuvront,** U.S. Army Research Institute of Environmental Medicine; **James B. Delehanty III,** U.S. Naval Research Lab.; **Theresa G. Evans-Nguyen,** The Charles Stark Draper Lab., Inc.; **Konrad Faulstich,** Embedded System Engineering GmbH (Germany); **Marjorie J. Greene,** CNA Corp.; **Peter Kiesel,** Palo Alto Research Center, Inc.; **Baochuan Lin,** U.S. Naval Research Lab.; **Igor L. Medintz,** U.S. Naval Research Lab.; **Christopher Myers,** Naval Health Research Ctr.; **Worth Nowlin, Jr.,** Texas A&M Univ.; **Richard M. Ozanich,** Pacific Northwest National Lab.; **Lada Rasochova,** Univ. of California, San Diego; **Steven A. Ripp,** The Univ. of Tennessee; **Albert Skip Rizzo III,** The Univ. of Southern California; **Kim E. Sapsford,** U.S. Food and Drug Administration; **Aurel Ymeti,** Ostendum R&D BV (Netherlands); **Kevin Wang,** Banyan Biomarkers, Inc.; **David E. Wolf,** Radiation Monitoring Devices, Inc.

Monday 25 April

SESSION 1 . . . . . Mon. 8:00 am to 12:00 pm

Global Health and Disease Surveillance I

Session Chairs: **Bernhard H. Weigl,** PATH;
Sárka O. Southern, Gaia Medical Institute

Instrument free nucleic acid amplification assays for global health settings *(Invited Paper)*, Bernhard H. Weigl, PATH (USA). . . . . [8029A-01]

Novel approaches in diagnosing tuberculosis, Arend H. J. Kolk, Ngoc A. Dang, Sjoukje Kuijper, Univ. van Amsterdam (Netherlands); Tim Gibson, Scensive Technologies, Ltd. (United Kingdom); Richard Anthony, Royal Tropical Institute (Netherlands); Mareli Claassens, Stellenbosch Univ. (South Africa); Erwin Kaal, DSM Food Specialties (Netherlands); Hans-Gerd Janssen, Unilever N.V. (Netherlands) . . . . . [8029A-02]

Massively multiplexed microbial identification using resequencing DNA microarrays for outbreak investigation, Tomasz A. Leski, U.S. Naval Research Lab. (USA) . . . . . [8029A-03]

'Label-free' methods for detection of viruses by magnetic relaxometry, Louis H. Strong, Daniel B. Hall, Gregory Derderian, Radiation Monitoring Devices, Inc. (USA); Michael A. Whitt, The Univ. of Tennessee Health Science Ctr. (USA); Gyula Varadi, Radiation Monitoring Devices, Inc. (USA). . . . . [8029A-04]

Tunable wavelength interrogated sensor platform (TWIST) for point-of-care diagnostics of infectious diseases, Sonia Grego, Kristin H. Gilchrist, Brian R. Stoner, RTI International (USA) . . . . . [8029A-05]

Constructing paths through social networks for disease surveillance, Marjorie J. Greene, CNA Corp. (USA) . . . . . [8029A-06]

Solving stochastic epidemiological models using computer algebra, Juan F. Ospina, Univ. EAFIT (Colombia) . . . . . [8029A-07]

Molecular and cellular sensing on health diagnostic compact disc in portable computer for global health and telemedicine, Logan Liu, Univ. of Illinois at Urbana-Champaign (USA). . . . . [8029A-08]

Lab-on-a-cellphone as an emerging telemedicine platform, Onur Mudanyali, Derek Tseng, Cetin Oztoprak, Serhan O. Isikman, Ikbal Sencan, Oguzhan Yaglidere, Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . [8029A-09]

On-chip blood analysis using lensless microscopy, Serhan O. Isikman, Univ. of California, Los Angeles (USA); Sungkyu Seo, Korea Univ. (Korea, Republic of); Ikbal Sencan, Onur Mudanyali, Ting-Wei Su, Waheb Bishara, Anthony Erlinger, Aydogan Ozcan, Univ. of California, Los Angeles (USA). . . . . [8029A-10]

Lunch Break . . . . . 12:00 to 1:30 pm

SESSION 2 . . . . . Mon. 1:30 to 3:10 pm

Global Health and Disease Surveillance II

Session Chairs: **Bernhard H. Weigl,** PATH;
Sárka O. Southern, Gaia Medical Institute

Digital microbiology: detection and classification of unknown bacterial pathogens using a label-free laser light scatter-sensing system, Bartek P. Rajwa, Purdue Univ. (USA); M. Murat Dundar, Ferit Akova, Indiana Univ.-Purdue Univ. Indianapolis (USA); Valery Patsekin, J. Eric Dietz, Purdue Univ. (USA); Arun K. Bhunia, Ctr. for Food Safety Engineering (USA); E. Daniel Hirleman, J. Paul Robinson, Purdue Univ. (USA) . . . . . [8029A-11]

Digital pathology: development and validation of feature analysis on consecutive tissue sections, Trevor D. Johnson, Frank Voelker, G. David Young, Steven Potts, Flagship Biosciences, LLC (USA) . . . . . [8029A-12]

Concurrent magnetic resonance and diffuse optical imaging for neo-adjuvant therapy assessment, Madhavi Seetamraju, Xuefeng Zhang, Radiation Monitoring Devices, Inc. (USA); Scott Davis, Dartmouth College (USA); Rajan Gurjar, Richard Myers, Radiation Monitoring Devices, Inc. (USA); Brian W. Pogue, Dartmouth College (USA); Gerald Entine, Radiation Monitoring Devices, Inc. (USA). . . . . [8029A-13]

Light without substrate amendment: the bacterial luciferase gene cassette as a mammalian bioreporter, Dan Close, Tingting Xu, Pat Jegier, Abby Smartt, Steven A. Ripp, Gary Sayler, The Univ. of Tennessee (USA) . . . . . [8029A-14]

Characterization of a chromosomally integrated luxCDABE marker for investigation of STEC shedding in cattle, Yingying Hong, The Univ. of Tennessee (USA). . . . . [8029A-15]

SESSION 3 . . . . . Mon. 3:40 to 5:40 pm

Global Health: Ensuring Safe Water Supply

Session Chairs: **Peter Kiesel,** Palo Alto Research Center, Inc.;
Sárka O. Southern, Gaia Medical Institute

Measuring from source to tap: ensuring water supply safety and security *(Invited Paper)*, Dan J. Kroll, Hach Co., Inc. (USA) . . . . . [8029A-16]

Development of water purification using solar powered deep UV LEDs, Brad Butterfield, General Dynamics Advanced Information Systems (USA) . . [8029A-17]

On-the-flow pathogen detection in water, Peter Kiesel, Joerg Martini, Malte F. Huck, Noble M. Johnson, Marshall Bern, Palo Alto Research Center, Inc. (USA) . . . . . [8029A-18]

Large area radiation source for water and wastewater treatment, Michael T. Mueller, Seungwoo Lee, Anthony Kloba, Anthony Durkowski, Mark Eaton, Nalin Kumar, Stellar Micro Devices (USA); Charlotte Rambo, Suresh Pillai, Texas A&M Univ. (USA) . . . . . [8029A-19]

Early warning system for detection of microbial contamination of source waters *(Invited Paper)*, Claus T. Mogensen, Anders Bentien, Mogens Lau, Bo Højris, Kåre Iversen, Grundfos AS (Denmark) . . . . . [8029A-20]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 4 . . . . . Tues. 10:00 am to 12:30 pm

Military Health and Traumatic Brain Injury I

Session Chairs: **C. Edward Dixon,** Univ. of Pittsburgh; **Kevin N. Montgomery,** Stanford Univ.

Traumatic brain injury produced by explosure to blasts-a critical problem in current wars: biomarkers, clinical studies, and animal models *(Invited Paper)*, C. Edward Dixon, Univ. of Pittsburgh (USA) . . . . . [8029A-21]

Biomarkers for severe, moderate and mild traumatic brain injury, Kevin Wang, Banyan Biomarkers, Inc. (USA) . . . . . [8029A-22]

Saliva-based biomarkers for noninvasive diagnostics: applications for mTBI, PTSD and HIV/AIDS, Sárka O. Southern, Gaia Medical Institute (USA) [8029A-23]

Field-based multiplexed and quantitative assay platforms for diagnostics of TBI and wound infections, Srivatsa Venkatasubbarao, Intelligent Optical Systems, Inc. (USA). . . . . [8029A-24]

Virtual reality exposure therapy for combat related PTSD, Albert S. Rizzo III, The Univ. of Southern California (USA) . . . . . [8029A-25]

Functional brain abnormalities in PTSD as revealed by magnetoencephalography (MEG), Apostolos P. Georgopoulos, Univ. of Minnesota, Twin Cities (USA) . . . . . [8029A-26]

Accelerating the commercialization of university technologies for military healthcare applications: the role of the proof of concept process, Rosibel Ochoa, Lada Rasochova, Univ. of California, San Diego (USA) . . . . . [8029A-27]

Lunch/Exhibition Break . . . . . 12:30 to 1:30 pm

SESSION 5 . . . . . Tues. 1:30 to 2:50 pm

Military Health and Traumatic Brain Injury II

Session Chairs: **C. Edward Dixon,** Univ. of Pittsburgh; **Kevin N. Montgomery,** Stanford Univ.

Detecting gait alterations due to concussion impairment with radar using information-theoretic techniques, Jennifer Palmer, Kristin Bing, Amy Sharma, Eugene Greneker, Georgia Tech Research Institute (USA). . . . . [8029A-28]

A miniature pressure sensor for blast event evaluation, Nan Wu, Wenhui Wang, Ye Tian, Christopher Niezrecki, Xingwei Wang, Univ. of Massachusetts Lowell (USA) . . . . . [8029A-29]

Point-of-care instrument for monitoring tissue health during skin graft repair, Rajan Gurjar, Madhavi Seetamraju, David E. Wolf, Radiation Monitoring Devices, Inc. (USA). . . . . [8029A-30]

Towards trustworthy medical device systems, Nathanael Paul, Oak Ridge National Lab. (USA); David C. Klonoff M.D., Mills-Peninsula Diabetes Research Institute (USA) . . . . . [8029A-31]

SESSION 6 . . . . . Tues. 2:50 to 6:00 pm

Disaster Response and Situational Awareness

Session Chairs: **Ricardo Arias,** U.S. Dept. of Defense; **Carl W. Taylor,** Univ. of South Alabama

Beyond command and control, Ricardo Arias, U.S. Dept. of Defense (USA) . . . . . [8029A-32]

Classification of airborne particles from two-dimension, angle-resolved optical scattering (TAOS) patterns by a new feature extraction method, Giovanni F. Crosta, Univ. degli Studi di Milano-Bicocca (Italy); Yongle Pan, U.S. Army Research Lab. (USA); Richard K. Chang, Yale Univ. (USA). . . . . [8029A-49]

Inter-organizational information sharing and coordination in disaster relief efforts, Jamison M. Day, Louisiana State Univ. (USA) . . . . . [8029A-33]

Paradigms for integration and data synthesis of military, civilian and infrastructure health through adaptive software defined radio and antennas (SDR-A), Gerald Lilienthal, Argon ST (USA) . . . . . [8029A-34]

Communication architectures for remote environmental monitoring, Tarun Soni, Argon ST, Inc. (USA) . . . . . [8029A-35]

Using social media to communicate during crises: an analytic methodology, Marjorie J. Greene, CNA (USA) . . . . . [8029A-36]

Mobile sensors for environmental chemical awareness, Erica Forzani, Cheng Chen, Amlendu Prabhakar, Rui Wang, Francis Tsow, Nongjian Tao, Arizona State Univ. (USA) . . . . . [8029A-38]

The development of a multiband system for early detection of wildlife fires and indoor search and rescue operations, Benedict Gouverneur, Guy Gielis, Jonathan Cloots, Stefan Nemeth, Jan P. Vermeiren, Xenics NV (Belgium) . . . . . [8029A-39]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Global Health

Field-portable semen analysis using lensless microscopy on a chip, Ting-Wei Su, Anthony Erlinger, Derek Tseng, Aydogan Ozcan, Univ. of California, Los Angeles (USA) . . . . . [8029A-46]

Amplification-free point of care immunosensor for high sensitivity monitoring of lung transplant rejection, Pei-Yu Chung, Evelyn R. Bracho-Sanchez, Peng Jiang, Gregory Schultz, Christopher D. Batich, Univ. of Florida (USA) . . . . . [8029A-47]

A non-contact ECG sensing platform, Xiong Yu, Case Western Reserve Univ. (USA) . . . . . [8029A-48]

Environmental Monitoring

Detecting relative microparticle concentrations with GMR sensors, Bryan Cox, Despina Davis, Louisiana Tech Univ. (USA) . . . . . [8029A-50]

Aerosol sensing technologies in the mining industry, Sam Janisko, National Institute for Occupational Safety and Health (USA) . . . . . [8029A-51]

A statistical method to correct radiometric data measured by AVHRR onboard the National Oceanic and Atmospheric Administration (NOAA) Polar Orbiting Environmental Satellites (POES), Md. Z. Rahman, LaGuardia Community College (USA). . . . . [8029A-52]

Evaluating the capability of SPOT5 data in monitoring pollarding forest areas of Northern Zagros: case study--Kurdistan, pollarded forests of Baneh, Djafar Oladi, Ayob Moradi, Univ. of Mazandaran (Iran, Islamic Republic of). . . [8029A-53]

Low-power wireless trace gas sensing network, Clinton J. Smith, Stephen So, Amir Khan, Mark A. Zondlo, Gerard Wysocki, Princeton Univ. (USA). . . [8029A-54]

Simultaneous detection of atmospheric nitrous oxide and carbon monoxide using a quantum cascade laser, Amir Khan, Kang Sun, Mark A. Zondlo, Princeton Univ. (USA) . . . . . [8029A-55]

Novel handheld x-ray fluorescence spectrometer for routine testing for the presence of lead, Noa M. Rensing, Timothy C. Tiernan, Michael R. Squillante, Radiation Monitoring Devices, Inc. (USA) . . . . . [8029A-56]

Environmental monitoring of brominated flame retardants, Mary C. Vagula, Gannon Univ. (USA). . . . . [8029A-57]

Wednesday 27 April

SESSION 7 . . . . . Wed. 1:30 to 3:30 pm

Oil Spill (DHW) and Ocean Monitoring I

Session Chairs: **Sárka O. Southern,** Gaia Medical Institute;
Weilin Will Hou, U.S. Naval Research Lab.

Joint Session with Conference 8030:
Ocean Sensing and Monitoring III

Measurement techniques for the Deepwater Horizon (MC-252) oil spill response *(Invited Paper)*, Richard Crout, National Oceanic and Atmospheric Administration (USA) . . . . . [8030-18]

Operational mapping of the DWH deep subsurface dispersed oil, Harvey Seim, The Univ. of North Carolina at Chapel Hill (USA); Richard Crout, Glen Rice, National Oceanic and Atmospheric Administration (USA) . . . . . [8029A-41]

Combining numerical ocean circulation models with satellite observations in a trajectory forecast system: a rapid response to the Deepwater Horizon oil spill *(Invited Paper)*, Yonggang Liu, Robert H. Weisberg, Chuanmin Hu, Univ. of South Florida (USA). . . . . [8030-19]

Automated oil spill detection with multispectral imagery, Brian Bradford, Pedro J. Sanchez-Reyes, ITT Corp. Geospatial Systems (USA). . . . . [8030-20]

In situ characterization of distributions of dissolved contaminants using underwater mass spectrometry, R. Timothy Short, Ryan J. Bell, Ashish Chaudhary, Strawn K. Toler, Friso H. W. van Amerom, SRI St. Petersburg (USA) . . . . . [8029A-42]

SESSION 8 . . . . . Wed. 4:00 to 6:00 pm

Oil Spill (DHW) and Ocean Monitoring II

Session Chairs: **Sárka O. Southern,** Gaia Medical Institute;
Robert Arnone, U.S. Naval Research Lab.

Joint Session with Conference 8030:
Ocean Sensing and Monitoring III

An empirical approach to derive MODIS ocean color patterns under severe sun glint, Chuanmin Hu, Univ. of South Florida (USA). . . . . [8030-21]

Making sense of ocean sensing: the Gulf of Mexico Coastal Ocean Observing System links observations to applications, Chris Simoniello, Gulf of Mexico Coastal Ocean Observing System Regional Association (USA) and Univ. of South Florida (USA); Ann E. Jochens, Matthew K. Howard, Texas A&M Univ. (USA); Joseph Swaykos, The Univ. of Southern Mississippi (USA); Douglas R. Levin, National Oceanic and Atmospheric Administration (USA); Debbi Stone, The Florida Aquarium, Inc. (USA); Barb Kirkpatrick, Mote Marine Lab. and Aquarium (USA) . . . . . [8029A-43]

Building interoperable data systems in the Gulf of Mexico: a case study, Matthew K. Howard, Texas A&M Univ. (USA). . . . . [8029A-44]

Developing technologies for regional ocean observing systems, Jan R. van Smirren, Robert I. Smith, Gulf of Mexico Coastal Ocean Observing System Regional Association (USA). . . . . [8029A-45]

Texas coastal ocean observation network: data access and archive software, Gary A. Jeffress, Scott Duff, Texas A&M Univ. Corpus Christi (USA) . . . . . [8030-22]

Applications of high frequency radar for emergency response in the coastal ocean: utilization of the Central Gulf of Mexico Ocean Observing System during the Deepwater Horizon oil spill and vessel tracking, Stephan Howden, The Univ. of Southern Mississippi (USA); Donald Barrick, Hector Aguilar, CODAR Ocean Sensors (USA) . . . . . [8030-23]

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Biometric Technology for Human Identification VIII

Conference Chairs: **B. V. K. Vijaya Kumar,** Carnegie Mellon Univ.; **Salil Prabhakar,** DigitalPersona, Inc.; **Arun A. Ross,** West Virginia Univ.

Program Committee: **George Bebis,** Univ. of Nevada, Reno; **Thirimachos Bourlai,** West Virginia Univ.; **Julien Bringer,** Morpho (France); **Mark Burge,** MITRE Corp.; **Bernadette Dorizzi,** TELECOM & Management SudParis (France); **Eliza Yingzi Du,** Indiana Univ.-Purdue Univ. Indianapolis; **Jianjiang Feng,** Tsinghua Univ. (China); **Julian Fierrez,** Univ. Autónoma de Madrid (Spain); **Patrick J. Flynn,** Univ. of Notre Dame; **Venu Govindaraju,** Univ. at Buffalo; **John M. Irvine,** The Charles Stark Draper Lab., Inc.; **Anil K. Jain,** Michigan State Univ.; **Sabah A. Jassim,** Univ. of Buckingham (United Kingdom); **Ioannis A. Kakadiaris,** Univ. of Houston; **Josef Kittler,** Univ. of Surrey (United Kingdom); **Ajay Kumar,** The Hong Kong Polytechnic Univ. (Hong Kong, China); **David Maltoni,** Univ. degli Studi di Bologna (Italy); **Brian Martin,** L-1 Identity Solutions, Inc.; **Karthik Nandakumar,** Institute for Infocomm Research (Singapore); **Karl Ricanek, Jr.,** Univ. of North Carolina at Wilmington; **Marios Savvides,** Carnegie Mellon Univ.; **Michael E. Schuckers,** St. Lawrence Univ.; **Alex Stoianov,** Information and Privacy Commissioner/Ontario (Canada); **Zhenan Sun,** Institute of Automation (China); **Kar-Ann Toh,** Yonsei Univ. (Korea, Republic of); **Damon L. Woodard,** Clemson Univ.; **Pong C. Yuen,** Hong Kong Baptist Univ. (Hong Kong, China)

Monday 25 April

SESSION 8 . . . . . Mon. 9:00 to 10:00 am

Face Biometrics

Session Chair: **Arun A. Ross,** West Virginia Univ.

Superresolution benefit for face recognition, Shuowen Hu, Robert A. Maschal, Jr., Susan S. Young, Stephen M. Won, U.S. Army Research Lab. (USA); Tsai Hong, Jonathon Phillips, National Institute of Standards and Technology (USA) . . . . . [8029B-58]

A quantitative comparison of 3D face databases for 3D face recognition, Dirk Smeets, Jeroen Hermans, Dirk Vandermeulen, Paul Suetens, Katholieke Univ. Leuven (Belgium) . . . . . [8029B-59]

QUEST hierarchy for hyperspectral face recognition, David Ryer, U.S. Air Force (USA); Trevor J. Bihl, Kenneth W. Bauer, Air Force Institute of Technology (USA); Steven K. Rogers, Air Force Research Lab. (USA) . . . . . [8029B-60]

SESSION 9 . . . . . Mon. 10:30 to 11:15 am

Invited Session I

Session Chair: **Salil Prabhakar,** DigitalPersona, Inc.

TBD *(Invited Paper)*, , ... [8029B-61]

SESSION 10 . . . . . Mon. 11:15 am to 12:15 pm

Fingerprint and Voice Biometrics

Session Chair: **Salil Prabhakar,** DigitalPersona, Inc.

Adding localization information in a fingerprint binary feature vector representation, Julien Bringer, Vincent Despiegel, Mélanie Favre, Morpho (France) . . . . . [8029B-62]

Speech biometric mapping for cryptographic key generation, Keerati Inthavisas, Daniel P. Lopresti, Lehigh Univ. (USA) . . . . . [8029B-63]

C-BET evaluation of voice biometrics, Dmitry O. Gorodnichy, Canada Border Services Agency (Canada); Michael Thiemi, International Biometric Group (Canada); Elan Dubrofsky, Canada Border Services Agency (Canada) . [8029B-64]

Lunch Break . . . . . 12:15 to 2:00 pm

SESSION 11 . . . . . Mon. 2:00 to 2:45 pm

Invited Session II

Session Chair: **B. V. K. Vijaya Kumar,** Carnegie Mellon Univ.

TBD *(Invited Paper)*, , ... [8029B-65]

SESSION 12 . . . . . Mon. 2:45 to 3:45 pm

Iris Biometrics

Session Chair: **B. V. K. Vijaya Kumar,** Carnegie Mellon Univ.

Impact of out-of-focus blur on iris recognition, Nadezhda A. Sazonova, The Univ. of Alabama at Tuscaloosa (USA); Stephanie C. Schuckers, Peter Johnson, Clarkson Univ. (USA); Paulo Lopez-Meyer, Edward S. Sazonov, The Univ. of Alabama at Tuscaloosa (USA); Lawrence Hornak, West Virginia Univ. (USA) . . . . . [8029B-66]

A simple shape prior model for iris image segmentation, Daniel Bishop, Anthony J. Yezzi, Jr., Georgia Institute of Technology (USA) . . . . . [8029B-67]

Security enhanced BioEncoding for protecting iris codes, Osama M. Ouda, Chiba Univ. (Japan) and Mansoura Univ. (Egypt); Norimichi Tsumura, Toshiya Nakaguchi, Chiba Univ. (Japan) . . . . . [8029B-68]

SESSION 13 . . . . . Mon. 4:15 to 5:15 pm

Ocular Biometrics

Session Chair: **Salil Prabhakar,** DigitalPersona, Inc.

Challenging ocular image recognition, Victor P. Pauca, Michael Forkin, Xiao Xu, Robert J. Plemmons, Wake Forest Univ. (USA); Arun A. Ross, West Virginia Univ. (USA) . . . . . [8029B-69]

Segmentation-free ocular detection and recognition, Andres F. Rodriguez, B. V. K. Vijaya Kumar, Carnegie Mellon Univ. (USA) . . . . . [8029B-70]

Eye safety considerations in the design of an iris capture system, Gil Abramovich, Frederick W. Wheeler, GE Global Research (USA) . . . . [8029B-71]

Course of Related Interest

SC952 **Applications of Detection Theory** (Carrano) Thursday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Tuesday-Wednesday 26-27 April 2011 • Proceedings of SPIE Vol. 8030

Ocean Sensing and Monitoring III

Conference Chairs: **Weilin W. Hou,** U.S. Naval Research Lab.; **Robert Arnone,** U.S. Naval Research Lab.

Program Committee: **Kendall L. Carder,** SRI International; **Georges R. Fournier,** Defence Research and Development Canada (Canada); **Michael P. Strand,** Naval Surface Warfare Ctr. Panama City Div.; **Chuck Trees,** NATO Undersea Research Ctr. (Italy); **Alan Weidemann,** U.S. Naval Research Lab.; **Sarah Woods,** U.S. Naval Research Lab.

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 1 . . . . . Tues. 10:00 am to 12:10 pm

Remote Sensing

Session Chair: **Joan S. Cleveland,** Office of Naval Research

Hyperspectral and multispectral above-water radiometric measurements to monitor satellite data quality over coastal area *(Invited Paper)*, Samir Ahmed, The City College of New York (USA); Robert Arnone, U.S. Naval Research Lab. (USA); Curtiss O. Davis, Oregon State Univ. (USA); Alex Gilerson, Tristan Harmel, Soe Min Hlaing, Alberto Tonizzo, The City College of New York (USA); Alan Weidemann, U.S. Naval Research Lab. (USA) . . . . . [8030-01]

Estimation of the attenuation coefficient of the water body using polarimetric observations, Alberto Tonizzo, Tristan Harmel, Amir Ibrahim, Alex Gilerson, Samir Ahmed, The City College of New York (USA) . . . . . [8030-02]

Automated detection and removal of cloud shadows on HICO images, Ruhul Amin, U.S. Naval Research Lab. (USA) and Mississippi State Univ. (USA); Richard Gould, Weilin W. Hou, U.S. Naval Research Lab. (USA); Zhongping Lee, Mississippi State Univ. (USA); Robert Arnone, U.S. Naval Research Lab. |(USA). . . . . [8030-03]

Influence of aerosol estimation on coastal water products retrieved from HICO images, Karen W. Patterson, Gia M. Lamela, U.S. Naval Research Lab. (USA) . . . . . [8030-04]

A plan for the polarimetric remote sensing of the oceans, Deric J. Gray, U.S. Naval Research Lab. (USA) . . . . . [8030-05]

Infrared imaging of surface waves interaction with a submerged object, Ivan Savelyev, Geoffrey B. Smith, U.S. Naval Research Lab. (USA) . . . . . [8030-06]

Lunch/Exhibition Break . . . . . 12:10 to 1:40 pm

SESSION 2 . . . . . Tues. 1:40 to 3:00 pm

UW Imaging

Optical modulation techniques for underwater detection, ranging and imaging, Linda J. Mullen, Brandon Cochenour, Alan Laux, Derek Alley, Naval Air Systems Command (USA). . . . . [8030-07]

Impacts of optical turbulence on underwater imaging, Weilin W. Hou, U.S. Naval Research Lab. (USA) . . . . . [8030-08]

Turbulence measurements for underwater imaging, Sarah Woods, Weilin W. Hou, Wesley Goode, Ewa Jarosz, Alan Weidemann, U.S. Naval Research Lab. (USA) . . . . . [8030-09]

Experimental imaging performance evaluation for alternate configurations of undersea pulsed laser serial imagers, F. R. Dalgleish, A. K. Vuorenkoski, B. Ouyang, F. M. Caimi, G. Nootz, Florida Atlantic Univ. (USA) . . . . . [8030-10]

SESSION 3 . . . . . Tues. 3:30 to 5:50 pm

Ocean and Riverine Sensing

Creation of bathymetric maps using satellite imagery, Bradley L. McCarthy, The Boeing Co. (USA); Richard C. Olsen, Angela M. Kim, Naval Postgraduate School (USA) . . . . . [8030-11]

Using WorldView-2 to determine ocean bottom-type and bathymetry, Krista R. Lee, Richard C. Olsen, Fred A. Kruse, Angela M. Kim, Naval Postgraduate School (USA) . . . . . [8030-12]

Automated, in-water determination of colored dissolved organic material and phytoplankton community structure using the optical phytoplankton discriminator, Gary J. Kirkpatrick, Mote Marine Lab. and Aquarium (USA); Steven E. Lohrenz, The Univ. of Southern Mississippi (USA); Mark A. Moline, California Polytechnic State Univ., San Luis Obispo (USA); Oscar Schofield, Rutgers Univ. (USA) . . . . . [8030-13]

Design and implementation of cooperative autonomous underwater vehicles for Antarctic exploration, Arturo E. Cadena, Jr., Escuela Superior Politécnica del Litoral (Ecuador) . . . . . [8030-14]

Automated identification of rivers and shorelines in aerial imagery using image texture, Paul McKay, Cheryl Ann Blain, U.S. Naval Research Lab. (USA); Robert S. Linzell, QinetiQ North America (USA) . . . . . [8030-15]

Merging imagery and models for river current prediction, Cheryl Ann Blain, U.S. Naval Research Lab. (USA); Robert S. Linzell, QinetiQ North America (USA); Paul McKay, U.S. Naval Research Lab. (USA) . . . . . [8030-16]

Using thermal remote sensing as a tool for calibrating a hydrodynamic model in inland waters, Nima Pahlevan, Aaron D. Gerace, John R. Schott, Rochester Institute of Technology (USA) . . . . . [8030-17]

Wednesday 27 April

SESSION 4 . . . . . Wed. 1:30 to 3:30 pm

Oil Spill (DHW) and Ocean Monitoring I

Session Chairs: **Weilin Will Hou,** U.S. Naval Research Lab.; **Sárka O. Southern,** Gaia Medical Institute

Joint Session with Conference 8029A: Sensing Technologies for Global Health, Military Medicine, Disaster Response, and Environmental Monitoring

Measurement techniques for the Deepwater Horizon (MC-252) oil spill response *(Invited Paper)*, Richard Crout, National Oceanic and Atmospheric Administration (USA) . . . . . [8030-18]

Operational mapping of the DWH deep subsurface dispersed oil, Harvey Seim, The Univ. of North Carolina at Chapel Hill (USA); Richard Crout, Glen Rice, National Oceanic and Atmospheric Administration (USA) . . . . . [8029A-41]

Combining numerical ocean circulation models with satellite observations in a trajectory forecast system: a rapid response to the Deepwater Horizon oil spill *(Invited Paper)*, Yonggang Liu, Robert H. Weisberg, Chuanmin Hu, Univ. of South Florida (USA). . . . . [8030-19]

Automated oil spill detection with multispectral imagery, Brian Bradford, Pedro J. Sanchez-Reyes, ITT Corp. Geospatial Systems (USA). . . . . [8030-20]

In situ characterization of distributions of dissolved contaminants using underwater mass spectrometry, R. Timothy Short, Ryan J. Bell, Ashish Chaudhary, Strawn K. Toler, Friso H. W. van Amerom, SRI St. Petersburg (USA) . . . . . [8029A-42]

SESSION 5 . . . . . Wed. 4:00 to 6:00 pm

Oil Spill (DHW) and Ocean Monitoring II

Session Chairs: **Sárka O. Southern,** Gaia Medical Institute;
Robert Arnone, U.S. Naval Research Lab.

Joint Session with Conference 8029A: Sensing Technologies for Global Health, Military Medicine, Disaster Response, and Environmental Monitoring

Monday-Friday 25-29 April 2011 • Proceedings of SPIE Vol. 8031

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Micro- and Nanotechnology Sensors, Systems, and Applications III

Conference Chairs: **Thomas George,** Zyomed Corp.; **M. Saif Islam,** Univ. of California, Davis; **Achyut K. Dutta,** Banpil Photonics, Inc.

Program Committee: **Debjyoti Banerjee,** Texas A&M Univ.; **Steve Blair,** The Univ. of Utah; **Anja Boisen,** Technical Univ. of Denmark (Denmark); **Robert Candler,** Univ. of California, Los Angeles; **Scott D. Collins,** Univ. of Maine; **Nibir K. Dhar,** Defense Advanced Research Projects Agency; **Ernest J. Garcia,** Sandia National Labs.; **Savas Kaya,** Ohio Univ.; **Shanalyn A. Kemme,** Sandia National Labs.; **Nobuhiko P. Kobayashi,** Univ. of California, Santa Cruz; **Ryan P. Lu,** Space and Naval Warfare Systems Command; **Joseph N. Mait,** U.S. Army Research Lab.; **Robert Osiander,** The Johns Hopkins Univ.; **Nezih Pala,** Florida International Univ.; **Jeremy J. Pietron,** U.S. Naval Research Lab.; **Michael K. Rafailov,** RICHER International LLC; **Noriko Satake,** UC Davis Medical Ctr.; **Andre U. Sokolnikov,** Visual Solutions and Applications; **Kyung-Ah Son,** Jet Propulsion Lab.; **Thomas G. Thundat,** Oak Ridge National Lab.; **David V. Wick,** Sandia National Labs.; **Eui-Hyeok Yang,** Stevens Institute of Technology; **Karl Y. Yee,** Jet Propulsion Lab.

Monday 25 April

SESSION 1 . . . . . Mon. 8:00 to 9:50 am

Dip Pen Nanolithography

Session Chairs: **Ryan P. Lu,** Space and Naval Warfare Systems Command; **Debjyoti Banerjee,** Texas A&M Univ.

Tip-based manofabrication (TBN): an approach to true nanotechnology *(Keynote Presentation),* Kristen Bloschock, Adam R. Schofield, System Planning Corp. (USA); Thomas Kenny, Stanford Univ. (USA) . . . . . [8031-01]

Direct-write scanning probe lithography: toward a desktop fab *(Invited Paper)*, Louise R. Giam, Chad A. Mirkin, Northwestern Univ. (USA) . . . . . [8031-02]

Tip-based patterning of graphite and CVD graphene *(Invited Paper)*, Bryan Hicks, Norimasa Yoshimizu, Cornell Univ. (USA); Christopher O' Connell, Univ. of Rhode Island (USA); Amit K. Lal, Clifford R. Pollock, Cornell Univ. (USA) [8031-03]

Nanofabrication using heated probe tips *(Invited Paper)*, Jonathan R. Felts, Patrick C. Fletcher, Suhas Somnath, James Pikul, Zhenting Dai, Univ. of Illinois at Urbana-Champaign (USA); Woo Kyung Lee, Paul E. Sheehan, U.S. Naval Research Lab. (USA); William P. King, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [8031-04]

Laser-assisted nanoprocessing and growth of semiconductor nanostructures *(Invited Paper)*, Costas P. Grigoropoulos, David J. Hwang, Sang-Gil Ryu, Eunpa Kim, Jae-Hyuck Yoo, Bin Xiang, Oscar D. Dubon, Andrew M. Minor, Univ. of California, Berkeley (USA). . . . . [8031-05]

SESSION 2 . . . . . Mon. 10:20 to 11:30 am

Advanced Nanoscale Materials Systems

Session Chair: **Nobuhiko P. Kobayashi,** Univ. of California, Santa Cruz

Semiconductor nanomembranes: a platform for new science and technology *(Keynote Presentation)*, Max G. Lagally, Univ. of Wisconsin-Madison (USA) . . . . . [8031-06]

Development of carbon nanotube-based sensors *(Invited Paper)*, M. Meyyappan, NASA Ames Research Ctr. (USA). . . . . [8031-07]

Pillar-structured thermal neutron detectors: performance expectations and fabrication challenges *(Invited Paper)*, Rebecca J. Nikolic, Adam M. Conway, Radoslav Radev, Qinghui Shao, Lars F. Voss, Tzu-Fang Wang, Lawrence Livermore National Lab. (USA); Barry C. L. Cheung, Univ. of Nebraska-Lincoln (USA); Lorenzo Fabris, Charles L. Britton, Jr., Milton N. Ericson, Oak Ridge National Lab. (USA) . . . . . [8031-08]

Lunch Break . . . . . 11:30 am to 12:45 pm

SESSION 3 . . . . . Mon. 12:45 to 2:35 pm

Micro/Nanotechnology for MM-Wave/THz Security Applications

Session Chair: **Robert Osiander,** The Johns Hopkins Univ. Applied Physics Lab.

The role of THz and submillimeter wave technology in DHS *(Keynote Presentation)*, Thomas P. Coty, U.S. Dept. of Homeland Security (USA); Anna Tedeschi, Strategic Analysis, Inc. (USA) . . . . . [8031-09]

High-performance heterostructure backward diode detectors *(Invited Paper)*, Patrick J. Fay, Ze Zhang, Univ. of Notre Dame (USA). . . . . [8031-10]

A micro-fabricated sheet-beam Orotron THz source *(Invited Paper)*, Stergios J. Papadakis, Joan A. Hoffmann, Andrew H. Monica, David M. Deglau, Robert Osiander, The Johns Hopkins Univ. Applied Physics Lab. (USA); J. Yu, Thomas M. Antonsen, Jr., Gregory S. Nusinovich, The Univ. of Maryland (USA). . [8031-11]

MEMS-based uncooled THz detectors for staring imagers *(Invited Paper)*, Allen Cox, Honeywell ACS Labs. (USA) . . . . . [8031-12]

Integrated chip-scale THz technology *(Invited Paper)*, Michael C. Wanke, Sandia National Labs. (USA); Mark Lee, The Univ. of Texas at Dallas (USA); Chris D. Nordquist, Michael J. Cich, Adam M. Rowen, James R. Gillen, Sandia National Labs. (USA); Christian L. Arrington, Albert D. Grine, LMATA Govt. Services (USA); Charles T. Fuller, John L. Reno, Sandia National Labs. (USA) . . . . . [8031-13]

SESSION 4 . . . . . Mon. 2:35 to 5:15 pm

THz Characterization of Semiconductor Materials

Session Chair: **Andre U. Sokolnikov,** Visual Solutions and Applications

Programmatic perspectives with technical examples for THz materials characterization *(Keynote Presentation)*, Walter R. Buchwald, Air Force Research Lab. (USA) . . . . . [8031-14]

THz characterization of hydrated and anhydrous materials *(Invited Paper)*, Andre U. Sokolnikov, Visual Solutions and Applications (USA) . . . . . [8031-15]

THz heterodyne sensing with AlInN/GaN hot-electron microbolometers using quantum cascade lasers *(Invited Paper)*, Vladimir V. Mitin, Rahul Ramaswamy, Kai Wang, Univ. at Buffalo (USA); Andrey V. Muraviev, Univ. at Buffalo (USA) and Rensselaer Polytechnic Institute (USA); Gottfried Strasser, Andrea G. Markelz, Univ. at Buffalo (USA); Michael S. Shur, Rensselaer Polytechnic Institute (USA); Remis Gaska, Sensor Electronic Technology, Inc. (USA); Andrei V. Sergeev, Univ. at Buffalo (USA). . . . . [8031-16]

Ultra-fast metal-insulator transition in vanadium oxide thin films *(Invited Paper)*, Shriram Ramanathan, Harvard School of Engineering and Applied Sciences (USA) . . . . . [8031-17]

Silicon and nitride FETs for THz sensing *(Invited Paper)*, Michael S. Shur, Rensselaer Polytechnic Institute (USA). . . . . [8031-18]

Terahertz active metamaterials and lasers *(Invited Paper)*, Benjamin S. Williams, Amir Ali Tavallaee, Philip Hon, Tatsuo Itoh, Univ. of California, Los Angeles (USA); Qisheng Chen, Northrop Grumman Aerospace Systems (USA) . . . . . [8031-19]

Course of Related Interest

SC1034 **Lab-on-a-Chip Technology - Towards Portable Detection Systems** (Gärtner) Friday, 8:30 am to 12:30 pm

See full course listing and descriptions on pp. 144-192.

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 5 . . . . . Tues. 10:00 to 11:50 am

MEMS Optical Systems

Session Chairs: **David V. Wick,** Sandia National Labs.; **Shanalyn A. Kemme,** Sandia National Labs.

Technology for Navy and Marine Corps EO/IR sensors and sensor systems *(Keynote Presentation)*, Michael Duncan, Office of Naval Research (USA) . . . . . [8031-20]

MEMs adaptive optics at the Naval Research Laboratory *(Invited Paper)*, Sergio R. Restaino, Jonathan R. Andrews, Ty Martinez, Christopher C. Wilcox, Freddie Santiago, Don M. Payne, U.S. Naval Research Lab. (USA) . . . . . [8031-21]

Actuation for deformable thin-shelled composite mirrors *(Invited Paper)*, Christopher C. Wilcox, U.S. Naval Research Lab. (USA); David V. Wick, Brett E. Bagwell, Sandia National Labs. (USA); Robert C. Romeo, Robert N. Martin, Composite Mirror Applications, Inc. (USA); Michael S. Baker, Nicole L. Breivik, Brad L. Boyce, Sandia National Labs. (USA); Ty Martinez, Sergio R. Restaino, U.S. Naval Research Lab. (USA) . . . . . [8031-22]

Micro ion frequency standard *(Invited Paper)*, Peter D. Schwindt, Yuan Jau, Heather Partner, Roy H. Olsson III, Kenneth Wojciechowski, Darwin K. Serkland, Lu Fang, Adrian Casias, Ronald P. Manginell, Matthew Moorman, Sandia National Labs. (USA) . . . . . [8031-23]

Imaging a linearly or circularly polarized scene: micro-components and shrimp *(Invited Paper)*, Shanalyn A. Kemme, David A. Scrymgeour, Alvaro A. Cruz-Cabrera, Robert R. Boye, Robert S. Ellis, Joel R. Wendt, Tony R. Carter, Sally Samora, Sandia National Labs. (USA) . . . . . [8031-24]

Lunch/Exhibition Break . . . . . 11:50 am to 12:50 pm

SESSION 6 . . . . . Tues. 12:50 to 2:00 pm

Nanophotonics

Session Chair: **Steve Blair,** The Univ. of Utah

Trends in nanophotonics *(Keynote Presentation)*, Gernot S. Pomrenke, Air Force Office of Scientific Research (USA) . . . . . [8031-25]

Nanomembranes for optofluidic and autonomous systems *(Invited Paper)*, Oliver G. Schmidt, Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden (Germany) . . . . . [8031-26]

Integrated microsystems for molecular pathology *(Invited Paper)*, Axel Scherer, California Institute of Technology (USA) . . . . . [8031-27]

SESSION 7 . . . . . Tues. 2:00 to 2:40 pm

Photon Trapping with 1D Structures and Novel Device Applications

Session Chair: **M. Saif Islam,** Univ. of California, Davis

Efficient light-trapping nanostructures in thin silicon solar cells *(Invited Paper)*, Sang Eon Han, Anastassios Mavrokefalos, Matthew Branham, Carl G. Chen, Massachusetts Institute of Technology (USA) . . . . . [8031-28]

Magnetically responsive photonic nanostructures: making color with magnets *(Invited Paper)*, Yadong Yin, Univ. of California, Riverside (USA) . . . . . [8031-29]

SESSION 8 . . . . . Tues. 2:40 to 4:40 pm

Advanced Nanomaterials, Nanolithography and Nanomanufacturing

Session Chair: **Eui-Hyeok Yang,** Stevens Institute of Technology

Functionalized DNA materials for sensing and medical applications *(Keynote Presentation)*, Dwight L. Woolard, U.S. Army Research Office (USA); James O. Jensen, U.S. Army Edgewood Chemical Biological Ctr. (USA). . . . . [8031-30]

Photonic meta materials, nanoscale plasmonics, and super lens *(Invited Paper)*, Xiang Zhang, Univ. of California, Berkeley (USA) . . . . . [8031-31]

Manufacturing coatings of micro- and nanoparticles by controlled evaporation of drops and thin films *(Invited Paper)*, Daniel Attinger, Columbia Univ. (USA) . . . . . [8031-32]

Synthesis and characterization of carbon-based nanomaterials and devices for nanoelectronics and microfluidics *(Invited Paper)*, Eui-Hyeok Yang, Stevens Institute of Technology (USA) . . . . . [8031-33]

Wednesday 27 April

SESSION 9 . . . . . Wed. 8:00 to 9:40 am

MAST-Navigation

Joint Session with conference 8045

Session Chairs: **Larry H. Matthies,** Jet Propulsion Lab.; **Joseph N. Mait,** U.S. Army Research Lab.

Results from MAST joint experiment 3.1 *(Invited Paper)*, John G. Rogers III, Georgia Institute of Technology (USA) and Univ. of Pennsylvania (USA); Alex Cunningham, Manohar Paluri, Henrik I. Christensen, Georgia Institute of Technology (USA); Nathan Michael, Vijay Kumar, Univ. of Pennsylvania (USA); Larry H. Matthies, Jeremy Ma, Jet Propulsion Lab. (USA); Frank Dellaert, Georgia Institute of Technology (USA) . . . . . [8031-34]

Autonomous navigation with teams of aerial robots *(Invited Paper)*, Nathan Michael, Univ. of Pennsylvania (USA) . . . . . [8031-35]

Vision-aided landing and ingress of a micro-air-vehicle using a monocular camera *(Invited Paper)*, Roland Brockers, Jet Propulsion Lab. (USA); Patrick Bouffard, Univ. of California, Berkeley (USA); Jeremy Ma, Larry H. Matthies, Jet Propulsion Lab. (USA); Claire Tomlin, Univ. of California, Berkeley (USA) [8031-36]

Estimation of vehicle velocity and proximity via wide-field integration of optic flow *(Invited Paper)*, James S. Humbert, Steven Gerardi, Andrew Hyslop, Univ. of Maryland, College Park (USA) . . . . . [8031-37]

Compact beam scanning 240GHz radar for navigation and collision avoidance *(Invited Paper)*, Kamal Sarabandi, Mehrnoosh Vahidpour, Maysam Moallem, Jack R. East, Univ. of Michigan (USA). . . . . [8031-38]

SESSION 10 . . . . . Wed. 9:40 to 11:30 am

MAST-Communication

Joint Session with conference 8045

Session Chairs: **William Nothwang,** U.S. Army Research Lab.; **Joseph N. Mait,** U.S. Army Research Lab.

New techniques for efficient flexible wireless transceivers in nanometer CMOS *(Invited Paper)*, Michael Flynn, Univ. of Michigan (USA) . . . . . [8031-39]

Reconfigurable firmware-defined radios synthesized from standard digital logic cells *(Invited Paper)*, David D. Wentzloff, Muhammad Faisal, Youngmin Park, Univ. of Michigan (USA) . . . . . [8031-40]

Radio signal strength tracking and control for robotic networks *(Invited Paper)*, Brian M. Sadler, Paul Yu, Jeffrey Twigg, U.S. Army Research Lab. (USA) . . . . . [8031-41]

Enhanced ad hoc wireless connectivity in complex environment using small radio repeater systems *(Invited Paper)*, Kamal Sarabandi, Youngjun Song, Jungsuek Oh, Univ. of Michigan (USA) . . . . . [8031-42]

Lunch/Exhibition Break . . . . . 11:30 am to 12:45 pm

SESSION 11 . . . . . Wed. 12:45 to 2:55 pm

Quality Factors for Nano/Micromechanical Resonators

Session Chairs: **Robert Candler,** Univ. of California, Los Angeles; **Thomas George,** Zyomed Corp.

Precision navigation and timing enabled by microtechnology: are we there yet? *(Keynote Presentation)*, Andrei M. Shkel, Defense Advanced Research Projects Agency (USA) . . . . . [8031-43]

Energy dissipation in micro-mechanical resonators *(Invited Paper)*, Farrokh Ayazi, Georgia Institute of Technology (USA) . . . . . [8031-44]

The effect of surface chemistry on the quality factors of micromechanical resonators *(Invited Paper)*, Melissa A. Hines, Cornell Univ. (USA). . . . . [8031-45]

Finite element modeling and simulation of thermo-elastical damping of MEMS vibrations *(Invited Paper)*, Saulius Kausinis, Kaunas Univ. of Technology (Lithuania); Karl Y. Yee, Jet Propulsion Lab. (USA); Rimantas Barauskas, Kaunas Univ. of Technology (Lithuania) . . . . . [8031-46]

Thermal energy loss mechanisms in micro- to nanoscale devices *(Invited Paper)*, Amy E. Duwel, Marc S. Weinberg, Draper Lab. (USA) . . . [8031-47]

Computational modeling of anchor loss in MEMS devices and correlations with experiments *(Invited Paper)*, K. C. Park, Univ. of Colorado at Boulder (USA) . . . . . [8031-48]

SESSION 12 . . . . . Wed. 3:25 to 5:15 pm

MEMS Performance Challenges

Session Chair: **Ernest J. Garcia,** Sandia National Labs.

An analysis of microsystems development at Sandia National Laboratories *(Keynote Presentation)*, Gilbert V. Herrera, Sandia National Labs. (USA) . [8031-49]

MEMS performance challenges: packaging and shock tests *(Invited Paper)*, Liwei Lin, Univ. of California, Berkeley (USA) . . . . . [8031-50]

Sensors for hydraulic-induced fracturing characterization *(Invited Paper)*, Jose Mireles, Jr., Univ. Autónoma de Ciudad Juarez (Mexico); Horacio Estrada, Ctr. Nacional de Metrología (Mexico); Roberto Ambrosio, Univ. Autónoma de Ciudad Juarez (Mexico). . . . . [8031-51]

Tribology in MEMS *(Invited Paper)*, Michael T. Dugger, Sandia National Labs. (USA) . . . . . [8031-52]

MEMS and nanostructures: challenges and opportunities *(Invited Paper)*, Victor M. Castano, Univ. Nacional Autónoma de México (Mexico) . . . . . [8031-53]

Thursday 28 April

SESSION 13 . . . . . Thurs. 8:00 to 11:30 am

Joint Session with conference 8035

Nanotechnologies for Energy Generation and Storage

Session Chairs: **Jeremy J. Pietron,** U.S. Naval Research Lab.; **Nezih Pala,** Florida International Univ.

Thermoelectric energy conversion using nanostructured materials *(Invited Paper)*, Carl G. Chen, Andrew Muto, D. Kramer, Ken McEnaney, H.-P. Feng, Massachusetts Institute of Technology (USA); W. S. Liu, Q. Zhang, B. Yu, Zhifeng Ren, Boston College (USA) . . . . . [8031-54]

Engineering carbon nanomaterials for future applications: energy and sensor *(Invited Paper)*, Wonbong Choi, Florida International Univ. (USA) . . . . . [8031-55]

Developments in MEMS scale printable alkaline and Li-ion technology *(Invited Paper)*, Karl Littau, Corie L. Cobb, Palo Alto Research Center, Inc. (USA) . . . . . [8031-56]

Further studies in the electrochemical/mechanical strength of printed microbatteries *(Invited Paper)*, Daniel A. Steingart, The City College of New York (USA) . . . . . [8031-57]

Energy and size-scalable 3D battery architecutres *(Invited Paper)*, Jeffrey W. Long, U.S. Naval Research Lab. (USA). . . . . [8031-58]

Ultrathin, microscale epitaxial compound semiconductor solar cells *(Invited Paper)*, John A. Rogers, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [8031-59]

Little Robeep: miniature power sources for autonomous systems *(Invited Paper)*, Shriram Ramanathan, Harvard School of Engineering and Applied Sciences (USA) . . . . . [8031-60]

Self-powered nanosystems: nanogenerators, piezotronics, and piezo-phototronics *(Invited Paper)*, Zhong Lin Wang, Georgia Institute of Technology (USA) . . . . . [8031-61]

Nanotechnology enabled flexible energy harvesting *(Invited Paper)*, Michael C. McAlpine, Princeton Univ. (USA). . . . . [8031-62]

Lunch/Exhibition Break . . . . . 11:30 am to 12:45 pm

SESSION 14 . . . . . Thurs. 12:45 to 2:35 pm

Micro- and Nanotechnology for Health Care Applications

Session Chairs: **Scott D. Collins,** Univ. of Maine; **Noriko Satake,** UC Davis Medical Ctr.

Cancer nanotechnology: new pipeline for diagnostics, imaging agents, and therapies *(Keynote Presentation)*, Krzysztof Ptak, NCI Ctr. for Strategic Scientific Initiatives (USA) . . . . . [8031-63]

Nanomaterial strategies for immunodetection *(Invited Paper)*, Marc D. Porter, The Univ. of Utah (USA) . . . . . [8031-64]

Nanoparticle-targeted therapy against childhood acute lymphoblastic leukemia *(Invited Paper)*, Noriko Satake, UC Davis Medical Ctr. (USA); Joyce S. Lee, Kai Xiao, Juntao Luo, Susmita Sarangi, UC Davis Cancer Ctr. (USA); Astra Chang, Bridget McLaughlin, Ping Zhou, Elaina Kenny, Liliya Kraynov, Sarah Arnott, Jeannine McGee, Jan Nolta, UC Davis Medical Ctr. (USA); Kit S. Lam, UC Davis Cancer Ctr. (USA) . . . . . [8031-65]

Microfluidic and nanofluidic systems for the detection and quantification of biomolecules *(Invited Paper)*, Pamela N. Nge, Ming Yu, Weichun Yang, Jie Xuan, Mark N. Hamblin, Aaron R. Hawkins, Milton L. Lee, Adam T. Woolley, Brigham Young Univ. (USA). . . . . [8031-66]

Quantum dots and microfluidic single molecule detection for screening genetic and epigenetic cancer markers in clinical samples *(Invited Paper)*, Tza-Huei Wang, The Johns Hopkins Univ. (USA) . . . . . [8031-67]

SESSION 15 . . . . . Thurs. 2:35 to 5:15 pm

Micro- and Nanotechnology for Future Harsh Environment Applications

Session Chair: **Kyung-Ah Son,** Jet Propulsion Lab.

Growth of carbon-based nanostructures *(Keynote Presentation)*, William C. Mitchel, John J. Boeckl, Air Force Research Lab. (USA) . . . . . [8031-68]

Micro- and nano-electronic technologies and their qualification methodology for harsh environment applications *(Invited Paper)*, Yuan Chen, NASA Langley Research Ctr. (USA); Mohammad Mojarradi, Elizabeth Kolawa, Jet Propulsion Lab. (USA) . . . . . [8031-69]

Electronics for harsh environments in space exploration: now and beyond *(Invited Paper)*, Jagdish U. Patel, Jet Propulsion Lab. (USA) . . . . . [8031-70]

Chemical vapor sensing with carbon *(Invited Paper)*, Frank K. Perkins, U.S. Naval Research Lab. (USA) . . . . . [8031-71]

Graphene field-effect transistors for label-free chemical and biological sensors *(Invited Paper)*, Yasuhide Ohno, Kenzo Maehashi, Kazuhiko Matsumoto, The Institute of Scientific and Industrial Research (Japan) . . . . . [8031-72]

Graphene transistors: from rad-hard electronics to radiation detection *(Invited Paper)*, Yong P. Chen, Purdue Univ. (USA) . . . . . [8031-73]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

On chip MWCNT-PDMS micro-temperature sensors for MEMS/MST, Ajit Khosla, Simon Fraser Univ. (Canada) . . . . . [8031-85]

Integration of CMM software standards for nanopositioning and nanomeasuring machines, Erik Sparrer, Torsten Machleidt, Eberhard Manske, Karl-Heinz Franke, Technische Univ. Ilmenau (Germany) . . . . . [8031-86]

A novel atomic layer deposition method to fabricate economical and robust large-area microchannel plate detectors, Anil Mane, Qing Peng, Matthew Wetstein, Argonne National Lab. (USA); Henry J. Frisch, The Univ. of Chicago (USA) and Argonne National Lab. (USA); Oswald H. Siegmund, Univ. of California, Berkeley (USA); Jeffrey W. Elam, Argonne National Lab. (USA) . . . . . [8031-87]

Fabrication of plasmonic nanopore array for biomolecule sensor, Seong Soo Choi, Sun Moon Univ. (Korea, Republic of); Moung Jin Park, Korea Military Academy (Korea, Republic of); Nam Kyu Park, DaiSik Kim, Seoul National Univ. (Korea, Republic of); Kyung Jin Park, National Nanofab Ctr. (Korea, Republic of) . . . . . [8031-88]

Compacted nanoscale sensors by merging ZnO nanorods with interdigitated electrodes, Qin Wang, Boban Gavric, Susanne Almqvist, Andreas Bergström, Wlodek Kaplan, Jan Y. Andersson, Acreo AB (Sweden). . . . . [8031-89]

Optimization of plasmonic grating THz source using finite element analysis, Justin W. Cleary, Solid State Scientific Corp. (USA); Bahareh Haji-saeed, Jed Khoury, Walter R. Buchwald, Charles L. Woods, Air Force Research Lab. (USA); John Kierstead, Solid State Scientific Corp. (USA). . . . . [8031-90]

Highly tunable corrugated metal nano-grating laser using current injection, Jed Khoury, Bahareh Haji-saeed, Charles L. Woods, Air Force Research Lab. (USA); John Kierstead, Solid State Scientific Corp. (USA) . . . . . [8031-91]

Design of an ultrasensitive active pixel sensor that is based on silicon nanostructures, Wayne Richardson, Qusemde (USA) . . . . . [8031-92]

Zero-bandgap graphene for infrared sensing applications, Ning Xi, Michigan State Univ. (USA). . . . . [8031-93]

Scalable fabrication of micro- and nanoparticles utilizing the Rayleigh instability in multi-material fibers, Soroush Shabahang, Joshua Kaufman, Ayman F. Abouraddy, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [8031-94]

Differential thermal analysis microsystem for explosive detection, Jesper K. Olsen, Technical Univ. of Denmark (Denmark); Larry R. Senesac, Oak Ridge National Lab. (USA); Thomas G. Thundat, Univ. of Alberta (Canada); Anja Boisen, Technical Univ. of Denmark (Denmark). . . . . [8031-95]

Spatially resolved leakage radiation spectroscopy of integrated plasmonic microresonators, Pieter G. Kik, Amitabh Ghoshal, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8031-96]

Rapid laser direct writing for extremely sensitive surface-enhanced Raman scattering substrates based on the photoreduction mechanism of silver nanoparticles, Chen-Han Huang, Hsing-Ying Lin, National Chung Cheng Univ. (Taiwan) and National Cheng Kung Univ. (Taiwan) . . . . . [8031-97]

Nanofabrication of large-scale periodic metal nanostructure arrays by nano-imprint lithography and laser annealing, Chen-Han Huang, Hsing-Ying Lin, National Chung Cheng Univ. (Taiwan) and National Cheng Kung Univ. (Taiwan). . . . . [8031-98]

An implementation for the detection and analysis of negative peaks in an applied current signal across a silicon nanopore, Joseph Billo, Waseem Asghar, Samir Iqbal, Univ. of Texas at Arlington (USA) . . . . . [8031-99]

Nanostencil lithography for high-throughput fabrication of infrared plasmonic sensors, Serap Aksu, Ahmet A. Yanik, Ronen Adato, Alp Artar, Min Huang, Hatice Altug, Boston Univ. (USA) . . . . . [8031-100]

Cathodoluminescence of metal gratings and electron-beam induced current in metal-oxide-metal junctions for plasmonic applications, Janardan Nath, Robert E. Peale, Casey Schwarz, Yuqing Lin, Leonid Chernyak, Univ. of Central Florida (USA); Jeffrey A. Bean, Guy Zummo, Glenn D. Boreman, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Walter R. Buchwald, Air Force Research Lab. (USA) . . . . . [8031-101]

Nanochemical sensors: polyaniline nanofibers and graphene, Bruce H. Weiller, The Aerospace Corp. (USA) . . . . . [8031-102]

Nanosensors: from near-field to far-field applications, Samuel P. Hernandez-Rivera, Julio G. Briano, Oliva M. Primera-Pedrozo, Leonardo C. Pacheco-Londoño, Pedro M. Fierro-Mercado, Natacha Souto-Melgar, Gloria M. Herrera, Marcia del R. Balaguera, Hilsamar Felix-Rivera, Univ. de Puerto Rico Mayagüez (USA) . . . . . [8031-103]

Plasmonic photonic crystal MEMS platform for IFF and sensing applications, Irina Puscasu, ICx Photonics (USA) . . . . . [8031-104]

Hydrogenation effect on graphene field effect devices relevant to photonic device application, Ahalapitiya H. Jayatissa, Madhav Gautam, The Univ. of Toledo (USA) . . . . . [8031-105]

Design of low-cost photonic crystal-based three-dimensional invisibility cloak, Geng Zheng, Hualiang Zhang, Yuankun Lin, Univ. of North Texas (USA) . . . . . [8031-106]

Microoptoelectromechanical (MOEM) accelerometers: possibility versus performance, Jagannath Nayak, Research Ctr. Imarat (India); Talabattula Srinivas, Indian Institute of Science (India) . . . . . [8031-107]

Nanowire-based photodetectors: growth and development of chalcogenide nanostructured detectors, Matthew King, Sean Mclaughlin, David A. Kahler, Andre Berghmans, Brian P. Wagner, David J. Knuteson, Maaz Aziz, Narsingh B. Singh, Northrop Grumman Electronic Systems (USA) . . . . . [8031-108]

Effect of dielectric layer on the response times of electrostatic MEMS switches, Sudarshan R. Nelatury, Penn State Erie, The Behrend College (USA) . . . . . [8031-109]

Tuneable optical waveguide using dielectrophoretically manipulated nanoparticles in microfluidics, Aminuddin Kayani, Adam F. Chrimes, RMIT Univ. (Australia); Khashayar Khoshmanesh, Deakin Univ. (Australia); Arnan Mitchell, Kourosh Kalantar-Zadeh, RMIT Univ. (Australia). . . . . [8031-110]

Dielectrophoresis-Raman spectroscopy system for analysing suspended WO3 nanoparticles, Adam F. Chrimes, Kourosh Kalantar-Zadeh, RMIT Univ. (Australia). . . . . [8031-111]

Investigating the effects of nonspecific biomolecular adsorption on the efficiency of the electrocapillary based digital microfluidic biochips, Ali Ahmadi, Kurt D. Devlin, Mina Hoorfar, The Univ. of British Columbia (Canada) . . . . . [8031-112]

Friday 29 April

SESSION 16 . . . . . Fri. 8:00 to 9:00 am

Miniaturized Sensors and Systems

Session Chair: **Anja Boisen,** Technical Univ. of Denmark (Denmark)

Xsense: a miniaturised multisensor platform for explosives detection *(Invited Paper)*, Michael S. Schmidt, Jesper K. Olsen, Filippo G. Bosco, Natalie Kostesha, Mogens H. Jakobsen, Tommy S. Alstrøm, Jan Larsen, Technical Univ. of Denmark (Denmark); Carsten Johnsen, Kent A. Nielsen, Jan O. Jeppesen, Univ. of Southern Denmark (Denmark); Thomas G. Thundat, Univ. of Alberta (Canada); Anja Boisen, Technical Univ. of Denmark (Denmark) . . . . . [8031-74]

Explosives detection using nanoporous solids *(Invited Paper)*, Pilar Pina, Univ. de Zaragoza (Spain); Ismael Pellejero, Miguel Urbiztondo, Javier Sesé, Jesus Santamaria, Instituto de Nanociencia de Aragon (Spain) . . . . . [8031-75]

The photonic nose: a simple and versatile tool for sensing *(Invited Paper)*, Leonardo D. Bonifacio, Andre Arsenault, Opalux, Inc. (Canada); Geoffrey A. Ozin, Univ. of Toronto (Canada) . . . . . [8031-76]

SESSION 17 . . . . . Fri. 9:00 am to 12:20 pm

Micro-Nanotechnologies for Standoff Detection and Counter Insurgency

Session Chairs: **Thomas G. Thundat,** Univ. of Alberta (Canada); **Michael K. Rafailov,** RICHER International LLC (USA)

Quantum cascade lasers: a game changer for defense and homeland security IR photonics *(Keynote Presentation)*, Chandra Kumar N. Patel, Pranalytica, Inc. (USA). . . . . [8031-77]

QCL-assisted infrared chemical imaging *(Invited Paper)*, Miles J. Weida, Peter Puerki, Eric B. Takeuchi, Timothy Day, Daylight Solutions Inc. (USA) . . . [8031-78]

Ultrafast bandgap photonics *(Invited Paper)*, Michael K. Rafailov, The Reger Group (USA) . . . . . [8031-79]

Vibrational spectroscopy standoff detection of threat chemicals *(Invited Paper)*, Samuel P. Hernandez-Rivera, John R. Castro-Suarez, Leonardo C. Pacheco-Londoño, William Ortiz, Hilsamar Felix-Rivera, Jose L. Ruiz-Caballero, Univ. de Puerto Rico Mayagüez (USA) . . . . . [8031-80]

Nano-antenna-based detectors for focal plane arrays across the electromagnetic spectrum (from mmW to IR) *(Invited Paper)*, Michael A. Gritz, Borys P. Kolasa, Robert Burkholder, Raytheon Co. (USA) . . . . . [8031-81]

Standoff detection of explosives: a challenging approach for optical technologies *(Invited Paper)*, Sylvain Désilets, Defence Research & Development Canada, Valcartier (Canada); Nicolas Ho, INO (Canada); Pierre Mathieux, Jean-Robert Simard, Eldon Puckrin, Jean-Marc Theriault, Hugo Lavoie, Francis Théberge, Defence Research & Development Canada, Valcartier (Canada); François Babin, David Guay, Simon Deblois, INO (Canada); Jean Maheux, Gilles A. Roy, Marc Châteauneuf, Defence Research & Development Canada, Valcartier (Canada) . . . . . [8031-82]

Standoff detection of chemicals using IR spectroscopy *(Invited Paper)*, Panos G. C. Datskos, Larry R. Senesac, Charles Van Neste, Marissa E. Morales, Oak Ridge National Lab. (USA). . . . . [8031-83]

Mid-wave/long-wave infrared lasers and their sensing applications *(Invited Paper)*, K. K. Law, Naval Air Warfare Ctr. Weapons Div. (USA) . . [8031-84]

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Next-Generation Spectroscopic Technologies IV

Conference Chairs: **Mark A. Druy,** Physical Sciences Inc.; **Richard A. Crocombe,** Thermo Fisher Scientific Inc.

Program Committee: **John M. Dell,** The Univ. of Western Australia (Australia); **Erik Deutsch,** Block Engineering, LLC; **Richard D. Driver,** Headwall Photonics Inc.; **Jason M. Eichenholz,** Ocean Optics, Inc.; **Michael B. Frish,** Physical Sciences Inc.; **David M. Haaland,** Spectral Resolutions; **Fred Haibach,** Thermo Fisher Scientific, Inc.; **Martin Kraft,** Carinthian Tech Research AG (Austria); **Jouko O. Malinen,** VTT Optical Instruments (Finland); **Christopher J. Manning,** Manning Applied Technologies, Inc.; **Curtis A. Marcott,** Light Light Solutions, LLC; **Robert G. Messerschmidt,** Rare Light Inc.; **Ellen V. Miseo,** Agilent Technologies, Inc.; **David W. Schiering,** Smiths Detection; **Eric B. Takeuchi,** Daylight Solutions, Inc.

Monday 25 April

SESSION 1 . . . . . Mon. 8:30 to 9:50 am

Enabling Technologies

Session Chair: **Richard A. Crocombe,** Thermo Fisher Scientific Inc.

Analysis on polarization interference imaging spectroscopy in remote sensing, Hongwen Gao, Chunmin Zhang, Xi'an Jiaotong Univ. (China) . [8032-01]

Light focusing by chirped waveguide grating coupler, Pradeep Kumar, Wayne State Univ. (USA); Brent C. Bergner, David Cook, Spectum Scientific, Inc. (USA); Ivan A. Avrutsky, Wayne State Univ. (USA). . . . . [8032-02]

New generation of compact femtosecond system for laser-based detection and identification of biological materials, Khan Lim, Yuan Liu, Matthieu Baudelet, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Evgueni Slobodtchikov, Peter Moulton, Q-Peak, Inc. (USA); Andrzej W. Miziolek, U.S. Army Research Lab. (USA); Martin C. Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8032-03]

A MEMS-based tunable Fabry-Perot filter, Neelam Gupta, U.S. Army Research Lab. (USA); Songsheng Tan, Dennis R. Zander, Infotonics Technology Ctr. (USA) . . . . . [8032-04]

SESSION 2 . . . . . Mon. 10:30 to 11:50 am

Laser-based and Cavity Ringdown Spectrometry I

Session Chair: **Mark A. Druy,** Physical Sciences Inc.

Microsensors based on quantum cascade lasers, Sheng Wu, Andrei Deev, California Institute of Technology (USA) . . . . . [8032-05]

Development of a field-deployable isotopic N_2O analyzer based on mid-infrared cavity ring-down spectroscopy, Alejandro D. Farinas, Eric R. Crosson, Picarro Inc. (USA); David Balslev-Clausen, Thomas Blunier, Univ. of Copenhagen (Denmark) . . . . . [8032-06]

Mid-infrared absorption spectroscopy using quantum cascade lasers, Erik Deutsch, John F. Heanue, Block Engineering, LLC (USA) . . . . . [8032-07]

Accuracy of miniature tunable diode laser absorption spectrometers, Michael B. Frish, Mark A. Druy, Physical Sciences Inc. (USA) . . . . . [8032-08]

Lunch Break . . . . . 11:50 am to 1:20 pm

SESSION 3 . . . . . Mon. 1:20 to 3:00 pm

Laser-based and Cavity Ringdown Spectrometry II

Session Chair: **Mark A. Druy,** Physical Sciences Inc.

Advances in QCL for security and crime fighting, Simon A. Nicholson, Cascade Technologies Ltd. (United Kingdom) . . . . . [8032-09]

Quantum cascade laser-based substance detection, Charles C. Harb, UNSW@ADFA (Australia); Thomas G. Spence, Loyola Univ. (USA) . . . . . [8032-10]

Small, low-power consumption CO-sensor for post-fire cleanup aboard spacecraft, John L. Bradshaw, John D. Bruno, Kevin M. Lascola, Richard P. Leavitt, John T. Pham, Frederick J. Towner, Maxion Technologies, Inc. (USA); David M. Sonnenfroh, Krishnan R. Parameswaran, Physical Sciences Inc. (USA) . . . . . [8032-11]

Intracavity laser absorption spectroscopy using mid-IR quantum cascade laser, Gautam Medhi, Univ. of Central Florida (USA); Andrey V. Muraviev, Himanshu Saxena, Zyberwear, Inc. (USA); Christopher J. Fredricksen, Tatiana N. Brusentsova, Robert E. Peale, Univ. of Central Florida (USA); Oliver J. Edwards, Zyberwear, Inc. (USA) . . . . . [8032-12]

On the accuracy of decay constant measurement by heterodyne cavity ringdown spectroscopy, Dilusha K. K. M. B. Silva, Aislinn van der Walt, John M. Dell, Lorenzo Faraone, The Univ. of Western Australia (Australia) . . . . . [8032-13]

SESSION 4 . . . . . Mon. 3:30 to 5:30 pm

Raman, SERS, and Security Applications

Session Chair: **Richard A. Crocombe,** Thermo Fisher Scientific Inc.

Rapid and field-deployable biological and chemical Raman-based identification, Edita Botonjic-Sehic, Marie Lesaicherre, Hacene Boudries, Morpho Detection (USA) . . . . . [8032-14]

Detection of fire protection and mineral glasses in industrial recycling using Raman mapping spectroscopy, Martin De Biasio, Thomas Arnold, Martin Kraft, Raimund Leitner, Carinthian Tech Research AG (Austria); Dirk Balthasar, Volker Rehrmann, TITECH GmbH (Germany) . . . . . [8032-15]

Toward non-invasive detection of concealed energetic materials in-field under ambient-light conditions, Emad L. Kiriakous, Queensland Univ. of Technology (Australia) . . . . . [8032-16]

Integration of optical devices and nanotechnology for conducting genome research, Pei-Yu Chung, Hanying Luo, Gregory Schultz, Peng Jiang, Christopher D. Batich, Univ. of Florida (USA) . . . . . [8032-17]

Application of an ion mobility spectrometer with pulsed ionization source in the detetction of dimethyl methylphosphonate and toluene diisocynate, Frank Gunzer, The German Univ. in Cairo (Egypt) . . . . . [8032-18]

Detection of trace concentrations of TATP in complex surroundings using SERS, Kevin M. Spencer, Susan L. Clauson, James M. Sylvia, EIC Labs., Inc. (USA) . . . . . [8032-19]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 5 . . . . . Tues. 10:00 am to 12:00 pm

Novel Spectrometers I

Session Chair: **Richard A. Crocombe,** Thermo Fisher Scientific Inc.

Two novel static polarization imaging spectrometers, Tingkui Mu, Chunmin Zhang, Xi'an Jiaotong Univ. (China) . . . . . [8032-20]

Photonic crystal slot waveguide optical absorption spectrometer for high-sensitivity near-infrared detection of xylene in water, Swapnajit Chakravarty, Omega Optics, Inc. (USA); Wei-Cheng Lai, The Univ. of Texas at Austin (USA); Xiaolong A. Wang, Omega Optics, Inc. (USA); Cheyun Lin, Ray T. Chen, The Univ. of Texas at Austin (USA) . . . . . [8032-21]

A compact and portable IR analyzer: progress of a MOEMS FT-IR system for MIR sensing, Andreas Kenda, Martin Lenzhofer, Martin Kraft, Carinthian Tech Research AG (Austria); Stephan Luettjohann, Bruker Optik GmbH (Germany); Thilo Sandner, Fraunhofer-Institut für Photonische Mikrosysteme (Germany) . [8032-22]

Portable coherent frequency domain terahertz spectrometer, Joseph R. Demers, Ronald T. Logan, Jr., Bryon L. Kasper, EMCORE Corp. (USA) . [8032-23]

Compact remote Raman and LIBS system for detection of minerals, water, ices, and atmospheric gases for planetary exploration, Anupam K. Misra, Shiv K. Sharma, Tayro E. Acosta, David E. Bates, Univ. of Hawai'i (USA) [8032-24]

Combination optical and mass spectrometric technologies for detection of chemical and biological threats to the food supply, Robert A. Lodder, Univ. of Kentucky (USA) . . . . . [8032-25]

Lunch/Exhibition Break . . . . . 12:00 to 1:30 pm

SESSION 6 . . . . . Tues. 1:30 to 3:10 pm

Novel Spectrometers II

Session Chair: **Mark A. Druy,** Physical Sciences Inc.

Real-time smart fluorescence sensor platform, Mike Ponstingl, Custom Sensors & Technology (USA) . . . . . [8032-26]

TerraSpec real-time mineral analysis for economic mineral deposit exploration, Brian Curtiss, ASD, Inc. (USA) . . . . . [8032-27]

Sensing of FWHM and peak wavelength for LEDs via a low-cost filter-based spectrum sensor and PSO optimization, Cheng-Chun Chang, Chien-Chou Chen, Nan-Ting Lin, National Taipei Univ. of Technology (Taiwan); Umpei Kurokawa, Byung Il Choi, nanoLambda (USA) . . . . . [8032-28]

A compact, fast, wide-field imaging spectrometer system, Pantazis Mouroulis, Byron van Gorp, Jet Propulsion Lab. (USA); Martin Feldman, Louisiana State Univ. (USA) . . . . . [8032-29]

High-speed resonant FTIR spectrometer, Julia Rentz Dupuis, David L. Carlson, David J. Mansur, Thomas Evans, Robert M. Vaillancourt, James R. Engel, OPTRA, Inc. (USA); Bradley B. Engel, Nelson Air Corp. (USA) . . . . . [8032-30]

SESSION 7 . . . . . Tues. 3:40 to 5:20 pm

Imaging and Chemometrics

Session Chair: **Richard A. Crocombe,** Thermo Fisher Scientific Inc.

Compact high-resolution VIS/NIR hyperspectral sensor, Timo Hyvärinen, Esko Herrala, Specim Spectral Imaging Ltd. (Finland). . . . . [8032-31]

Advances in hyperspectral LWIR pushbroom imagers, Hannu Holma, Antti-Jussi Mattila, Timo Hyvärinen, Specim Spectral Imaging Ltd. (Finland) . . [8032-32]

Near-infrared imaging spectroscopy for counterfeit drug detection, Thomas Arnold, Martin De Biasio, Raimund Leitner, CTR Carinthian Tech Research AG (Austria) . . . . . [8032-33]

Advanced algorithms for the identification of mixtures using condensed-phase FT-IR spectroscopy, Josep Arnó, Greger Andersson, Dustin Levy, Carol A. Tomczyk, Peng Zou, Eric Zuidema, Smiths Detection (USA) . . . . . [8032-34]

Development of simple algorithm for direct and rapid determination of cotton maturity from FT-IR spectroscopy, Yongliang Liu, Gary R. Gamble, Devron P. Thibodeaux, Agricultural Research Service (USA) . . . . . [8032-35]

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Advanced Photon Counting Techniques V

Conference Chairs: **Mark A. Itzler,** Princeton Lightwave, Inc.; **Joe C. Campbell,** Univ. of Virginia

Program Committee: **Gerald S. Buller,** Heriot-Watt Univ. (United Kingdom); **Sergio Cova,** Politecnico di Milano (Italy); **William H. Farr,** Jet Propulsion Lab.; **Robert H. Hadfield,** Heriot-Watt Univ. (United Kingdom); **Majeed M. Hayat,** The Univ. of New Mexico; **Michael A. Krainak,** NASA Goddard Space Flight Ctr.; **Robert A. Lamb,** SELEX Galileo Ltd. (United Kingdom); **Alan L. Migdall,** National Institute of Standards and Technology; **Simon Verghese,** MIT Lincoln Lab.; **Michael Wahl,** PicoQuant GmbH (Germany); **Hugo Zbinden,** Univ. of Geneva (Switzerland)

Wednesday 27 April

SESSION 1 . . . . . Wed. 8:00 to 10:10 am

SPADs I: Si-based SPADs

Session Chair: **Mark A. Itzler,** Princeton Lightwave, Inc.

Improving the performance of silicon single-photon avalanche diodes *(Invited Paper)*, Angelo Gulinatti, Ivan Rech, Politecnico di Milano (Italy); Piera Maccagnani, Consiglio Nazionale delle Ricerche (Italy); Massimo Ghioni, Sergio Cova, Politecnico di Milano (Italy) and Micro Photon Devices S.r.l. (Italy) [8033-01]

Tau-SPAD: a new red sensitive single-photon counting module, Gerald Kell, Fachhochschule Brandenburg (Germany); Andreas Buelter, Michael Wahl, Rainer Erdmann, PicoQuant GmbH (Germany) . . . . . [8033-02]

Characterization of commercial single-photon counting modules in operational mode, Thiago Ferreira da Silva, Inmetro (Brazil) and Pontifícia Univ. Católica do Rio de Janeiro (Brazil); Guilherme B. Xavier, Jean Pierre von der Weid, Pontifícia Univ. Católica do Rio de Janeiro (Brazil) . . . . . [8033-03]

Characterization of photon-counting detector responsivity for nonlinear two-photon absorption process, Suzana E. Sburlan, William H. Farr, Jet Propulsion Lab. (USA) . . . . . [8033-04]

Frequency up-conversion single-photon detectors for quantum communication systems, Lijun Ma, Oliver T. Slattery, Xiao Tang, National Institute of Standards and Technology (USA) . . . . . [8033-05]

Geiger-mode operation of Ge on Si avalanche photodiodes, Zhiwen Lu, Univ. of Virginia (USA); Yimin Kang, Intel Corp. (USA); Joe C. Campbell, Univ. of Virginia (USA) . . . . . [8033-06]

SESSION 2 . . . . . Wed. 10:40 am to 12:20 pm

SPADs II: Arrays

Session Chair: **Gerald S. Buller,** Heriot-Watt Univ. (United Kingdom)

CMOS SPAD: from fundamentals to single-photon imaging and applications *(Invited Paper)*, Edoardo Charbon, Matthew W. Fishburn, Yuki Maruyama, Technische Univ. Delft (Netherlands) . . . . . [8033-07]

MEGAFRAME: a fully integrated, time-resolved 160×128 SPAD pixel array with microconcentrators, Jochen Arlt, Univ. of Edinburgh (United Kingdom); Fausto Borghetti, Smart Optical Sensors and Interfaces (Italy); Claudio E. Bruschini, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Edoardo Charbon, Technische Univ. Delft (Netherlands); David T. F. Dryden, Univ. of Edinburgh (United Kingdom); Steve East, STMicroelectronics (R&D) Ltd. (United Kingdom); Matthew W. Fishburn, Technische Univ. Delft (Netherlands); Marek Gersbach, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Gerard Giraud, Univ. of Edinburgh (United Kingdom); Lindsay A. Grant, STMicroelectronics (R&D) Ltd. (United Kingdom); Robert K. Henderson, David U. Li, Univ. of Edinburgh (United Kingdom); Yuki Maruyama, Technische Univ. Delft (Netherlands); Justin A. Richardson, Univ. of Edinburgh (United Kingdom); David Stoppa, Fondazione Bruno Kessler (Italy); David Tyndall, Univ. of Edinburgh (United Kingdom); Chockalingam Veerappan, Technische Univ. Delft (Netherlands); Richard Walker, Univ. of Edinburgh (United Kingdom) . . . [8033-08]

Smart-pixel for 3D ranging imagers based on single-photon avalanche diode and time-to-digital converter, Bojan Markovic, Politecnico di Milano (Italy); Simone Tisa, Micro Photon Devices S.r.l. (Italy); Alberto Tosi, Franco Zappa, Politecnico di Milano (Italy) . . . . . [8033-09]

Scaling trends of single-photon avalanche diode arrays in nanometer CMOS technology *(Invited Paper)*, Justin A. Richardson, SELEX Galileo Ltd. (United Kingdom); Eric A. G. Webster, The Univ. of Edinburgh (United Kingdom); Lindsay A. Grant, STMicroelectronics (R&D) Ltd. (United Kingdom); Robert K. Henderson, The Univ. of Edinburgh (United Kingdom). . . . . [8033-10]

Lunch/Exhibition Break . . . . . 12:20 to 1:30 pm

SESSION 3 . . . . . Wed. 1:30 to 3:30 pm

SPADs III: Arrays

Session Chair: **Robert A. Lamb,** SELEX Galileo Ltd. (United Kingdom)

Resonant cavity silicon GPD arrays *(Invited Paper)*, Stefan A. Vasile, aPeak, Inc. (USA); M. Selim Unlu, Boston Univ. (USA) . . . . . [8033-11]

MBE back-illuminated silicon Geiger-mode avalanche photodiodes for enhanced ultra-violet response, Daniel R. Schuette, Brian F. Aull, Richard C. Westhoff, Joseph S. Ciampi, Gayatri E. Perlin, Douglas J. Young, David C. Shaver, MIT Lincoln Lab. (USA) . . . . . [8033-12]

Techniques for improved performances of direct-detection three-dimensional imaging laser radar system using Geiger-mode avalanche photodiode *(Invited Paper)*, Min Seok Oh, KAIST (Korea, Republic of) and Samsung Electronics (Korea, Republic of); Hong Jin Kong, Tae Hoon Kim, Sung Eun Jo, KAIST (Korea, Republic of). . . . . [8033-13]

Design considerations for high-altitude altimetry and lidar systems incorporating single-photon avalanche diode detectors, Philip A. Hiskett, Brian Howie, Peter Sinclair, Mark D. Hartree, James Henderson, Robert A. Lamb, SELEX Galileo Ltd. (United Kingdom) . . . . . [8033-14]

Geiger-mode avalanche photodiode focal plane arrays for 3D imaging ladar, Mark A. Itzler, Mark Entwistle, Mark Owens, Xudong Jiang, Ketan M. Patel, Krystyna Slomkowski, Sabbir S. Rangwala, Princeton Lightwave, Inc. (USA); Peter Zalud, Tom Senko, John R. Tower, Joseph Ferraro, Sarnoff Corp. (USA) [8033-15]

SESSION 4 . . . . . Wed. 4:00 to 6:00 pm

SPADs IV: Circuits and Integration

Session Chair: **Joe C. Campbell,** Univ. of Virginia

Compact eight-channel SPAD module for photon timing applications, Corrado Cammi, Angelo Gulinatti, Ivan Rech, Francesco Panzeri, Massimo Ghioni, Politecnico di Milano (Italy) . . . . . [8033-16]

Efficient photon number detection with silicon avalanche photodiodes, Oliver Thomas, Zhiliang L. Yuan, James F. Dynes, Andrew W. Sharpe, Andrew J. Shields, Toshiba Research Europe Ltd. (United Kingdom) . . . . . [8033-17]

A technique to measure afterpulse probabilities in InGaAs SPADs at nanosecond time scales with sub-pico Coulomb avalanche charge, Alessandro Restelli, Joshua C. Bienfang, Alan L. Migdall, Charles W. Clark, National Institute of Standards and Technology (USA) and Joint Quantum Institute (USA) . . . . . [8033-18]

High-speed characterization of quantum systems in the near infrared, Christopher J. Healey, Xiaofan Mo, Chris Dascollas, Michael R. E. Lamont, Joshua A. Slater, Itzel Lucio Martinez, Philip Chan, Univ. of Calgary (Canada); Steve Hosier, Southern Alberta Institute of Technology (Canada); Wolfgang Tittel, Univ. of Calgary (Canada) . . . . . [8033-19]

InGaAs/InP negative feedback avalanche diodes (NFADs), Xudong Jiang, Mark A. Itzler, Kevin O'Donnell, Mark Entwistle, Krystyna Slomkowski, Princeton Lightwave, Inc. (USA) . . . . . [8033-20]

Active hold-off characterization of negative avalanche feedback single-photon detectors, William H. Farr, Jet Propulsion Lab. (USA) . . . . . [8033-21]

Thursday 28 April

SESSION 5 . . . . . Thurs. 8:00 to 10:20 am

Analog Semiconductor SPDs

Session Chair: **Joe C. Campbell,** Univ. of Virginia

HgCdTe APD-based linear-mode photon counting components and ladar receivers *(Invited Paper)*, Michael D. Jack, Raytheon Co. (USA) . . . . . [8033-22]

Linear-mode photon counting with the noiseless gain HgCdTe e-APD *(Invited Paper)*, Jeffrey D. Beck, Richard Scritchfield, DRS RSTA, Inc. (USA); William Sullivan III, Texas Tech Univ. (USA); Pradip Mitra, DRS RSTA, Inc. (USA); Robert J. Martin, Analog/Digital Integrated Circuits, Inc. (USA); Robert Strittmatter, Currant Innovations (USA); Anthony D. Gleckler, GEOST, Inc. (USA) . . . . . [8033-23]

Application of an end-to-end linear mode photon-counting (LMPC) model to noiseless-gain HgCdTe APDs, Anthony D. Gleckler, Robert Strittmatter, GEOST, Inc. (USA); Jeffrey D. Beck, DRS Sensors & Targeting Systems, Inc. (USA) . . . . . [8033-24]

New developments in nano-injection-based imagers *(Invited Paper)*, Hooman Mohseni, Northwestern Univ. (USA) . . . . . [8033-25]

Opportunities for single-photon detection using visible light photon counters *(Invited Paper)*, Jungsang Kim, Duke Univ. (USA) . . . . . [8033-26]

SESSION 6 . . . . . Thurs. 10:50 to 11:20 am

Solid State PMT

Session Chair: **William H. Farr,** Jet Propulsion Lab.

CMOS solid state photomultipliers for ultra-low light levels *(Invited Paper)*, Erik B. Johnson, Christopher J. Stapels, Xaio-Jie Chen, Chad Whitney, Eric C. Chapman, Guy Alberghini, Radiation Monitoring Devices, Inc. (USA); Frank Augustine, Augustine Engineering (USA); James F. Christian, Radiation Monitoring Devices, Inc. (USA) . . . . . [8033-27]

SESSION 7 . . . . . Thurs. 11:20 am to 12:20 pm

Photocathode-based SPDs I

Session Chair: **William H. Farr,** Jet Propulsion Lab.

High-performance HPD for photon counting *(Invited Paper)*, Atsuhito Fukasawa, Akifumi Kamiya, Shinichi Muramatsu, Yasuharu Negi, Motohiro Suyama, Hamamatsu Photonics K.K. (Japan) . . . . . [8033-28]

Multichannel intensified photodiode at near infrared *(Invited Paper)*, Verle W. Aebi, Derek F. Sykora, Michael J. Jurkovic, Kenneth A. Costello, Intevac Photonics, Inc. (USA) . . . . . [8033-29]

Lunch/Exhibition Break . . . . . 12:20 to 1:30 pm

SESSION 8 . . . . . Thurs. 1:30 to 2:20 pm

Photocathode-based SPDs II

Session Chair: **William H. Farr,** Jet Propulsion Lab.

Development of large area fast microchannel plate photo-detectors from Argonne National Laboratory *(Invited Paper)*, Karen Byrum, Argonne National Lab. (USA) . . . . . [8033-30]

Microchannel plate imaging photon counters for ultraviolet through NIR detection with high time resolution, Oswald H. Siegmund, John V. Vallerga, Anton S. Tremsin, Jason B. McPhate, Univ. of California, Berkeley (USA)[8033-31]

SESSION 9 . . . . . Thurs. 2:20 to 5:50 pm

Superconducting SPDs

Session Chair: **Robert H. Hadfield,** Heriot-Watt Univ. (United Kingdom)

Fast superconducting IR single-photon detectors with a microwave reflectometry readout *(Invited Paper)*, Daniel F. Santavicca, Yale Univ. (USA); Boris S. Karasik, Jet Propulsion Lab. (USA); Bertrand M. Reulet, Univ. de Sherbrooke (Canada); Faustin W. Carter, Luigi Frunzio, Daniel E. Prober, Yale Univ. (USA) . . . . . [8033-32]

Photon-number resolving transition edge sensors and superconducting nanowire single-photon detectors for optical Schrödinger cat state generation *(Invited Paper)*, Thomas Gerrits, National Institute of Standards and Technology (USA) . . . . . [8033-33]

Thermal excitation of vortices in superconducting nanowires for detection of infrared photons *(Invited Paper)*, Alexey D. Semenov, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [8033-34]

Performance and yield of large-area superconducting nanowire single-photon detectors *(Invited Paper)*, Vikas Anant, Photon Spot Inc. (USA) and Massachusetts Institute of Technology (USA) . . . . . [8033-35]

Developments in efficiency, timing, and implementations of superconducting nanowire single-photon detectors *(Invited Paper)*, Michael G. Tanner, John A. O'Connor, Chandra M. Natarajan, Robert H. Hadfield, Heriot-Watt Univ. (United Kingdom) . . . . . [8033-36]

Putting superconducting nanowire detectors to use *(Invited Paper)*, Valery Zwiller, Sander N. Dorenbos, Esteban Bermudez-Urena, Reinier Heeres, Maaike Witteveen, Hatim Azzouz, P. Forndiaz, Tomoko Fuse, Tony Zijlstra, Teun Klapwijk, Technische Univ. Delft (Netherlands) . . . . . [8033-37]

Friday 29 April

SESSION 10 . . . . . Fri. 8:10 to 9:00 am

Single-Photon Sources

Session Chair: **Michael Wahl,** PicoQuant GmbH (Germany)

Single-photon emission from artificial atoms in diamond *(Invited Paper)*, Helmut Fedder, Fedor Jelezko, Jörg Wrachtrup, Univ. Stuttgart (Germany) . . . . . [8033-38]

Efficient narrow-band PDC source for quantum interfaces, Sergey V. Polyakov, Andreas Muller, Alex Ling, Natalia Borjemscaia, Edward B. Flagg, Alan L. Migdall, Glenn S. Solomon, National Institute of Standards and Technology (USA) . . . . . [8033-39]

SESSION 11 . . . . . Fri. 9:00 to 10:10 am

Photon Counting Applications I

Session Chair: **Michael Wahl,** PicoQuant GmbH (Germany)

Quantum information with photon-number-resolved measurements of continuous-wave quantum sources *(Invited Paper)*, Olivier Pfister, Univ. of Virginia (USA) . . . . . [8033-40]

Improved correlation determination for intensity correlation interferometers, Phan D. Dao, Patrick J. McNicholl, Air Force Research Lab. (USA) . . . . . [8033-41]

Photon correlation spectroscopy in ophthalmology, Luigi L. Rovati, Univ. degli Studi di Modena e Reggio Emilia (Italy) . . . . . [8033-42]

SESSION 12 . . . . . Fri. 10:40 am to 12:00 pm

Photon Counting Applications II

Session Chair: **Mark A. Itzler,** Princeton Lightwave, Inc.

A SPAD-based hybrid system for time-gated fluorescence measurements *(Invited Paper)*, Alberto Gola, Lucio Pancheri, Claudio Piemonte, David Stoppa, Fondazione Bruno Kessler (Italy) . . . . . [8033-43]

New photon-counting detectors for single-molecule fluorescence spectroscopy and imaging *(Invited Paper)*, Xavier Michalet, Ryan A. Colyer, Giuseppe Scalia, Shimon Weiss, Univ. of California, Los Angeles (USA); Oswald H. Siegmund, Anton S. Tremsin, John V. Vallerga, Univ. of California, Berkeley (USA); Federica A. Villa, Fabrizio Guerrieri, Ivan Rech, Simone Tisa, Angelo Gulinatti, Franco Zappa, Massimo Ghioni, Sergio Cova, Politecnico di Milano (Italy) . . . . . [8033-44]

Single-photon detectors for ultra-low-voltage time-resolved emission measurements of VLSI circuits, Franco Stellari, Peilin Song, Alan J. Weger, IBM Thomas J. Watson Research Ctr. (USA) . . . . . [8033-45]

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Photonic Microdevices/Microstructures for Sensing III

Conference Chairs: **Hai Xiao,** Missouri Univ. of Science and Technology; **Xudong Fan,** Univ. of Michigan; **Anbo Wang,** Virginia Polytechnic Institute and State Univ.

Program Committee: **Hatice Altug,** Boston Univ.; **Junhang Dong,** Univ. of Cincinnati; **Henry H. Du,** Stevens Institute of Technology; **Erica Forzani,** Arizona State Univ.; **Bai-Ou Guan,** Jinan Univ. (China); **Susan M. Maley,** U.S. Dept. of Energy; **Radislav A. Potyrailo,** GE Global Research; **Venkataraman S. Swaminathan,** U.S. Army Armament Research, Development and Engineering Ctr.; **Wei Jin,** The Hong Kong Polytechnic Univ. (Hong Kong, China); **Ian M. White,** Univ. of Maryland, College Park; **Yibing Zhang,** ExxonMobil Research and Engineering Co.; **Mohammed M. Zourob,** Biophage Pharma Inc. (Canada)

Wednesday 27 April

SESSION 1 . . . . . Wed. 1:00 to 3:20 pm

Microphotonic Biosensors

Session Chairs: **Xudong Fan,** Univ. of Michigan; **Hai Xiao,** Missouri Univ. of Science and Technology

Photonic crystal microarray nanopatform for high-throughput detection of biomolecules for diagnostic assays, Swapnajit Chakravarty, Omega Optics, Inc. (USA); Wei-Cheng Lai, The Univ. of Texas at Austin (USA); Xiaolong A. Wang, Omega Optics, Inc. (USA); Cheyun Lin, Ray T. Chen, The Univ. of Texas at Austin (USA) . . . . . [8034-01]

Identification of biological agents using surface-enhanced Raman scattering *(Invited Paper)*, Tracy L. Paxon, Frank J. Mondello, R. Scott Duthie, Casey Renko, Andrew A. Burns, GE Global Research (USA); Marie Lesaicherre, Morpho Detection (USA) . . . . . [8034-02]

A new generation of mid-infrared sensors based on quantum cascade laser *(Invited Paper)*, Hooman Mohseni, Northwestern Univ. (USA) . . . . . [8034-03]

Immobilization of aptamers onto unmodified glass surfaces for affordable biosensors, Rui Chen, Cheryl Surman, Radislav A. Potyrailo, Andrew Pris, GE Global Research (USA); Eric A. Holwit, Veronica K. Sorola, Johnathan L. Kiel, Air Force Research Lab. (USA) . . . . . [8034-04]

Integrated photonic structures for parallel fluorescence and refractive index biosensing, Meredith M. Lee, Thomas D. O'Sullivan, Antonio Cerruto, Victor Liu, Stanford Univ. (USA); Jingyu Zhang, The Univ. of New Mexico (USA); Ofer Levi, Univ. of Toronto (Canada); Heon Lee, Korea Univ. (Korea, Republic of); Steven R. J. Brueck, The Univ. of New Mexico (USA); Shanhui Fan, James S. Harris, Stanford Univ. (USA) . . . . . [8034-05]

SESSION 2 . . . . . Wed. 3:50 to 5:30 pm

New and Enabling Microphotonic Devices and Sensors I

Session Chair: **Bai-Ou Guan,** Jinan Univ. (China)

Fiber-optic intrinsic Fabry-Perot interferometric sensors fabricated by femtosecond lasers *(Invited Paper)*, Tingyun Wang, Shanghai Univ. (China) . . . . . [8034-06]

Micro-structured sapphire fiber sensor for measurement of high-temperature in harsh environments, Xia Fang, Tao Wei, Yukun Han, Baokai Cheng, Xinwei Lan, Hai Xiao, Missouri Univ. of Science and Technology (USA) . . . . . [8034-07]

Thinned fiber Bragg grating magnetic field sensor with nano-magnetic fluid, Ciming Zhou, Li Ding, Dongli Wang, Desheng Jiang, Wuhan Univ. of Technology (China) . . . . . [8034-08]

ZnO nanowires for high-sensitivity ultraviolet photonic detectors integrated on CMOS, Robert Olah, Achyut Dutta, Banpil Photonics, Inc. (USA); Deli Wang, Tariq Manzur, ... [8034-09]

Thursday 28 April

SESSION 3 . . . . . Thurs. 8:00 to 10:00 am

Microphotonic Chemical Sensors

Session Chairs: **Hai Xiao,** Missouri Univ. of Science and Technology; **Xudong Fan,** Univ. of Michigan

Passive infrared sensing using plasmonic resonant dust particles, Mark S. Mirotznik, Univ. of Delaware (USA); William A. Beck, Kimberly Olver, John W. Little, U.S. Army Research Lab. (USA) . . . . . [8034-10]

Lithography free fabrication of high-aspect-ratio silver-coated silicon nanopillars as Raman-enhancing substrates for explosives detection, Michael S. Schmidt, Jörg Hübner, Anja Boisen, Technical Univ. of Denmark (Denmark) . . . . . [8034-11]

On-chip plasmonic systems for ultrasensitive nanospectroscopy *(Invited Paper)*, Hatice Altug, Ahmet A. Yanik, Ronen Adato, Serap Aksu, Arif E. Cetin, Alp Artar, Mustafa Turkmen, Boston Univ. (USA) . . . . . [8034-12]

Ultra-fast and ultra-sensitive 2,4-dinitrotoluene vapor sensing using gold nanoparticle assembled SERS probes, Maung Kyaw Khaing Oo, Chia-Fang Chang, Xudong Fan, Univ. of Michigan (USA) . . . . . [8034-13]

Toward development of nanostructured-integrated optical waveguide sensors with tunable dual-output capacity, Mustafa M. Aslan, TÜBITAK Marmara Research Ctr. (Turkey) and Univ. of Louisville (USA); Sergio B. Mendes, Univ. of Louisville (USA); Kerim Allakhverdiev, TÜBITAK Marmara Research Ctr. (Turkey) and Institute of Physics ANAS (Azerbaijan); Tarik Baykara, TÜBITAK Marmara Research Ctr. (Turkey) . . . . . [8034-14]

SESSION 4 . . . . . Thurs. 10:30 am to 12:10 pm

New and Enabling Microphotonic Devices and Sensors II

Session Chairs: **Anbo Wang,** Virginia Polytechnic Institute and State Univ.; **Hai Xiao,** Missouri Univ. of Science and Technology

Fully distributed fiber-optic sensing based on acoustically induced long-period grating *(Invited Paper)*, Dorothy Y. Wang, Virginia Polytechnic Institute and State Univ. (USA) . . . . . [8034-15]

Polarimetric heterodyning fiber grating laser sensors *(Invited Paper)*, Bai-Ou Guan, Jinan Univ. (China) . . . . . [8034-16]

U-shaped nano-apertures for enhanced optical transmission and resolution, Mustafa Turkmen, Boston Univ. (USA) and Erciyes Univ. (Turkey); Serap Aksu, Arif E. Cetin, Alp Artar, Ahmet A. Yanik, Hatice Altug, Boston Univ. (USA). . . [8034-17]

Lunch/Exhibition Break . . . . . 12:10 to 1:40 pm

SESSION 5 . . . . . Thurs. 1:40 to 3:20 pm

New and Enabling Microphotonic Devices and Sensors III

Session Chairs: **Bai-Ou Guan,** Jinan Univ. (China); **Yibing Zhang,** ExxonMobil Research and Engineering Co.

Nanoscale optics with negative metamaterials *(Invited Paper)*, Srinivas Sridhar, Northeastern Univ. (USA) . . . . . [8034-18]

High-sensitivity temperature sensing by employing an on-chip high-Q PDMS-coated toroidal microcavity, Bei-Bei Li, Xue-Feng Jiang, Qihuang Gong, Yunfeng Xiao, Peking Univ. (China). . . . . [8034-19]

Resonant cavity enhancement of polycrystalline PbTe films for IR detectors on Si-ROICs, Timothy W. C. Zens, Massachusetts Institute of Technology (USA) and U.S. Air Force (USA); Jianfei Wang, Piotr Becla, Anuradha M. Agarwal, Lionel C. Kimerling, Massachusetts Institute of Technology (USA) . . . . . [8034-20]

Frequency tunable nonlinear-optical negative-index metamirror for sensing applications, Alexander K. Popov, Univ. of Wisconsin-Stevens Point (USA) . . . . . [8034-21]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Fiber Bragg grating high-current sensor based on magnetic coupling, Ciming Zhou, Dongli Wang, Wenju Zhang, Lin Wu, Yuan Yao, Wuhan Univ. of Technology (China) . . . . . [8034-22]

Monday-Thursday 25-28 April 2011 • Proceedings of SPIE Vol. 8035

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Energy Harvesting and Storage: Materials, Devices, and Applications II

Conference Chairs: **Nibir K. Dhar,** Defense Advanced Research Projects Agency/Microelectronics Technology Office; **Priyalal S. Wijewarnasuriya,** U.S. Army Research Lab.; **Achyut K. Dutta,** Banpil Photonics, Inc.

Program Committee: **Pulickel M. Ajayan,** Rice Univ.; **Palani Balaya,** National Univ. of Singapore (Singapore); **Fow-Sen Choa,** Univ. of Maryland, Baltimore County; **Deryn Chu,** U.S. Army Research Lab.; **Angelo S. Gilmore,** EPIR Technologies, Inc.; **M. Saif Islam,** Univ. of California, Davis; **Ahalapitiya H. Jayatissa,** The Univ. of Toledo; **Nobuhiko P. Kobayashi,** Univ. of California, Santa Cruz; **Pat McGrath,** Booz Allen Hamilton Inc.; **Robert Olah,** Banpil Photonics, Inc.; **Unil A. Perera,** Georgia State Univ.; **A. Fred Semendy,** U.S. Army Research Lab.; **Ashok K. Sood,** Magnolia Optical Technologies, Inc.; **Rao Surampudi,** Jet Propulsion Lab.; **Patrick J. Taylor,** U.S. Army Research Lab.; **Sudhir B. Trivedi,** Brimrose Corp. of America; **Rama Venkatasubramanian,** RTI International; **Chunlei Wang,** Florida International Univ.

Monday 25 April

OPENING REMARKS. . . . . Mon. 8:15 to 8:20 am

Session Chair: **Nibir K. Dhar,**
Defense Advanced Research Projects Agency

SESSION 1 . . . . . Mon. 8:20 to 10:05 am

Advanced Lithium Batteries: Electrodes I

Session Chairs: **Nibir K. Dhar,** Defense Advanced Research Projects Agency; **Achyut Dutta,** Banpil Photonics, Inc.

Emergence of power and energy as a driver in the modern army *(Keynote Presentation)*, John M. Pellegrino, U.S. Army Research Lab. (USA) . . . . . [8035-01]

Mesoporous electrode materials for lithium battery applications *(Invited Paper)*, Palani Balaya, National Univ. of Singapore (Singapore). . [8035-02]

Search for greener Li-ion batteries: an alternative offered by organic electroactive materials *(Invited Paper)*, Franck Dolhem, Philippe Poizot, Univ. de Picardie Jules Verne (France) . . . . . [8035-03]

Sustainable nanostructured materials for energy storage *(Invited Paper)*, Jaephil Cho, Ulsan National Institute of Science and Technology (Korea, Democratic Peoples Republic of) . . . . . [8035-04]

SESSION 2 . . . . . Mon. 10:35 to 11:55 am

Advanced Lithium Batteries: Electrodes II

Session Chairs: **Palani Balaya,** National Univ. of Singapore (Singapore); **Chunlei Wang,** Florida International Univ.

Recent advances in nanocrystalline intermetallic tin compounds for the negative electrode of lithium ion batteries *(Invited Paper)*, Jose L. Tirado, Ricardo Alcantara, Uche Nwokeke, Francisco Nacimiento, Pedro Lavela, Univ. de Córdoba (Spain) . . . . . [8035-05]

Green energy storage materials: advanced nanostructured materials for lithium-ion batteries *(Invited Paper)*, Sagar Mitra, Indian Institute of Technology Bombay (India) . . . . . [8035-06]

Micro- and nanostructural design approaches for improved Li-ion batteries *(Invited Paper)*, Shen J. Dillon, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [8035-07]

Computational design of high-performance lithium ion battery cathodes *(Invited Paper)*, Stefan N. Adams, R. Prasada Rao, National Univ. of Singapore (Singapore) . . . . . [8035-08]

Lunch Break . . . . . 11:55 am to 1:15 pm

SESSION 3 . . . . . Mon. 1:15 to 3:10 pm

Advanced Lithium Batteries: Electrolites

Session Chairs: **Chunlei Wang,** Florida International Univ.; **Palani Balaya,** National Univ. of Singapore (Singapore)

Battery technologies for DOD applications: present and future *(Invited Paper)*, Deanna Y. Tyler, U.S. Army Research, Development and Engineering Command (USA); Christopher H. Hurley, U.S. Army CERDEC Intelligence and Information Warfare Directorate (USA) . . . . . [8035-09]

Enabling organosilicon-based electrolytes for lithium ion batteries *(Invited Paper)*, Zhengcheng Zhang, Argonne National Lab. (USA). . . . . [8035-10]

Soft matter electrolytes for Li-ion batteries *(Invited Paper)*, Aninda J. Bhattacharyya, Indian Institute of Science, Bangalore (India). . . . . [8035-11]

All solid state rechargeable lithium batteries with three-dimensionally ordered macroporous ceramic electrolyte *(Invited Paper)*, Kiyoshi Kanamura, Ryo Osone, Hirokazu Munakata, Tokyo Metropolitan Univ. (Japan) . . . . [8035-12]

An external sensor for instantaneous measurement of the internal temperature in lithium-ion rechargeable cells, Rengaswamy Srinivasan, Bliss G. Carkhuff, Michael E. Butler, A. Carson Baisden, The Johns Hopkins Univ. Applied Physics Lab. (USA). . . . . [8035-13]

All-solid-state thin film microbatteries fabricated by rf sputtering *(Invited Paper)*, Li Lu, National Univ. of Singapore (Singapore) . . . . . [8035-14]

SESSION 4 . . . . . Mon. 3:40 to 5:15 pm

Advanced Capacitors Technology

Session Chairs: **Palani Balaya,** National Univ. of Singapore (Singapore); **Minato Egashira,** Yamaguchi Univ. (Japan)

Pseudo-capacitive reactions based on imidazolium ion *(Invited Paper)*, Minato Egashira, Tomoyo Tanaka, Yuki Matsuno, Nobuko Yoshimoto, Masayuki Morita, Yamaguchi Univ. (Japan). . . . . [8035-15]

Advances in solid polymer electrochemical capacitors and hybrid energy systems *(Invited Paper)*, Keryn K. Lian, Univ. of Toronto (Canada) . . . . . [8035-16]

Carbon nanotube and 1-Ethyl-3methylimidazolium tetrafluoroborate-based electrochemical double layer capacitors *(Invited Paper)*, W. Jud Ready, Georgia Tech Research Institute (USA). . . . . [8035-17]

In-situ preparation of PEDOT/V_2O_5 nanocomposite and its synergism for enhanced capacitive behavior, P. Ragupathy, H. N. Vasan, N. Munichandraiah, N. Vasanthacharya, Indian Institute of Science (India) . . . . . [8035-18]

Design, fabrication, and evaluation of on-chip microsupercapacitors *(Invited Paper)*, Majid Beidaghi, Chunlei Wang, Florida International Univ. (USA) . . . . . [8035-19]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 5 . . . . . Tues. 10:00 am to 12:10 pm

Photovoltaic Cells and Related Technologies

Session Chairs: **Nibir K. Dhar,** Defense Advanced Research Projects Agency; **Achyut Dutta,** Banpil Photonics, Inc.

Photovoltaic commercialization potential in the U.S. *(Keynote Presentation)*, Martha Symko-Davies, National Renewable Energy Lab. (USA) . . . . . [8035-20]

Simulation of novel energy harvesting devices, Vijay Parameshwaran, Robert Olah, Achyut Dutta, Banpil Photonics, Inc. (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA). . . . . [8035-21]

Nanoscale engineering: optimized electron-hole kinetics of quantum dot solar cells, Kimberly A. Sablon, U.S. Army Research Lab. (USA) . . . . . [8035-22]

Low-cost, chemical-etched black silicon solar cells, Hao-Chih Yuan, Alan C. Goodrich, Jihun Oh, Fatima Toor, Vernon E. Yost, Matthew R. Page, Howard M. Branz, National Renewable Energy Lab. (USA). . . . . [8035-23]

Nano-photocatalysts for solar fuels applications, Simona E. Hunyadi Murph, Savannah River National Lab. (USA). . . . . [8035-24]

Metal-black scattering centers to enhance light harvesting by thin film solar cells, Christopher J. Fredricksen, LRC Engineering Inc. (USA) and Univ. of Central Florida (USA); Robert E. Peale, Deep Panjwani, Univ. of Central Florida (USA); Isaiah Oladeji, SISOM Thin Films, LLC (USA); Kenneth M. Beck, Pacific Northwest National Lab. (USA); F. Khalilzadeh Rezaie, Univ. of Central Florida (USA) . . . . . [8035-25]

Fabrication of dye sensitized solar cells using sol-gel coated nanostructured metal oxide thin films, Ahalapitiya H. Jayatissa, The Univ. of Toledo (USA) . . . . . [8035-26]

Lunch/Exhibition Break. . . . . 12:10 to 1:30 am

SESSION 6 . . . . . Tues. 1:30 to 3:05 pm

Advanced Fuel Cells

Session Chair: **Palani Balaya,** National Univ. of Singapore (Singapore)

Embeddable miniature solid oxide fuel cells *(Invited Paper)*, Shriram Ramanathan, Harvard School of Engineering and Applied Sciences (USA) . . . . . [8035-27]

Interfacial effects on the ionic conductivity of thin film electrolytes for micro-solid oxide fuel cells (μ-SOFCs) *(Invited Paper)*, Enrico Traversa, National Institute for Materials Science (Japan) . . . . . [8035-28]

Development of reversible solid oxide fuel cell for power generation and hydrogen production *(Invited Paper)*, G. B. Jung, J. Y. Chen, S. H. Chan, Yuan Ze Univ. (Taiwan). . . . . [8035-29]

Advanced electro-ceramics: role of processing and structure *(Invited Paper)*, Avesh K. Tyagi, Bhabha Atomic Research Ctr. (India) . . . . . [8035-30]

Recent development of miniatured enzymatic biofuel cell, Yin Song, Florida International Univ. (USA) . . . . . [8035-31]

SESSION 7 . . . . . Tues. 3:35 to 5:15 pm

Advanced Harvesting Devices

Session Chairs: **Priyalal S. Wijewarnasuriya,** U.S. Army Research Lab.; **Achyut Dutta,** Banpil Photonics, Inc.

Multimodal vibration energy harvesting *(Invited Paper)*, Shashank Priya, Virginia Polytechnic Institute and State Univ. (USA) . . . . . [8035-32]

Perpetual harvesting device electronics, Robert Olah, Genki Mizuno, Achyut Dutta, Banpil Photonics, Inc. (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA) . . . . . [8035-33]

Development of MEMS-based pyroelectric thermal energy harvesters, Scott R. Hunter, Thirumalesh Bannuru, Oak Ridge National Lab. (USA); Salwa Mostafa, The Univ. of Tennessee (USA); Nickolay V. Lavrik, Slobodan Rajic, Panos G. C. Datskos, Oak Ridge National Lab. (USA) . . . . . [8035-34]

Innovative microbial fuel cell design for energy harvesting and corrosion protection, Chih-Chien Kung, Xiong Yu, Case Western Reserve Univ. (USA) . . . . . [8035-35]

Ultra-high transmittance through nanostructure-coated glass for solar cell applications, Roger E. Welser, Adam W. Sood, Magnolia Solar, Inc. (USA); Ashok K. Sood, Magnolia Optical Technologies, Inc. (USA); David J. Poxson, Sameer Chhajed, Jaehee Cho, E. Fred Schubert, Rensselaer Polytechnic Institute (USA); Dennis L. Polla, Defense Advanced Research Projects Agency (USA); Nibir K. Dhar, Defense Advanced Researech Projects Agency (USA) . . . . . [8035-36]

Challenges and opportunities in polycrystalline CdTe thin-film solar cells *(Invited Paper)*, Ramesh G. Dhere, David S. Albin, Joel Duenow, Timothy A. Gessert, National Renewable Energy Lab. (USA) . . . . . [8035-37]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Energy harvesting from mortar tube firing impulse to supplement fire-control electronics battery, Jahangir S. Rastegar, Richard T. Murray, Omnitek Partners, LLC (USA); Ralph Tillinghast, Carlos M. Pereira, Hai-Long Nguyen, U.S. Army Armament Research, Development and Engineering Ctr. (USA) . . . . . [8035-45]

Piezoelectric energy harvesting power sources for gun-fired munitions, Jahangir S. Rastegar, Richard T. Murray, Omnitek Partners, LLC (USA); Carlos M. Pereira, Hai-Long Nguyen, U.S. Army Armament Research, Development and Engineering Ctr. (USA). . . . . [8035-46]

Energy harvesting and self-sustainability of electronic devices for various types of energy, Tomasz P. Jannson, Thomas C. Forrester, Pedram Boghrat, Daniel M. Bock, Kevin Degrood, Andrew A. Kostrzewski, Kang S. Lee, Eric Gans, Kevin Walter, Physical Optics Corp. (USA) . . . . . [8035-47]

Design and optimization of a fiber-based luminescent solar concentrator, Esmaeil Banaei, Ayman F. Abouraddy, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8035-48]

Energy harvesting roads via pyroelectric effect: a possible approach, Ashok K. Batra, Sudip Bhatacharjee, Ashwith K. Chilvery, Alabama A&M Univ. (USA) . . . . . [8035-49]

Investigation on solution processed films for organic photovoltaic cells, Ashok K. Batra, Ashwith K. Chilvery, Padmaja Guggilla, M. D. Aggarwal, M. E. Edwards, Alabama A&M Univ. (USA). . . . . [8035-50]

Ligand-engineered optical performance of nanocrystal photovoltaics and photodetectors, George M. Williams, Jr., Voxtel, Inc. (USA). . . . . [8035-51]

Quantum well and quantum dot energy harvesting devices, Roger E. Welser, Magnolia Solar, Inc. (USA); Ashok K. Sood, Magnolia Optical Technologies, Inc. (USA); Oleg A. Laboutin, Kopin Corp. (USA); Louis J. Guido, Virginia Polytechnic Institute and State Univ. (USA); Nibir K. Dhar, Defense Advanced Researech Projects Agency (USA); Priyalal S. Wijewarnasuriya, U.S. Army Research Lab. (USA) . . . . . [8035-52]

A high-temperature acoustic-electric system for power delivery and data communication through thick metallic barriers, Tristan J. Lawry, Kyle R. Wilt, Sebastian Roa-Prada, Jon D. Ashdown, Gary J. Saulnier, Henry A. Scarton, Rensselaer Polytechnic Institute (USA); Pankaj K. Das, Univ. of California, San Diego (USA); Andrew J. Gavens, Knolls Atomic Power Lab. (USA) . . . . . [8035-53]

Wednesday 27 April

SESSION 8 . . . . . Wed. 9:05 to 11:40 am

Advanced Thermo-Electric Devices

Session Chairs: **Gary E. Bulman,** RTI International;
Patrick J. Taylor, U.S. Army Research Lab.

Wearable thermoelectric generators *(Invited Paper)*, Krishna Settaluri, Katey Lo, Rajeev J. Ram, Massachusetts Institute of Technology (USA) . . . . . [8035-38]

Progress in Bi_2Te_3-based superlattice thermoelectric materials *(Invited Paper)*, Gary E. Bulman, David Stokes, Rama Venkatasubramanian, RTI International (USA). . . . . [8035-39]

Isothermal method for rapid, steady-state measurement of thermoelectric materials and devices, Patrick J. Taylor, Jay R. Maddux, U.S. Army Research Lab. (USA); Sudhir B. Trivedi, Brimrose Corp. of America (USA) . . . . . [8035-40]

Thin film thermoelectric energy harvesting for security and sensing applications *(Invited Paper)*, David A. Koester, Nextreme Thermal Solutions, Inc. (USA) . . . . . [8035-41]

Demonstration of 15-mW electrical power using 2-cc thermoelectric generators with radioisotope heat, Nicholas G. Baldasaro, Rama Venkatasubramanian, David Stokes, John Posthill, Peter Thomas, Ryan Wiitala, RTI International (USA) . . . . . [8035-42]

Nanoparticle-based thin-film thermoelectric materials, George M. Williams, Jr., Voxtel, Inc. (USA). . . . . [8035-43]

High figure of merit bulk thermoelectric nanomaterials from directed synthesis and assembly of sculpted chalcogenide and oxide nanocrystals *(Invited Paper)*, Theo Borca-Tasciuc, Ganpati Ramanath, Rensselaer Polytechnic Institute (USA) . . . . . [8035-44]

Thursday 28 April

SESSION 9 . . . . . .Thurs. 8:00 am

Nanotechnologies for Energy Generation and Storage

Joint Session with conference 8031

Session Chairs: **Jeremy J. Pietron,** U.S. Naval Research Lab.;
Nezih Pala, Florida International Univ.

Thermoelectric energy conversion using nanostructured materials *(Invited Paper)*, Carl G. Chen, Andrew Muto, D. Kramer, Ken McEnaney, H.-P. Feng, Massachusetts Institute of Technology (USA); W. S. Liu, Q. Zhang, B. Yu, Zhifeng Ren, Boston College (USA) . . . . . [8031-54]

Engineering carbon nanomaterials for future applications: energy and sensor *(Invited Paper)*, Wonbong Choi, Florida International Univ. (USA) . . . . . [8031-55]

Developments in MEMS scale printable alkaline and Li-ion technology *(Invited Paper)*, Karl Littau, Corie L. Cobb, Palo Alto Research Center, Inc. (USA) . . . . . [8031-56]

Further studies in the electrochemical/mechanical strength of printed microbatteries *(Invited Paper)*, Daniel A. Steingart, The City College of New York (USA) . . . . . [8031-57]

Energy and size-scalable 3D battery architecutres *(Invited Paper)*, Jeffrey W. Long, U.S. Naval Research Lab. (USA). . . . . [8031-58]

Ultrathin, microscale epitaxial compound semiconductor solar cells *(Invited Paper)*, John A. Rogers, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [8031-59]

SESSION 10 . . . . . .Thurs. 10:30 am

Joint Session with conference 8031

Nanotechnologies for Energy Generation and Storage

Session Chairs: **Jeremy J. Pietron,** U.S. Naval Research Lab.;
Nezih Pala, Florida International Univ.

Little Robeep: miniature power sources for autonomous systems *(Invited Paper)*, Shriram Ramanathan, Harvard School of Engineering and Applied Sciences (USA) . . . . . [8031-60]

Self-powered nanosystems: nanogenerators, piezotronics, and piezo-phototronics *(Invited Paper)*, Zhong Lin Wang, Georgia Institute of Technology (USA) . . . . . [8031-61]

Nanotechnology enabled flexible energy harvesting *(Invited Paper)*, Michael C. McAlpine, Princeton Univ. (USA). . . . . [8031-62]

Scanning Microscopies 2011: Advanced Microscopy Technologies for Defense, Homeland Security, Forensic, Life, Environmental, and Industrial Sciences

Conference Chairs: **Michael T. Postek,** National Institute of Standards and Technology; **Dale E. Newbury,** National Institute of Standards and Technology; **S. Frank Platek,** U.S. Food and Drug Administration

Conference Co-Chairs: **David C. Joy,** The Univ. of Tennessee; **Tim K. Maugel,** Univ. of Maryland, College Park

Program Committee: **Eva M. Campo,** Ctr. Nacional de Microelectrónica (Spain); **Ronald G. Dixson,** National Institute of Standards and Technology; **Lucille A. Giannuzzi,** L.A. Giannuzzi & Associates LLC; **Brendan J. Griffin,** The Univ. of Western Australia (Australia); **Michael A. Trimpe,** Hamilton County Coroner's Lab.; **Vladimir A. Ukraintsev,** Nanometrology International, Inc.; **John S. Villarrubia,** National Institute of Standards and Technology; **András E. Vladár,** National Institute of Standards and Technology; **Oliver C. Wells,** IBM Corp.

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 1 . . . . . Tues. 10:00 to 11:00 am

Keynote Session

Session Chairs: **Michael T. Postek,** National Institute of Standards and Technology; **Dale E. Newbury,** National Institute of Standards and Technology; **S. Frank Platek,** U.S. Food and Drug Administration

Is scanning electron microscopy/energy dispersive x-ray microanalysis (SEM/EDS) quantitative? *(Invited Paper)*, Dale E. Newbury, Nicholas W. M. Ritchie, National Institute of Standards and Technology (USA) . . . . . [8036-01]

Scanning microscopies in forensic science: classic and new applications *(Invited Paper)*, S. Frank Platek, Mark R. Witkowski, Nicola Ranieri, John B. Crowe, Adam C. Lanzarotta, Douglas C. Albright, U.S. Food and Drug Administration (USA) . . . . . [8036-02]

SESSION 2 . . . . . Tues. 11:00 am to 12:40 pm

Forensics

Session Chairs: **S. Frank Platek,** U.S. Food and Drug Administration; **Michael A. Trimpe,** Hamilton County Coroner's Lab.

Analysis of particles produced during airbag deployment by SEM/EDS and their deposition on surrounding surfaces, J. Matney Wyatt, U.S. Army Criminal Investigation Lab. (USA) . . . . . [8036-18]

Probative value of gunshot residue on victims of shootings and comparison of gunshot residue results with modern technology versus older testing of samples, Robert S. White, West Virginia State Police, Retired (USA); William J. Mershon, Tescan USA Inc. (USA) . . . . . [8036-04]

Scientific working group on gunshot residue (SWGGSR): progress report, Michael A. Trimpe, Hamilton County Coroner's Lab. (USA) . . . . . [8036-05]

Characterization and source identification of fugitive dusts by light and electron microscopy, Richard S. Brown, MVA Scientific Consultants (USA) . . . . . [8036-06]

Application possibilities of several modern methods of microscopy and microanalysis in forensic science field, Marek Kotrly, Ivana Turkova, Institute of Criminalistics Prague (Czech Republic) . . . . . [8036-07]

Lunch/Exhibition Break . . . . . 12:40 to 2:00 pm

SESSION 3 . . . . . Tues. 2:00 to 3:20 pm

Advancements in Scanning Electron Microscopy I

Session Chairs: **Eva M. Campo,** Univ. of Pennsylvania; **Lucille A. Giannuzzi,** L.A. Giannuzzi & Associates LLC

Quantitative scanning electron microscopy, András E. Vladár, Petr Cizmar, Bradley Damazo, Purushotham P. Kavuri, Michael T. Postek, National Institute of Standards and Technology (USA) . . . . . [8036-08]

Comparison of channeling contrast from ion and electron images, Lucille A. Giannuzzi, L.A. Giannuzzi & Associates LLC (USA); Joseph R. Michael, Sandia National Labs. (USA) . . . . . [8036-09]

FIB/SEM-EDX operations for intracellular granules characterization, Marziale Milani, Univ. degli Studi di Milano-Bicocca (Italy); Claudio Savoia, STMicroelectronics (Italy); Lyubov Didenko, Natalia Shevlyagina, Gamaleya Research Institute (Russian Federation); Francesco Tatti, FEI Co. (Netherlands) . . . . . [8036-10]

Pursuit of clean SEM and HIM, Purushotham P. Kavuri, András E. Vladár, Michael T. Postek, National Institute of Standards and Technology (USA)[8036-11]

SESSION 4 . . . . . Tues. 3:40 to 5:40 pm

Advancements in Scanning Electron Microscopy II

Session Chairs: **Lucille A. Giannuzzi,** L.A. Giannuzzi & Associates LLC; **Eva M. Campo,** Univ. of Pennsylvania

Advanced SCPM image composition with intra-frame drift correction, Petr Cizmar, András E. Vladár, Michael T. Postek, National Institute of Standards and Technology (USA) . . . . . [8036-12]

The characterization of nanoparticles using analytical electron microscopy, Whitney B. Hill, MVA Scientific Consultants (USA) . . . . . [8036-13]

Transmission electron microscopy of electrospun GaN nanofibers, Joshua L. Robles-Garcia, Anamaris Melendez, Univ. de Puerto Rico en Humacao (USA); Jorge J. Santiago-Aviles, Univ. of Pennsylvania (USA); Idalia Ramos, Univ. de Puerto Rico en Humacao (USA); Eva M. Campo, Univ. of Pennsylvania (USA) . . . . . [8036-14]

Study of LCE nanocomposites through electron microscopy, Núria Torras, Kirill E. Zinoviev, Ctr. Nacional de Microelectrónica (Spain); Douglas Yates, Lolita Rotkina, Univ. of Pennsylvania (USA); Jaume Esteve, Ctr. Nacional de Microelectrónica (Spain); E. M. Terentjev, Univ. of Cambridge (United Kingdom); Eva M. Campo, Univ. of Pennsylvania (USA) . . . . . [8036-15]

Morphological classification and microanalysis of fractured and degraded tire rubber, Giovanni F. Crosta, Univ. degli Studi di Milano-Bicocca (Italy) . . . . . [8036-16]

Morphological analysis and classification of dispersion in a polymer nano-composite, Giovanni F. Crosta, Univ. degli Studi di Milano-Bicocca (Italy) . . . . . [8036-17]

Wednesday 27 April

SESSION 5 . . . . . Wed. 8:30 to 10:30 am

Advancements in Helium Ion Microscopy

Session Chairs: **András E. Vladár,** National Institute of Standards and Technology; **Michael T. Postek,** National Institute of Standards and Technology

Nanometer-scale imaging and metrology, nano-fabrication with the Orion helium ion microscope, Bin Ming, András E. Vladár, Michael T. Postek, National Institute of Standards and Technology (USA) . . . . . [8036-19]

Investigation of cellular interactions of nanoparticles by helium ion microscopy, Bruce W. Arey, Vaithiyalingam Shutthanandan, Galya Orr, Pacific Northwest National Lab. (USA) . . . . . [8036-20]

Formation of embedded gold nanoclusters and nanocluster-cavity pairs in SrTiO3 single crystals, Vaithiyalingam Shutthanandan, Bruce W. Arey, Chongmin Wang, Grace Newhouse, Pacific Northwest National Lab. (USA); Suntharmpillai Thevuthasan, Pacific Northwest National Lab.. (USA) . . . . . [8036-21]

Creating nanohole arrays with the helium ion microscope, Mohan Ananth, Colin Sanford, Lewis Stern, David Ferranti, Chuong Huynh, Larry Scipioni, Carl Zeiss NTS, LLC (USA) . . . . . [8036-22]

Plasma FIB system for large volume cross-sectional metrology and analysis, Paul P. Tesch, Noel S. Smith, Noel P. Martin, Oregon Physics, LLC (USA) . . . . . [8036-23]

Secondary electrons energy distribution and energy selective imaging in helium ion microscope, Oleg F. Vyvenko, Yuri V. Petrov, St. Petersburg State Univ. (Russian Federation). . . . . [8036-24]

SESSION 6 . . . . . Wed. 11:00 am to 12:20 pm

Advances in Scanned Probe Microscopies I

Session Chairs: **Ronald G. Dixson,** National Institute of Standards and Technology; **Ndubuisi G. Orji,** National Institute of Standards and Technology

Progress on a metrological scanning probe microscope for traceable dimensional metrology at the nanoscale, Jan Herrmann, Bakir Babic, Christopher H. Freund, Malcolm A. Lawn, John R. Miles, Magnus T. Hsu, Malcolm B. Gray, National Measurement Institute of Australia (Australia); Daniel A. Shaddock, The Australian National Univ. (Australia) . . . . . [8036-25]

Measurement strategies and uncertainty estimations for pitch and step height calibrations by metrological AFM, Virpi Korpelainen, Jeremias Seppä, Antti Lassila, MIKES Mittatekniikan keskus (Finland) . . . . . [8036-26]

Study of a large range metrological atomic force microscope applied for calibration of a vertical PZT stage, Shihua Wang, Siew-Leng Tan, Gan Xu, A*STAR National Metrology Ctr. (Singapore) . . . . . [8036-27]

Traceable calibration of a critical dimension atomic force microscope (CD-AFM), Ronald G. Dixson, Ndubuisi Orji, National Institute of Standards and Technology (USA) . . . . . [8036-28]

Lunch/Exhibition Break . . . . . 12:20 to 2:00 pm

SESSION 7 . . . . . Wed. 2:00 to 4:30 pm

Advances in Scanned Probe Microscopies II

Session Chairs: **Ronald G. Dixson,** National Institute of Standards and Technology; **Ndubuisi G. Orji,** National Institute of Standards and Technology

Effects of tip characteristics on nanoparticle metrology with atomic force microscopy, Malcolm A. Lawn, Asa K. Jämting, Jan Herrmann, National Measurement Institute of Australia (Australia). . . . . [8036-29]

Development of photomask linewidth measurement and calibration using AFM and SEM in NMIJ, Kentaro Sugawara, Osamu Sato, Ichiko Misumi, Satoshi Gonda, Mingzi Lu, National Institute of Advanced Industrial Science and Technology (Japan) . . . . . [8036-30]

New developments at PTB in 3D-AFM with tapping and torsion AFM mode and vector approach probing strategy, Gaoliang Dai, Wolfgang Hässler-Grohne, Dorothee Hüser-Espig, Helmut Wolff, Jens Fluegge, Harald Bosse, Physikalisch-Technische Bundesanstalt (Germany) . . . . . [8036-31]

Pitch metrology for data storage: a plan for useful pitch standards down to 5 nm, Donald A. Chernoff, David L. Burkhead, Advanced Surface Microscopy, Inc. (USA). . . . . [8036-32]

Meniscus effects: a new model for ink transport in dip-pen nanolithography, Brandon L. Weeks, Mark W. Vaughn, Texas Tech Univ. (USA); Omkar A. Nafday, Nanolnk, Inc. (USA) . . . . . [8036-33]

Development of the interference microscope for traceable height step standard measurements and AFM calibration, Igor Malinovsky, National Metrology Institute of Brazil (Brazil). . . . . [8036-34]

Thursday 28 April

SESSION 8 . . . . . Thurs. 8:30 to 10:30 am

Advances in Optical Microscopy

Session Chairs: **Ravikiran Attota,** National Institute of Standards and Technology; **Tim K. Maugel,** Univ. of Maryland, College Park

Compressive decoding enabled lensless fluorescent imaging on a chip, Ahmet F. Coskun, Ikbal Sencan, Ting-Wei Su, Aydogan Ozcan, Univ. of California, Los Angeles (USA). . . . . [8036-35]

Through-focus scanning optical microscopy, Ravikiran Attota, National Institute of Standards and Technology (USA) . . . . . [8036-36]

High-speed 3D nonlinear optical imaging using FPGA, deformable and scanning mirrors, Masood Samim, Univ. of Toronto (Canada); Virginijus Barzda, Univ. of Toronto Mississauga (Canada) . . . . . [8036-37]

Dispersion free all reflective confocal microscope objective, Wojtek J. Walecki, Sunrise Optical LLC (USA); Mike Scaggs, Neoteric Concepts, LLC (USA); Fanny Szondy, Sunrise Optical LLC (USA) . . . . . [8036-38]

A λ/50 near-field scanning microscope resolution using a nano-antenna enhanced C-shaped ridge nano-aperture, Yao-Te Cheng, Yuzuru Takashima, Yin Yuen, Paul C. Hansen, Lambertus Hesselink, Stanford Univ. (USA) . [8036-39]

Use of fluorescence and scanning electron microscopy as tools in teaching biology, Nabarun Ghosh, West Texas A&M Univ. (USA); Jessica Silva, Eastfield College (USA); Don W. Smith, Univ. of North Texas (USA) . . . . . [8036-40]

SESSION 9 . . . . . Thurs. 11:00 am to 12:00 pm

Particle Beam Interaction Workshop

Session Chairs: **John S. Villarrubia,** National Institute of Standards and Technology; **András E. Vladár,** National Institute of Standards and Technology

Universal yield curves: understanding electron and ion interactions, David C. Joy, The Univ. of Tennessee (USA); Brendan J. Griffin, The Univ. of Western Australia (Australia) . . . . . [8036-41]

3D-measurement using a scanning electron microscope with 4 Everhart-Thornley detectors, Taras Vynnyk, Renke Scheuer, Eduard Reithmeier, Leibniz Univ. Hannover (Germany) . . . . . [8036-42]

Simulation of SEM images of core-shell nanospheres using CHARIOT Monte Carlo software, Shah Kwok Wei, A*STAR Institute of Materials Research and Engineering (Singapore); Sergey Babin, Sergey S. Borisov, Abeam Technologies (USA); Ming Yong Han, A*STAR Institute of Materials Research and Engineering (Singapore) . . . . . [8036-43]

Course of Related Interest

SC954 **Scanning Microscopy in Forensic Science** (Platek, Trimpe, McVicar, Postek) Monday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Laser Radar Technology and Applications XVI

Conference Chairs: **Monte D. Turner,** Defense Advanced Research Projects Agency; **Gary W. Kamerman,** FastMetrix, Inc.

Program Committee: **Philip Gatt,** Lockheed Martin Coherent Technologies; **Vasyl V. Molebny,** National Taras Shevchenko Univ. of Kyiv (Ukraine); **C. Russell Philbrick,** North Carolina State Univ.; **Upendra N. Singh,** NASA Langley Research Ctr.; **Ove Steinvall,** Swedish Defence Research Agency (Sweden)

Wednesday 27 April

SESSION 1 . . . . . Wed. 9:00 am to 12:20 pm

Advanced Systems and Measurements

Session Chair: **Monte D. Turner,**
Defense Advanced Research Projects Agency

Long-range target discrimination using UV fluorescence, Mark E. Bray, Jason J. Lepley, SELEX Galileo Ltd. (United Kingdom) . . . . . [8037-01]

Slant path 1.5 µm range gated imaging close to ground, Ove Steinvall, Magnus Elmqvist, Kjell Karlsson, Ove K. Gustafsson, Tomas R. Chevalier, Swedish Defence Research Agency (Sweden) . . . . . [8037-02]

Near infared lidar system for perimeter security and surveillance in low-visibility weather conditions, Richard I. Billmers, RL Associates Inc. (USA) . . . . . [8037-03]

Characterisation of small targets in a maritime environment by means of laser range profiling, Robin M. Schoemaker, Gijs Franssen, Koen Benoist, Arjan L. Mieremet, TNO Defence, Security and Safety (Netherlands) . . . . . [8037-04]

High-resolution hydrographic airborne laser scanner for surveying inland waters and shallow coastal zones, Martin Pfennigbauer, Andreas Ullrich, RIEGL Laser Measurement Systems GmbH (Austria) . . . . . [8037-05]

Underwater laser serial imaging using compressive sensing and digital mirror device, Bing Ouyang, Fraser R. Dalgleish, Walter Britton, Brian Ramos, Florida Atlantic Univ. (USA) . . . . . [8037-06]

High-precision, accuracy, and resolution 3D laser scanner employing pulsed-time-of-flight measurement, Martin Pfennigbauer, Andreas Ullrich, RIEGL Laser Measurement Systems GmbH (Austria); Joao Pereira do Carmo, European Space Research and Technology Ctr. (Netherlands) . . . . . [8037-07]

In cooperation with laser radar, Vasyl V. Molebny, National Taras Shevchenko Univ. of Kyiv (Ukraine); Gary W. Kamerman, FastMetrix, Inc. (USA); Ove Steinvall, Swedish Defence Research Agency (Sweden) . . . . . [8037-08]

Highly sensitive lidar with sensor-head of thumb size by using optical fiber preamplifier, Daisuke Inoue, Tadashi Ichikawa, Hiroyuki Matsubara, Xuesong Mao, Mtsutoshi Maeda, Chie Nagashima, Manabu Kagami, Toyota Central R&D Labs., Inc. (Japan) . . . . . [8037-09]

Lunch/Exhibition Break . . . . . 12:20 to 2:00 pm

SESSION 2 . . . . . Wed. 2:00 to 5:30 pm

Visualization and Data Analysis

Session Chair: **Ove Steinvall,**
Swedish Defence Research Agency (Sweden)

Line of sight analysis using voxelized discrete lidar, Shea Hagstrom, David W. Messinger, Rochester Institute of Technology (USA) . . . . . [8037-10]

Extracting intelligence from ladar sensing modalities, Allan M. Burwinkel, Stuart J. Shelley, Etegent Technologies, Ltd. (USA) . . . . . [8037-11]

Automatic merging of lidar point-clouds using data from low-cost GPS/IMU systems, Scott E. Budge, Utah State Univ. (USA); Kurt von Niederhausern, Ball Aerospace & Technologies Corp. (USA) . . . . . [8037-12]

Terrain classification of ladar data point clouds, Amy L. Neuenschwander, Lori A. Magruder, Marcus Tyler, The Univ. of Texas at Austin (USA); Melba M. Crawford, Purdue Univ. (USA) . . . . . [8037-13]

Automated method for detection and quantification of building damage and debris using light detection and ranging (lidar) data, Richard Labiak, Rochester Institute of Technology (USA) and Air Force Institute of Technology Civilian Institution Program (USA); Jan W. van Aardt, Darryl Eychner, Erin Wirch, Hans-Peter Bischof, Rochester Institute of Technology (USA) . . . . . [8037-14]

Lidar depth image compression using clustering, re-indexing, and JPEG2000, Dmitriy Karpman, David Ashbrook, Xiaoling Li, Ye Duan, Wenjun Zeng, Univ. of Missouri-Columbia (USA) . . . . . [8037-15]

Rapid high-fidelity visualisation of multispectral 3D mapping, Philip M. Tudor, Mark A. Christy, General Dynamics UK Ltd. (United Kingdom) . . . . . [8037-16]

A calibration and error correction method for improved texel (fused lidar/digital camera) images, Scott E. Budge, Ziang Wang, Utah State Univ. (USA) . . . . . [8037-17]

Quality metrics for 3D laser radar systems, Norman A. Lopez, Jeffrey R. Stevens, Robin R. Burton, FastMetrix, Inc. (USA) . . . . . [8037-18]

Thursday 28 April

SESSION 3 . . . . . Thurs. 9:00 to 10:20 am

Laser Remote Sensing

Session Chair: **Philip Gatt,** Lockheed Martin Coherent Technologies

Sensitivity of the polarization ratio method to aerosol concentration, Michelle G. Snyder, North Carolina State Univ. (USA); Andrea M. Brown, The Johns Hopkins Univ. (USA); C. Russell Philbrick, North Carolina State Univ. (USA) . . . . . [8037-19]

Pseudorandom noise code-based technique for cloud and aerosol discrimination applications, Joel Campbell, Narasimha S. Prasad, Michael Flood, Wallace Harrison, NASA Langley Research Ctr. (USA) . . . . . [8037-20]

Laser remote sensing of atmospheric properties, C. Russell Philbrick, Timothy P. Wright, Hans D. Hallen, North Carolina State Univ. (USA) . . . . . [8037-21]

Detection of microwave emission from solid targets ablated with an ultra-short pulsed laser, Joseph A. Miragliotta, Benjamin Brawley, Caroline Sailor, James B. Spicer, Jane W. Spicer, The Johns Hopkins Univ. (USA) . . . . . [8037-22]

SESSION 4 . . . . . Thurs. 10:40 am to 12:00 pm

Coherent Systems I

Session Chair: **C. Russell Philbrick,** North Carolina State Univ.

All-fiber coherent doppler lidar for wind sensing, Sameh Abdelazim, The City College of New York (USA) . . . . . [8037-23]

Minimization of differential Doppler induced fringe averaging in holographic aperture ladar, Ross L. Bobb, Bradley D. Duncan, Univ. of Dayton (USA); Matthew P. Dierking, Air Force Research Lab. (USA) . . . . . [8037-24]

Pulsed coherent fiber lidar transceiver for aircraft in-flight turbulence and wake-vortex hazard detection, Shantanu Gupta, Mehmetcan Akbulut, Youming Chen, Jacob Hwang, Horacio Verdun, Frank Kimpel, Fibertek, Inc. (USA)[8037-25]

Vertical and horizontal wind profiling from a high-energy, pulsed, 2-micron, coherent-detection doppler lidar and intercomparison with other sensors, Upendra N. Singh, NASA Langley Research Ctr. (USA) . . . . . [8037-26]

Lunch/Exhibition Break . . . . . 12:00 to 1:40 pm

SESSION 5 . . . . . Thurs. 1:40 to 3:00 am

Coherent Systems II

Session Chair: **C. Russell Philbrick,** North Carolina State Univ.

Performance considerations for coherent array receivers, Don Jacob, Philip Gatt, Lockheed Martin Coherent Technologies (USA) . . . . . [8037-27]

Piston phase determination and its effect on multi-aperture image resolution recovery, Jeffrey R. Kraczek, Paul McManamon, Joseph W. Haus, Univ. of Dayton (USA); Joseph C. Marron, Lockheed Martin Coherent Technologies (USA) . . . . . [8037-28]

Short pulse synthetic aperture ladar, Jennifer L. Carns, Air Force Research Lab. (USA); Bradley D. Duncan, Univ. of Dayton (USA); Matthew P. Dierking, Air Force Research Lab. (USA) . . . . . [8037-29]

Impact of Gaussian beam jitter on Gaussian beam coherent laser radar performance, Philip Gatt, Scott M. Shald, Lockheed Martin Coherent Technologies (USA) . . . . . [8037-30]

SESSION 6 . . . . . Thurs. 3:20 to 4:20 pm

Laser Doppler Vibrometry

Session Chair: **Vasyl Molebny,**
National Taras Shevchenko Univ. of Kyiv (Ukraine)

Green laser vibrometry based on single frequency monolithic microchip laser, Arkadiusz J. Antonczak, Pawel Koziol, Jaroslaw Z. Sotor, Krzysztof M. Abramski, Wroclaw Univ. of Technology (Poland) . . . . . [8037-31]

Multichannel flexible fiber vibrometer, Adam Waz, Pawel R. Kaczmarek, Arkadiusz J. Antonczak, Grzegorz Dudzik, Jaroslaw Z. Sotor, Grzegorz Sobon, Karol Krzempek, Krzysztof M. Abramski, Wroclaw Univ. of Technology (Poland) . . . . . [8037-32]

Airborne laser vibrometer for seismic subsurface inspection, Alastair D. McAulay, Lehigh Univ. (USA). . . . . [8037-33]

SESSION 7 . . . . . Thurs. 4:20 to 5:20 pm

Staring Array Lidar

Session Chair: **Vasyl Molebny,**
National Taras Shevchenko Univ. of Kyiv (Ukraine)

Flash ladar waveform measurements using an intensified photodiode focal plane array, Christopher Bracikowski, Chung M. Wong, Toni Uchima, Brian K. Baldauf, Northrop Grumman Aerospace Systems (USA) . . . . . [8037-34]

Topographic mapping flash lidar for multiple scattering, terrain, and forest mapping, Tanya Ramond, Carl S. Weimer, Eileen Saiki, Jeffrey T. Applegate, Ball Aerospace & Technologies Corp. (USA); Yongxiang Hu, NASA Langley Research Ctr. (USA); Thomas Delker, Lyle Ruppert, Ball Aerospace & Technologies Corp. (USA) . . . . . [8037-35]

Drogue tracking using 3D flash lidar for autonomous aerial refueling, Chao-I Chen, Roger Stettner, Advanced Scientific Concepts, Inc. (USA) . . . . . [8037-36]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

False-alarm reduction method by intensity dividing in three-dimensional imaging direct-detection laser radar using Geiger-mode avalanche photodiodes, Tae Hoon Kim, Hong Jin Kong, Min Seok Oh, Sung Eun Jo, KAIST (Korea, Republic of). . . . . [8037-55]

Fluorescence/depolarization lidar for mid-range stand-off detection of biological agents, Jacek Wojtanowski, Zygmunt Mierczyk, Krzysztof Kopczyński, Marek Zygmunt, Wiesław Piotrowski, Andrzej Gietka, Piotr Knysak, Tadeusz Drozd, Michal Muzal, Andrzej Mlodzianko, Andrzej Gawlikowski, Miroslawa H. Kaszczuk, Roman Ostrowski, Marcin Jakubaszek, Jaroslaw Mlynczak, Military Univ. of Technology (Poland) . . . . . [8037-56]

Commercial market flash ladar performance and specifications development, Matthew McQuillan, David W. Newton, Jennifer A. Green, William R. Roberts, Naval Surface Warfare Ctr. Dahlgren Div. (USA) . . . . . [8037-57]

Friday 29 April

SESSION 8 . . . . . Fri. 9:00 to 11:40 am

Detectors and Receiver Technology

Session Chair: **Gary W. Kamerman,** FastMetrix, Inc.

Flash ladar focal plane array technologies, George M. Williams, Jr., Voxtel, Inc. (USA) . . . . . [8037-37]

Geiger-mode ladar cameras, Ping Yuan, Rengarajan Sudharsanan, Xiaogang Bai, Joseph C. Boisvert, Paul A. McDonald, Eduardo L. Labios, Spectrolab, Inc. (USA); Bryan A. Morris, John P. Nicholson, Gary M. Stuart, Harrison Danny, Boeing-SVS, Inc. (USA); Stephen T. Van Duyne, Greg Pauls, Stephen D. Gaalema, Black Forest Engineering (USA) . . . . . [8037-38]

Coincidence processing algorithms for GmAPD laser radar systems, Norman A. Lopez, FastMetrix, Inc. (USA) . . . . . [8037-39]

Advanced coincidence processing of 3D laser radar data, Alexandru N. Vasile, Richard M. Marino, Luke Skelly, Michael O'Brien, MIT Lincoln Lab. (USA) . . . . . [8037-40]

Target detection capabilities of flash ladar detectors, George M. Williams, Jr., Voxtel, Inc. (USA). . . . . [8037-41]

Linear-mode avalanche photo-diode detectors with a quasi-deterministic gain component: statistical model studies, Douglas G. Youmans, Cobham Analytic Solutions (USA) . . . . . [8037-42]

GHz low-noise SWIR photo receivers, Xiaogang Bai, Ping Yuan, Paul A. McDonald, Joseph C. Boisvert, James J. Chang, Robyn L. Woo, Eduardo L. Labios, Rengarajan Sudharsanan, Spectrolab, Inc. (USA); Michael A. Krainak, Guangning Yang, Xiaoli Sun, Wei Lu, NASA Goddard Space Flight Ctr. (USA) . . . . . [8037-43]

SESSION 9 . . . . . Fri. 11:40 am to 12:20 pm

Novel Applications

Session Chair: **Gary W. Kamerman,** FastMetrix, Inc.

Lidar characteristics for detecting and tracking high-speed bullets, |Joseph S. J. Peri, The Johns Hopkins Univ. (USA) . . . . . [8037-44]

Small UAV surveillance and detection system, Ryan Franz, Brian S. Goldberg, Adsys Controls, Inc. (USA) . . . . . [8037-45]

Lunch Break . . . . . 12:20 to 1:40 pm

SESSION 10 . . . . . Fri. 1:40 to 3:20 pm

Lasers and Transmitter Technology

Session Chair: **Upendra N. Singh,** NASA Langley Research Ctr.

High output power, injection-seeded KTA ring-cavity optical parametric oscillator, Robert Foltynowicz, Michael D. Wojcik, Utah State Univ. (USA); Arlee V. Smith, AS-Photonics, LLC (USA) . . . . . [8037-46]

High-power diode-pumped Q-switched Er^{3+}:YAG single-crystal fiber laser for active imaging system, Igor Martial, Lab. Charles Fabry (France); Julien Didierjean, Nicolas Aubry, Fibercryst SAS (France); François Balembois, Patrick Georges, Lab. Charles Fabry (France) . . . . . [8037-47]

Field tests of optical ranging using PRBS modulation techniques, Joseph M. Kovalik, Keith E. Wilson, Malcolm W. Wright, Walton Williamson, Jet Propulsion Lab. (USA) . . . . . [8037-48]

Simulated lidar waveforms for understanding factors affecting waveform shape, Angela M. Kim, Richard C. Olsen, Naval Postgraduate School (USA) . . . . . [8037-49]

System gain optimization in direction detection ladar system, Long Wu, Yuan Zhao, Yong Zhang, Yu Zhang, Jie Wu, Harbin Institute of Technology (China) . . . . . [8037-50]

SESSION 11 . . . . . Fri. 3:40 to 5:00 pm

Autonomous Vehicle Sensors

Session Chair: **Gary W. Kamerman,** FastMetrix, Inc.

Virtual navigation of interior structures by lidar, Yongjian Xi, Xiaoling Li, Ye Duan, Univ. of Missouri-Columbia (USA); Norbert H. Maerz, Missouri Univ. of Science and Technology (USA). . . . . [8037-51]

Spectral ladar as a UGV navigation sensor, Michael A. Powers, General Dynamics Robotic Systems (USA); Christopher C. Davis, Univ. of Maryland, College Park (USA) . . . . . [8037-52]

Brassboard development of a MEMS-scanned ladar sensor for small ground robots, Barry L. Stann, John F. Dammann, U.S. Army Research Lab. (USA); Pey-Schuan Jian, Aerotek, Inc. (USA); Mark M. Giza, William B. Lawler, U.S. Army Research Lab. (USA) . . . . . [8037-53]

Compact 3D lidar based on optically coupled horizontal and vertical scanning mechanism for the autonomous navigation of robots, Min-Gu Lee, Seung-Ho Baeg, Moon-Hong Baeg, Korea Institute of Industrial Technology (Korea, Republic of); Ki Min Lee, Hae Seok Lee, LG Innotek (Korea, Republic of); Jong Ok Park, Hyundai Rotem Co. (Korea, Republic of); Hong Ki Kim, Samsung Electro-Mechanics (Korea, Republic of) . . . . . [8037-54]

Courses of Related Interest

SC1032 **Direct Detection Laser Radar Systems for Imaging Applications** (Richmond, Cain) Tuesday, 8:30 am to 5:30 pm
SC167 **Introduction to Laser Radar** (Kamerman) Monday, 8:30 am to 12:30 pm
SC168 **Advanced Coherent Laser Radars Design and Applications** (Kamerman) Monday, 1:30 to 5:30 pm
SC1031 **Radar Micro-Doppler Signatures - Principles and Applications** (Chen, Tahmoush) Monday, 1:30 to 5:30 pm
SC1035 **Military Laser Safety** (Marshall) Wednesday, 8:30 am to 5:30 pm
SC997 **High Power Laser Beam Quality** (Ross) Wednesday, 1:30 to 5:30 pm
SC1033 **Optical Phased Array Technologies and Systems** (Probst, McManamon) Thursday, 8:30 am to 5:30 pm
SC838 **Laser Range Gated Imaging Techniques** (Duncan) Tuesday, 1:30 to 5:30 pm
SC995 **Target Detection Algorithms for Hyperspectral Imagery** (Nasrabadi) Thursday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Atmospheric Propagation VIII

Conference Chairs: **Linda M. Wasiczko Thomas,** U.S. Naval Research Lab.; **Earl J. Spillar,** Air Force Research Lab.

Program Committee: **Larry C. Andrews,** Univ. of Central Florida; **Gary J. Baker,** Lockheed Martin Space Systems Co.; **Harris Rayvon Burris, Jr.,** U.S. Naval Research Lab.; **James M. Cicchiello,** Northrop Grumman Electronic Systems; **G. Charmaine C. Gilbreath,** U.S. Naval Research Lab.; **Gary G. Gimmestad,** Georgia Tech Research Institute; **Kenneth J. Grant,** Defence Science and Technology Organisation (Australia); **Christopher I. Moore,** U.S. Naval Research Lab.; **Jonathan M. Saint Clair,** The Boeing Co.; **David H. Tofsted,** U.S. Army Research Lab.; **Morio Toyoshima,** National Institute of Information and Communications Technology (Japan); **Cynthia Y. Young,** Univ. of Central Florida

Tuesday 26 April

SESSION 1 . . . . . Tues. 1:30 to 3:20 pm

Performance, Modeling, and Simulation

Session Chair: **Larry C. Andrews,** Univ. of Central Florida

Monte Carlo-based multiple-scattering channel modeling for non-line-of-sight ultraviolet communications *(Invited Paper)*, Robert J. Drost, Brian M. Sadler, U.S. Army Research Lab. (USA) . . . . . [8038-01]

Performance modeling of the effects of aperture phase error, turbulence, and thermal blooming on tiled subaperture systems, Charles L. Leakeas, Richard J. Bartell, Salvatore J. Cusumano, Air Force Institute of Technology (USA); Matthew Whitely, MZA Associates Corp. (USA) . . . . . [8038-02]

Practical calculation of the beam scintillation index based on the rigorous asymptotic propagation theory, Mikhail I. Charnotskii, Zel Technologies, LLC (USA); Gary J. Baker, Lockheed Martin Space Systems Co. (USA) . . . . . [8038-03]

Generation of atmospheric turbulence-induced time-varying optical signals for space-to-ground laser links, Morio Toyoshima, Takashi Sasaki, Hideki Takenaka, Yoshihisa Takayama, National Institute of Information and Communications Technology (Japan) . . . . . [8038-04]

Fading probability density function of free-space optical communication channels with pointing error, Zhijun Zhao, Rui Liao, Michigan Technological Univ. (USA) . . . . . [8038-05]

SESSION 2 . . . . . Tues. 3:50 to 5:10 pm

Atmospheric Measurements

Session Chair: **Earl J. Spillar,** Air Force Research Lab.

Characterizing aerosol extinction in the UV-NIR spectral range, Gary G. Gimmestad, David W. Roberts, Georgia Tech Research Institute (USA) . [8038-06]

Validation of technique to hyperspectrally characterize the lower atmosphere with limited surface observations, Robb M. Randall, Steven T. Fiorino, Michelle F. Gerling, Adam D. Downs, Air Force Institute of Technology (USA) . . . . . [8038-07]

Simulation of plane wave propagation through non-Kolmogorov turbulent atmosphere: a comparison between simulations and theory, Venkata S. R. Gudimetla, Air Force Research Lab. (USA); Richard B. Holmes, Boeing LTS Inc. (USA) . . . . . [8038-08]

Measurements of atmospheric parameters using the SOR atmospheric monitor, Earl J. Spillar, Air Force Research Lab. (USA) . . . . . [8038-09]

Wednesday 27 April

SESSION 3 . . . . . Wed. 8:30 to 10:20 am

Laser Communication I

Session Chair: **Linda M. Wasiczko Thomas,** U.S. Naval Research Lab.

Analysis of the propagation channel and its impact on the ORCA laser communication system *(Invited Paper)*, David T. Wayne, Troy Leclerc, Paul Sauer, Ronald L. Phillips, Larry C. Andrews, Florida Space Institute (USA) . . . . . [8038-10]

Free-space optical channel propagation tests over a 147 km link, Juan C. Juarez, The Johns Hopkins Univ. Applied Physics Lab. (USA) . . [8038-11]

Characterization of impact ionization engineered InGaAs avalanche photodiodes for free-space lasercomm applications, Harris R. Burris, Jr., Michael S. Ferraro, William S. Rabinovich, Linda M. Wasiczko Thomas, Christopher I. Moore, Ben B. Xu, U.S. Naval Research Lab. (USA); William D. Waters, William R. Clark, OptoGration Inc. (USA) . . . . . [8038-12]

Analysis of fading in the propagation channel for the ORCA laser communication system, Paul Sauer, David T. Wayne, Troy Leclerc, Ronald L. Phillips, Larry C. Andrews, Florida Space Institute (USA) . . . . . [8038-13]

Evaluation of a control algorithm for mobile FSO node alignment, Dayong Zhou, Peter G. LoPresti, Hazem Refai, The Univ. of Oklahoma - Tulsa (USA) . . . . . [8038-14]

SESSION 4 . . . . . Wed. 10:50 am to 12:20 pm

Laser Communication II

Session Chair: **Gary J. Baker,** Lockheed Martin Space Systems Co.

Observations of atmospheric effects for FALCON laser communication system flight test *(Invited Paper)*, Thomas M. Fletcher, James A. Cunningham, Daniel Baber, Timothy Goode, Brian Gaughan, ITT Advanced Engineering & Sciences (USA) . . . . . [8038-15]

PDF computations for power-in-the-bucket measurements of an IR laser beam propagating in the maritime environment, Charles Nelson, The Johns Hopkins Univ. (USA); Svetlana Avramov-Zamurovic, Reza Malek-Madani, U.S. Naval Academy (USA); Olga Korotkova, Univ. of Miami (USA); Raymond Sova, The Johns Hopkins Univ. Applied Physics Lab. (USA); Frederic Davidson, The Johns Hopkins Univ. (USA) . . . . . [8038-16]

Near-the-ground laser communication system: anisoplantic studies based on the PSF measurements, Aleksandr V. Sergeyev, Michael C. Roggemann, Casey D. Demars, Michigan Technological Univ. (USA) . . . . . [8038-17]

Evaluation of the performance of a fiber-bundle-based optical wireless link, Peter G. LoPresti, Dayong Zhou, Hazem Refai, The Univ. of Oklahoma - Tulsa (USA) . . . . . [8038-18]

Lunch/Exhibition Break . . . . . 12:20 to 1:50 pm

SESSION 5 . . . . . Wed. 1:50 to 4:20 pm

Components and Techniques

Session Chair: **Harris Rayvon Burris, Jr.,** U.S. Naval Research Lab.

Turbulence modeling for non-line-of-sight ultraviolet scattering channels *(Invited Paper)*, Haipeng Ding, Zhengyuan Xu, Univ. of California, Riverside (USA); Brian M. Sadler, U.S. Army Research Lab. (USA) . . . . . [8038-19]

Laser communication of FM audio/video signals using InGaAs modulating retro-reflectors, Kenneth J. Grant, Bradley A. Clare, Wayne Martinsen, Kerry A. Mudge, Defence Science and Technology Organisation (Australia); Harris R. Burris, Jr., Christopher I. Moore, Jake Overfield, Charmaine Gilbreath, William S. Rabinovich, Joseph A. Duperre III, U.S. Naval Research Lab. (USA) . . . . [8038-20]

Orbital angular momentum receiver bandwidth for laser communications systems operating in atmospheric turbulence, Frida S. Vetelino, Ricky J. Morgan, Aerospace Missions Corp. (USA) . . . . . [8038-21]

Buffered block acknowledgement (BuBa) protocol for highly errored data links, Christopher I. Moore, Harris R. Burris, Jr., Linda M. Wasiczko Thomas, Michele R. Suite, Walter R. Smith, Jr., Rita Mahon, William S. Rabinovich, U.S. Naval Research Lab. (USA) . . . . . [8038-22]

Blackbody remote optical thermometry through turbulent atmosphere, Gil A. Tidhar, Norman S. Kopeika, Ben-Gurion Univ. of the Negev (Israel) . . . . [8038-23]

A flexible testbed for adaptive optics in strong turbulence, Jason D. Schmidt, Michael J. Steinbock, Air Force Institute of Technology (USA) . . . . . [8038-24]

USAF High Energy Laser (HEL) systems: HEL-generated extinction effects and degradation of multibandpass algorithm efficiencies during missile staging (case PRC DF-21; GHADR 110), Clifford A. Paiva, BSM Research Associates (USA) . . . . . [8038-25]

Laser Technology for Defense and Security VII

Conference Chairs: **Mark Dubinskii,** U.S. Army Research Lab.; **Stephen G. Post,** Missile Defense Agency

Program Committee: **Mark W. Neice,** High Energy Laser Joint Technology Office; **Nils C. Fernelius,** Air Force Research Lab.; **Steven R. Bowman,** U.S. Naval Research Lab.; **Anthony M. Johnson,** Univ. of Maryland, Baltimore County; **Scott Christensen,** Nufern

Monday 25 April

SESSION 1 . . . . . Mon. 9:00 to 10:30 am

Bulk Solid State Lasers I

Session Chair: **Mark Dubinskii,** U.S. Army Research Lab.

Pulsed 2-micron lasers based on Tm^{3+}-doped monoclinic double tungstate crystals *(Invited Paper)*, Xavier Mateos, Martha Segura, Maria Cinta Pujol Baiges, Joan Josep Carvajal, Magdalena Aguilò, Francesc Diaz, Univ. Rovira i Virgili (Spain); Won Bae Cho, Ajou Univ. (Korea, Republic of); Valentin P. Petrov, Uwe Griebner, Max-Born-Institut für Nichtlineare Optik und Kurzzeitspektroskopie (Germany) . . . . . [8039-01]

74% laser efficiency using 10% Yb^{3+} doped Lu_2O_3 ceramic, Jasbinder S. Sanghera, Woohong Kim, Guillermo R. Villalobos, Jesse A. Frantz, Brandon Shaw, U.S. Naval Research Lab. (USA); Frederic H. Kung, Univ. Research Foundation (USA); Ishwar Aggarwal, U.S. Naval Research Lab. (USA) . . . . . [8039-02]

Tm-doped disordered molybdate crystals for ultrashort mode-locked solid state lasers, Maria D. Serrano, Xiumei Han, Mauricio Rico, Maria Concepción Cascales, Carlos Zaldo, Instituto de Ciencia de Materiales de Madrid (Spain) . . . . . [8039-03]

Resonantly diode pumped Ho^{3+}:YVO_4 2.1-micron laser, George A. Newburgh, Mark Dubinskii, U.S. Army Research Lab. (USA) . . . . . [8039-04]

SESSION 2 . . . . . Mon. 11:00 am to 12:40 pm

Bulk Solid State Lasers II and Beam Combining

Session Chair: **Stephen G. Post,** Missile Defense Agency

Spectroscopy and laser performance of resonantly pumped Er^{3+}-doped double tungstate single crystals, Mark Dubinskii, Viktor Fromzel, Nikolay Ter-Gabrielyan, U.S. Army Research Lab. (USA); Maria D. Serrano, Maria Concepción Cascales, Carlos Zaldo, Instituto de Ciencia de Materiales de Madrid (Spain) . . . . . [8039-05]

Composite Yb:YAG/Yb:GSAG cryogenic amplifier for picosecond pulses, Darren A. Rand, Scot E. J. Shaw, Juan R. Ochoa, Daniel J. Ripin, Tso Yee Fan, MIT Lincoln Lab. (USA); Hector Martin, Laurence S. Hawes, Jiamin Zhang, Samvel Sarkisyan, Eric Wilson, Paul Lundquist, Applied Energetics, Inc. (USA). . [8039-06]

Edge-pumped Yb:YAG disk amplifier with multipassed extraction, John Vetrovec, Drew A. Copeland, Aqwest, LLC (USA); Detao Du, General Atomics Aeronautical Systems, Inc. (USA) . . . . . [8039-07]

Coherent combining of high-power Yb fiber amplifiers, Charles X. Yu, Steven J. Augst, Shawn Redmond, Daniel V. Murphy, Antonio Sanchez-Rubio, Tso Yee Fan, MIT Lincoln Lab. (USA) . . . . . [8039-08]

High-efficiency Yb:YAG thin disk laser at room and cryogenic temperatures, T. Carson, Tim C. Newell, William P. Latham, Air Force Research Lab. (USA); Natasa Vretenar, The Univ. of New Mexico (USA); Tim L. Lucas, Boeing-SVS, Inc. (USA); P. Peterson, Boeing LTS Inc. (USA). . . . . [8039-48]

Lunch Break . . . . . 12:40 to 1:50 pm

SESSION 3 . . . . . Mon. 1:50 to 3:30 pm

Laser Diodes I

Ultra-high-intensity 1550nm single junction pulsed laser diodes, Jean-Francois Boucher, Laser Components Canada, Inc. (Canada); John J. Callahan, SemiNex Corp. (USA) . . . . . [8039-09]

Elevated-temperature operation of lasers and laser diode arrays, Ryan Feeler, Jay Doster, Wade F. Collins, Mark E. Kushina, Northrop Grumman Cutting Edge Optronics (USA). . . . . [8039-10]

High-performance blue and green laser diodes based on nonpolar/semipolar InGaN, Mathew C. Schmidt, Christiane Poblenz, Yu-Chia Chang, Ben Li, Mark J. Mondry, Thomas C. Hasenberg, Justin Iveland, Michael R. Krames, Richard Craig, James W. Raring, James S. Speck, Steven P. DenBaars, Shuji Nakamura, Soraa, Inc. (USA) . . . . . [8039-11]

High-brightness QCW pump stacks based on 200W laser diode bars and mini bars at 808nm and 940nm, Yuri Berk, Yoram Karni, Yaki Openhaim, Ronen Diamant, Genadi Klumel, Shalom Cohen, Ophir Peleg, SCD Semiconductor Devices (Israel) . . . . . [8039-12]

Extending the locking range of VHG-stabilised diode laser bars using wavefront compensator phaseplates, Roy McBride, Jozef J. Wendland, PowerPhotonic, Ltd. (United Kingdom); Natalia Trela, Howard J. Baker, Heriot-Watt Univ. (United Kingdom). . . . . [8039-13]

SESSION 4 . . . . . Mon. 4:00 to 6:30 pm

Fiber Lasers: CW and Pulsed

Session Chair: **Scott Christensen,** Nufern

Recent progress in power scaling of resonantly-pumped Yb-free Er-doped fiber lasers *(Invited Paper)*, Mark Dubinskii, Jun Zhang, Viktor Fromzel, Tigran Sanamyan, U.S. Army Research Lab. (USA). . . . . [8039-14]

Monolithic, narrow linewidth, polarization maintaining, thulium fiber laser using femtosecond laser written fiber bragg gratings, Christina C. C. Willis, Joshua D. Bradford, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [8039-15]

Co-pumped 130 W monolithic single frequency fiber amplifier with an optically induced thermal gradient, Clint Zeringue, Christopher Vergien, Iyad A. Dajani, Air Force Research Lab. (USA) . . . . . [8039-16]

Amplification of gain switched thulium doped laser with 1.5ns pulsewidth, Bryce N. Samson, Jim Ding, Chiachi Wang, Kanishka Tankala, Adrian L. G. Carter, Nufern (USA) . . . . . [8039-17]

Generation and amplification of femtosecond laser pulses in Tm:fiber, Robert A. Sims, Pankaj Kadwani, Lawrence Shah, Martin C. Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8039-18]

Atmospheric gas detection using broadband mid-IR thulium fiber-based sources, Pankaj Kadwani, Robert A. Sims, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Jeffrey Chia, College of Optical Sciences, The Univ. of Arizona (USA); Faleh Altal, Masdar Institute of Science and Technology (United Arab Emirates); Lawrence Shah, Martin C. Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8039-19]

Compactly packaged, photonic crystal fiber-based MOPA delivering mJ-energy, MW-peak-power, near diffraction-limited, high spectral brightness ns pulses, Fabio Di Teodoro, Northrop Grumman Aerospace Systems (USA) . . . . . [8039-20]

Courses of Related Interest

SC1036 **Diode Pumped Alkali Lasers** (Perram) Wednesday, 1:30 to 5:30 pm
SC1035 **Military Laser Safety** (Marshall) Wednesday, 8:30 am to 5:30 pm
SC1033 **Optical Phased Array Technologies and Systems** (Probst, McManamon) Thursday, 8:30 am to 5:30 pm
SC997 **High Power Laser Beam Quality** (Ross) Wednesday, 1:30 to 5:30 pm

See full course listing and descriptions on pp. 144-192.

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 5 . . . . . Tues. 10:20 to 11:50 am

Laser Diodes II and Beam Combining

Session Chair: **Steven R. Bowman,** U.S. Naval Research Lab.

Extremely high-brightness, kW-class fiber coupled diode lasers with wavelength stabilization *(Invited Paper)*, Robin K. Huang, Bien Chann, John D. Glenn, TeraDiode, Inc. (USA). . . . . [8039-21]

Progress in commercial wavelength-stabilized high-brightness diode sources suitable for pumping Yb-doped fiber lasers, Aaron Brown, Paul O. Leisher, Ling Bao, Mike Grimshaw, Mark A. DeVito, Kirk Price, Keith W. Kennedy, Shelly Lin, Mitchell Reynolds, Scott R. Karlsen, Jay A. Small, Robert J. Martinsen, Jim Haden, nLIGHT Corp. (USA). . . . . [8039-22]

Diode laser beam combining for directed energy applications, Yakov G. Soskind, Richard Gifford, Joseph Aletta, Mark DeLorenzo, David Pollock, DHPC Technologies, Inc. (USA); Allan Chan, Richard C. Cooke, U.S. Army CERDEC Intelligence and Information Warfare Directorate (USA) . . . . . [8039-23]

Passive coherent beam combining of fiber lasers using volume Bragg gratings, Apurva Jain, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Christine P. Spiegelberg, Vadim Smirnov, OptiGrate Corp. (USA); Leonid B. Glebov, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [8039-24]

Lunch/Exhibition Break . . . . . 11:50 am to 1:20 pm

SESSION 6 . . . . . Tues. 1:20 to 3:10 pm

Mid-IR Lasers and Mid-IR Fiber Material Development

Session Chair: **Anthony M. Johnson,**
Univ. of Maryland, Baltimore County

Oxide glasses for mid-infrared lasers *(Invited Paper)*, Billy D. Richards, Animesh Jha, Gin Jose, Univ. of Leeds (United Kingdom); Xin Jiang, Max-Planck-Institut für die Physik des Lichts (Germany); Mark Dubinskii, U.S. Army Research Lab. (USA) . . . . . [8039-25]

Integrated multispectral high-power laser platform for defense and security applications, Boris Tadjikov, Alexei G. Tsekoun, Arkadiy Lyakh, Richard Maulini, Pranalytica, Inc. (USA); Chandra Kumar N. Patel, Pranalytica, Inc. (USA) and Univ. of California, Los Angeles (USA) . . . . . [8039-26]

Recent advances in high-power quantum cascade laser systems, Eric B. Takeuchi, Timothy Day, Bill Chapman, Michael B. Pushkarsky, Daylight Solutions Inc. (USA). . . . . [8039-27]

Power scaling of diode-pumped 2.7-µm Er^{3+}-doped Y_2O_3 ceramic laser, Tigran Sanamyan, Mark Dubinskii, U.S. Army Research Lab. (USA) . . . . [8039-28]

Development of tellurite fibers for multiband mid-IR (2-5µm) fiber laser source, Shantanu Gupta, Jiangfan Xia, Richard A. Utano, Fibertek, Inc. (USA); Aoxiang Lin, Jean Toulouse, Lehigh Univ. (USA); Michael J. Myers, Kigre, Inc. (USA); Kevin Vora, Eric D. Mazur, Harvard Univ. (USA) . . . . . [8039-29]

SESSION 7 . . . . . Tues. 3:40 to 6:00 pm

Laser Material Development: Single Crystalline, Ceramics, Fibers

Session Chair: **Nils C. Fernelius,** Air Force Research Lab.

Submicrometer-grained highly transparent sesquioxide ceramics: synthesis, processing, and properties, John Ballato, Clemson Univ. (USA); Karn Serivalsatit, Clemson Univ. (USA) and Chulalongkorn Univ. (Thailand) . . [8039-30]

Development of ceramic fibers for high-energy lasers, Geoff E. Fair, Air Force Research Lab. (USA); Hyun Jun Kim, Heedong Lee, Kristin A. Keller, Triplicane A. Parthasarathy, UES, Inc. (USA). . . . . [8039-31]

Spectroscopy and laser potential of transition metal doped $Cd_{(1-x)}Mn_xTe$ for MWIR applications, Tigran Sanamyan, Mark Dubinskii, U.S. Army Research Lab. (USA); Witold Palosz, Joo-Soo Kim, Sudhir B. Trivedi, Brimrose Corp. of America (USA) . . . . . [8039-32]

Characterization of dysprosium for visible solid state lasers, Shawn P. O'Connor, Steven R. Bowman, Nicholas J. Condon, U.S. Naval Research Lab. (USA) . . . . . [8039-33]

Performance comparison of SCHOTT laser glasses, Mark J. Davis, Joseph Hayden, SCHOTT North America, Inc. (USA) . . . . . [8039-34]

Low-noise single frequency all phosphate fiber laser, Peter Hofmann, College of Optical Sciences, The Univ. of Arizona (USA); Arturo Chavez-Pirson, NP Photonics, Inc. (USA); Axel Schülzgen, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Lingyun Xiong, Albane Laronche, Jacques Albert, Carleton Univ. (Canada); Nasser Peyghambarian, College of Optical Sciences, The Univ. of Arizona (USA). . . . . [8039-35]

Development of Er-doped photonic crystal fiber for high-energy laser applications, E. Joseph Friebele, Charles G. Askins, U.S. Naval Research Lab. (USA); Chad G. Carlson, U.S. Air Force Academy (USA); Mark Dubinskii, Jun Zhang, U.S. Army Research Lab. (USA); Benjamin G. Ward, U.S. Air Force Academy (USA) . . . . . [8039-36]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Ultrafast bandgap photonics applications: IRCM and laser VLO, Michael K. Rafailov, RICHER International LLC (USA) . . . . . [8039-41]

Spectral beam combining using superimposed reflective volume Bragg grating, Benjian Shen, Jichun Tan, Guangwei Zheng, Yanlan He, Xiujian Li, Yisheng Yang, National Univ. of Defense Technology (China) . . . . . [8039-42]

Generalized active mode locking due to amplitude modulation in a ultra-short pulse laser using maple, Daniel E. Sierra, Univ. EAFIT (Colombia) . . . . . [8039-43]

Analysis of the performance of VCSELs in WDM, Kaikai Xu, Univ. of California, Irvine (USA) . . . . . [8039-44]

Counter-directed energy weapons system, Ryan Franz, Brian S. Goldberg, Adsys Controls, Inc. (USA) . . . . . [8039-45]

High-energy microlaser and compact MOPA transmitter, Brian K. Brickeen, Joseph Mosovsky, The Pennsylvania State Univ. Electro-Optics Ctr. (USA) . . . . . [8039-46]

Modeling of first-order distributed feedback semiconductor lasers, Meng-Mu Shih, Peter S. Zory, Univ. of Florida (USA) . . . . . [8039-47]

Wednesday 27 April

SESSION 8 . . . . . Wed. 8:30 to 9:50 am

Lasers for Specific Applications and Latest Technology for Laser Functionality

Session Chair: **Mark Dubinskii,** U.S. Army Research Lab.

Multifunction laser source for ground and airborne applications, Bruno Crépy, CILAS (France) . . . . . [8039-37]

Laser sources for Raman spectroscopy, Joyce P. Kilmer, Andrew Iadevaia, Yusong Yin, Photonics Industries International, Inc. (USA) . . . . . [8039-38]

Liquid metal-cooled heat sink for advanced high-power laser diodes, John Vetrovec, Aqwest, LLC (USA); Jeremy Junghans, Northrop Grumman Cutting Edge Optronics (USA) . . . . . [8039-39]

Laser damage testing for ion beam sputtered optical coatings at 2µm and 2.94µm, Christopher S. Wood, Ove Lyngnes, Precision Photonics Corp. (USA) . . . . . [8039-40]

CONFERENCE WRAP-UP . . . . . Wed. 9:50 to 10:10 am

Session Chair: **Mark Dubinskii,** U.S. Army Research Lab.

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Active and Passive Signatures II

Conference Chairs: **G. Charmaine C. Gilbreath,** U.S. Naval Research Lab.; **Chadwick Todd Hawley,** National Signature Program

Program Committee: **Kelly W. Bennett,** U.S. Army Research Lab.; **Carlos Omar Font,** U.S. Naval Research Lab.; **Herbert J. Mitchell,** Naval Postgraduate School; **Joseph E. Peak,** U.S. Naval Research Lab.

Wednesday 27 April

SESSION 1 . . . . . Wed. 1:30 to 3:10 pm

Active and Passive Signatures

Session Chair: **Charmaine Gilbreath,** U.S. Naval Research Lab.

Status of active and passive signatures for detection and characterization of materials and activities of special interest *(Invited Paper)*, Chadwick T. Hawley, National Signature Program (USA) . . . . . [8040-01]

Composite signatures from airborne sensors *(Invited Paper)*, Sean M. Anklam, SpecTIR, LLC (USA) . . . . . [8040-02]

Acoustic signature analysis for underground anomalies, Latasha Solomon, Leng Sim, U.S. Army Research Lab. (USA). . . . . [8040-03]

2D signature for detection and identification of drugs, Vyacheslav A. Trofimov, Svetlana A. Varentsova, Lomonosov Moscow State Univ. (Russian Federation); Cunlin Zhang, Jingling Shen, Qingli Zhou, Yulei Shi, Capital Normal Univ. (China) . [8040-04]

SESSION 2 . . . . . Wed. 3:40 to 5:10 pm

Signature Mining in Large Data Sets

Session Chair: **Carlos Omar Font,** U.S. Naval Research Lab.

ALADDIN: signatures from uncued video *(Invited Paper)*, John S. Garofolo, National Institute of Standards and Technology (USA). . . . . [8040-05]

Uncertainties of measures in speaker recognition evaluation, Jin Chu Wu, Alvin F. Martin, Craig S. Greenberg, Raghu N. Kacker, National Institute of Standards and Technology (USA). . . . . [8040-06]

Advances in the design, development, and deployment of the U.S. Army Research Laboratory's Multimodal Signatures Database, Kelly W. Bennett, U.S. Army Research Lab. (USA); James Robertson, Clearhaven Technologies LLC (USA) . . . . . [8040-07]

Understanding and mitigating noise issues in magnetic sensors, resulting in improved signatures, Greg Fischer, Alan Edelstein, U.S. Army Research Lab. (USA) . . . . . [8040-08]

Thursday 28 April

SESSION 3 . . . . . Thurs. 8:30 to 9:50 am

Atmospheric Signatures

Session Chair: **Chadwick Todd Hawley,** National Signature Program

Real-time sensing and correction of tropospheric propagation variations *(Keynote Presentation)*, Kathy M. Minear, G. Pat Martin, Harris Corp. (USA); Barry Geldzahler, NASA Headquarters (USA); Jason Soloff, NASA Johnson Space Ctr. (USA). . . . . [8040-09]

Experimental signature studies in random and chaotic distributions in the atmosphere, Carlos O. Font, Joseph A. Duperre III, Charmaine Gilbreath, David Bonanno, Eshani Tarpara, U.S. Naval Research Lab. (USA). . . . . [8040-10]

Next generation signature-based hyperspectral detection: a challenge to atmospheric modelers *(Invited Paper)*, Alan P. Schaum, Brian J. Daniel, U.S. Naval Research Lab. (USA) . . . . . [8040-11]

SESSION 4 . . . . . Thurs. 9:50 to 11:00 am

Unique Applications

Session Chair: **Chadwick Todd Hawley,** National Signature Program

An optical fiber-based intruder detection sensor, Xiong Yu, Case Western Reserve Univ. (USA) . . . . . [8040-12]

The performance of all-optical switching based on fiber Bragg grating, Zhigang Zang, Kyushu Univ. (Japan); Wenxuan Yang, Harbin Institute of Technology (China) . . . . . [8040-13]

SESSION 5 . . . . . Thurs. 11:00 am to 12:10 pm

Spectral-Based Signatures

Session Chair: **Kelly W. Bennett,** U.S. Army Research Lab.

Two-dimensional, active, resonance-Raman signatures of fresh and aged explosives, bacteria, and chemicals *(Invited Paper)*, Jacob Grun, Robert Lunsford, U.S. Naval Research Lab. (USA); Pratima Kunapareddy, Sergei Nikitin, Research Support Instruments, Inc. (USA); David B. Gillis, Jeffrey H. Bowles, U.S. Naval Research Lab. (USA); Jared C. Gump, Naval Surface Warfare Ctr. Indian Head Div. (USA); Leonid I. Perlovsky, Air Force Research Lab. (USA) . . . [8040-14]

Spectral variations in HSI signatures of thin fabrics for detecting and tracking of dismounts, Jared Herweg, Rochester Institute of Technology (USA) and Air Force Institute of Technology (USA); John P. Kerekes, Rochester Institute of Technology (USA); Michael T. Eismann, Air Force Research Lab. (USA) . . . . . [8040-15]

Spectral analysis algorithm for material detection from multispectral imagery, Joseph K. Racine, Defense Intelligence Agency (USA) and Booz Allen Hamilton Inc. (USA) . . . . . [8040-16]

Lunch/Exhibition Break . . . . . 12:10 to 1:40 pm

SESSION 6 . . . . . Thurs. 1:40 to 3:20 pm

Signatures for Terrain Characterization and Mapping

Session Chair: **Frank Pipitone,** U.S. Naval Research Lab.

Quantification of constituents in areal and intimate binary mixtures of particulate materials, Michael West, Keith Manville, Ronald G. Resmini, MITRE Corp. (USA) . . . . . [8040-17]

Changes in apparent emissivity as a function of viewing geometry, Michael West, John M. Grossmann, Christopher Deloye, MITRE Corp. (USA) . . . [8040-18]

Complex soil electrical impedivity signatures, Simon J. Ghionea, David M. Hull, U.S. Army Research Lab. (USA) . . . . . [8040-19]

Crude oil and refined petroleum product detection on terrestrial substrates with airborne imaging spectroscopy, C. Scott Allen, George Mason Univ. (USA); Mark P. S. Krekeler, Miami Univ. (USA) . . . . . [8040-20]

Analyses of reflectance characteristics of selected plants, Miroslawa H. Kaszczuk, Zygmunt Mierczyk, Marek Zygmunt, Wiesław Piotrowski, Jadwiga Mierczyk, Military Univ. of Technology (Poland) . . . . . [8040-21]

SESSION 7 . . . . . Thurs. 3:50 to 5:20 pm

Depth Recovery for 3D Signatures

Session Chair: **Michael West,** MITRE Corp.

Efficient RPG detection in noisy 3D image data *(Invited Paper)*, Frank Pipitone, U.S. Naval Research Lab. (USA) . . . . . [8040-22]

Developing 3D signatures using lidar technology, Ralston Mitchell, The Aerospace Corp. (USA) . . . . . [8040-23]

On the discrimination of solid targets by their depolarization signatures for ladar applications to terrain mapping, Xiaoying Cao, Royal Military College of Canada (Canada); Gilles A. Roy, Defence Research and Development Canada (Canada); Robert Bernier, Les Instruments Optiques du St-Laurent Inc. (Canada); Gregoire Tremblay, Simon Roy, Christian Laflamme, Defence Research and Development Canada (Canada) . . . . . [8040-24]

Stereoscopic signatures derived from spectroscopic dielectrometry, Charmaine Gilbreath, U.S. Naval Research Lab. (USA); William F. Brooks, Northrop Grumman Information Technology-TASC (USA); Blerta Bajramaj, U.S. Naval Research Lab. (USA); Daniel Aiken, EMCORE Corp. (USA) . . . . . [8040-25]

Courses of Related Interest

SC1031 **Radar Micro-Doppler Signatures - Principles and Applications** (Chen, Tahmoush) Monday, 1:30 to 5:30 pm

SC995 **Target Detection Algorithms for Hyperspectral Imagery** (Nasrabadi) Thursday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. XXX-OOO.

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

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Head- and Helmet-Mounted Displays XVI: Design and Applications

Conference Chairs: **Peter L. Marasco,** Air Force Research Lab.; **Paul R. Havig,** Air Force Research Lab.

Program Committee: **Randall E. Bailey,** NASA Langley Research Ctr.; **Sion A. Jennings,** National Research Council Canada (Canada)

Thursday 28 April

SESSION 1 . . . . . Thurs. 8:00 to 10:00 am

Human Factors Issues in HMDs

Session Chair: **Paul R. Havig,** Air Force Research Lab.

Rise of the HMD: the need to review our human factors guidelines, Eric E. Geiselman, Paul R. Havig, Air Force Research Lab. (USA) . . . . . [8041-01]

Human-machine interface issues in the use of helmet-mounted displays in short conjugate simulators, James E. Melzer, Rockwell Collins Optronics (USA) . . . . . [8041-02]

How much camera separation should be used for the capture and presentation of 3D stereoscopic imagery on binocular HMDs?, John P. McIntire, Paul R. Havig, Eric E. Geiselman, Eric L. Heft, Air Force Research Lab. (USA) . . . . . [8041-03]

Preliminary experimental results from a dichoptic vision system, Michael P. Browne, SA Photonics (USA); Kirk Moffitt, Human Factors Consultant (USA); Darrel G. Hopper, Bridget I. Fath, Air Force Research Lab. (USA) . . . . . [8041-04]

Evaluation of anti-glare applications for the Vuzix Tac-Eye LT, Jason Roll, Noel Trew, LeeAnn Perkins, Matt Geis, Paul R. Havig, Air Force Research Lab. (USA) . . . . . [8041-05]

Virtual reality in a cave: limitations and the need for HMDs, Paul R. Havig, John P. McIntire, Eric E. Geiselman, Air Force Research Lab. (USA) . . . . [8041-06]

SESSION 2 . . . . . Thurs. 10:30 to 11:50 am

HMD Components

Session Chair: **Peter L. Marasco,** Air Force Research Lab.

Sensor image augmentation to avoid saturation, Kohei Funabiki, Japan Aerospace Exploration Agency (Japan); Takashi Yoshida, NEC Corp. (Japan); Kazuho Tawada, Shimadzu Corp. (Japan); Hiroka Tsuda, Japan Aerospace Exploration Agency (Japan). . . . . [8041-07]

Transfer alignment from a personal dead reckoning system to a handheld IMU, Lauro V. Ojeda, Johann Borenstein, Univ. of Michigan (USA) . . . . . [8041-08]

Active matrix organic light emitting diode (AMOLED)-XL performance and life test results, David A. Fellowes, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8041-09]

Spatial noise in microdisplays for near to eye applications, David A. Fellowes, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8041-10]

Lunch/Exhibition Break . . . . . 11:50 am to 1:20 pm

SESSION 3 . . . . . Thurs. 1:20 to 3:00 pm

Current HMD Developments

Session Chair: **Randall E. Bailey,** NASA Langley Research Ctr.

Binocular Scorpion helmet-mounted display, Robert Atac, Mark Edel, Gentex Corp. (USA) . . . . . [8041-11]

Wide field of view digital night vision head-mounted display, Michael P. Browne, SA Photonics (USA) . . . . . [8041-12]

Full-color, see-through, daylight-readable, goggle-mounted display, Christian D. DeJong, Microvision, Inc. (USA) . . . . . [8041-13]

Development of a dichoptic foveal/peripheral head-mounted display with partial binocular overlap, Dale R. Tyczka, Martha J. Chatten, John B. Chatten, Chatten Associates, Inc. (USA); John O. Merritt, The Merrit Goup (USA); H. Lee Task, Task Consulting (USA); Darrel G. Hopper, Bridget I. Fath, Air Force Research Lab. (USA) . . . . . [8041-14]

Head-worn displays for NextGen, Randall E. Bailey, Jarvis J. Arthur III, NASA Langley Research Ctr. (USA). . . . . [8041-15]

SESSION 4 . . . . . Thurs. 3:30 to 4:50 pm

Flight Tests and Theater Operations

Session Chair: **Sion A. Jennings,** National Research Council Canada (Canada)

Flight tests with enhanced/synthetic vision system for rescue helicopter, Hiroka Tsuda, Kohei Funabiki, Tomoko Iijima, Japan Aerospace Exploration Agency (Japan); Kazuho Tawada, Shimadzu Corp. (Japan); Takashi Yoshida, NEC Corp. (Japan). . . . . [8041-16]

In-flight evaluation of an optical head motion tracker III, Kazuho Tawada, Masakazu Okamoto, Shimadzu Corp. (Japan) . . . . . [8041-17]

Qualification testing of the Scorpion HMCS for A-10 and F-16, Robert Atac, Tony Bugno, Gentex Corp. (USA) . . . . . [8041-18]

The reported incidence of man-machine interface issues in Army aviators using the Aviator's Night Vision System (ANVIS) in a combat theatre, Keith L. Hiatt, U.S. Army Research Institute of Environmental Medicine (USA); Clarence E. Rash, U.S. Army Aeromedical Research Lab. (USA). . . . . [8041-19]

SESSION 5 . . . . . Thurs. 4:50 to 5:30 pm

HMDs in Non-Piloted Systems

Session Chair: **Peter L. Marasco,** Air Force Research Lab.

Mask-mounted display (MMD) design considerations for diver operating environment, Richard Manley, Dennis G. Gallagher, William W. Hughes, Charles G. Holmes, Naval Surface Warfare Ctr. Panama City Div. (USA) . . . . . [8041-20]

Has the HMD taken off yet? A look toward the future of HMDs, Paul R. Havig, Air Force Research Lab. (USA) . . . . . [8041-21]

Course of Related Interest

SC159 **Head-Mounted Displays: Design and Applications** (Melzer, Browne)
Wednesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Monday-Tuesday 25-26 April 2011 • Part of Proceedings of SPIE Vol. 8042

Display Technologies and Applications for Defense, Security, and Avionics V

Conference Chairs: **John Tudor Thomas,** General Dynamics Canada Ltd. (Canada); **Daniel D. Desjardins,** Air Force Research Lab.

Program Committee: **Reginald Daniels,** Air Force Research Lab.; **Eric W. Forsythe,** U.S. Army Research Lab.; **Michael J. Hackert,** NAVAIR; **David C. Huffman,** L-3 Display Systems; **Rick J. Johnson,** Rockwell Collins, Inc.; **Mark A. Livingston,** U.S. Naval Research Lab.; **Gail Nicholson,** Naval Surface Warfare Ctr. Crane Div.; **Kalluri R. Sarma,** Honeywell Technology; **Terrance M. Tierney,** U.S. Army Tank Automotive Research, Development and Engineering Ctr.

Monday 25 April

SESSION 1 . . . . . Mon. 1:30 to 3:00 pm

Army, Navy, Air Force Displays Roadmaps

Session Chair: **Daniel D. Desjardins,** Air Force Research Lab.

A look at current and future display needs for Air Force applications *(Invited Paper)*, Paul R. Havig, Air Force Research Lab. (USA) . . . . . [8042A-01]

Army roadmap for future displays *(Invited Paper)*, Eric W. Forsythe, U.S. Army Research Lab. (USA) . . . . . [8042A-02]

Navy roadmap for future displays *(Invited Paper)*, Randall O'Connor, Naval Air Systems Command (USA) . . . . . [8042A-03]

SESSION 2 . . . . . Mon. 3:30 to 4:50 pm

Future Display Issues and Research

Session Chair: **Kalluri R. Sarma,** Honeywell Technology

Flight instrument modifications for helmet-mounted SWIR imaging systems, Tim R. Robinson, John Green, Greg J. Grabski, Mickey A. Jacobson, Esterline Technologies Corp. (USA) . . . . . [8042A-04]

Light surface display, Hakki H. Refai, 3DIcon Corp. (USA) . . . . . [8042A-05]

Augmented reality maintenance system (ARMS) for complex military assets, Kevin Osborn, Noa M. Rensing, Timothy C. Tiernan, Radiation Monitoring Devices, Inc. (USA) . . . . . [8042A-06]

Performance and development considerations for a new generation of land vehicle displays, John T. Thomas, General Dynamics Canada Ltd. (Canada) . . . . . [8042A-07]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 3 . . . . . Tues. 10:00 to 10:40 am

Considerations for Use of 3D Displays

Session Chair: **Mark A. Livingston,** U.S. Naval Research Lab.

Hybrid magneto-photonic crystal (MPC) nanotechnology display technology for 3D auto stereo projection and flexible fiber composite display systems, Sutherland C. Ellwood, Jr., C. Frank Stirling, Photonica, Inc. (USA). . . . [8042A-08]

Precise positioning surveillance in 3D using night-vision stereoscopic photogrammetry, Jason M. Schwartz, Follow-Me Systems, LLC (USA) . . . . . [8042A-09]

SESSION 4 . . . . . Tues. 10:40 am to 12:00 pm

HUDs, HMDs, & Microdisplays

Session Chair: **Terrance M. Tierney,** U.S. Army Tank Automotive Research, Development and Engineering Ctr.

Ultra-high-resolution AMOLED, Ihor Wacyk, Olivier F. Prache, Amalkumar Ghosh, eMagin Corp. (USA) . . . . . [8042A-10]

Alternatives to flat panel displays in vehicle turrets, Gail Nicholson, Naval Surface Warfare Ctr. Crane Div. (USA) . . . . . [8042A-11]

Microdisplay contributions to system level performance, Tony Bacarella, Timothy Hogan, Kopin Corp. (USA) . . . . . [8042A-12]

General implications of HUD systems applied to automobile industries, Jose A. Betancur Ramírez, Gilberto Osorio Gómez, Univ. EAFIT (Colombia) . [8042A-13]

Lunch/Exhibition Break. . . . . 12:00 to 1:00 pm

SESSION 5 . . . . . Tues. 1:00 to 2:20 pm

Human Factors Considerations for Display Systems Engineering

Session Chair: **Reginald Daniels,** Air Force Research Lab.

Accounting for human neurocognitive function in the design and evaluation of 360 degree situational awareness display systems, Jason S. Metcalfe, DCS Corp. (USA); Thomas Mikulski, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); Scott Dittman, Vorteil Technologies, Inc. (USA). . . . . [8042A-14]

A methodology for the assessment of 360° local area awareness displays, Christopher Manteuffel, Matthew Jaswa, Tony Johnson, Jason S. Metcalfe, DCS Corp. (USA); Bradley J. Brumm, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA) . . . . . [8042A-15]

Visual tools for human guidance in manual operations, Gil Abramovich, Kevin G. Harding, GE Global Research (USA) . . . . . [8042A-16]

Head-mounted display (HMD) assessment for tracked vehicles, Gail Nicholson, William Hurley, Naval Surface Warfare Ctr. Crane Div. (USA)[8042A-17]

SESSION 6 . . . . . Tues. 2:20 to 5:10 pm

Display Subsystems and Supporting Technologies

Session Chair: **Michael J. Hackert,** Naval Air Systems Command

Non-RF wireless helmet-mounted display and two-way audio connectivity using covert free-space optical communications, Michael Strauss, Leo Volfson, Torrey Pines Logic, Inc. (USA). . . . . [8042A-18]

Evolution of LED backlighting in avionics displays, Josh Davis, Joe Tchon, Rockwell Collins, Inc. (USA) . . . . . [8042A-19]

ARINC 818 for video and display control, Tim Keller, Jon A. Alexander, Great River Technology, Inc. (USA). . . . . [8042A-20]

Evolution of low-profile and lightweight electrical connectors for soldier-worn applications, Eric Gans, Kang S. Lee, Tomasz Jannson, Kevin Walter, Physical Optics Corp. (USA) . . . . . [8042A-21]

Affordable multisensor digital video architecture for 360 degree situational awareness displays, Steven P. Scheiner, DCS Corp. (USA); Dina A. Khan, Alexander L. Marecki, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); David A. Berman, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Dana Carberry, General Dynamics Robotic Systems (USA) . . . . . [8042A-22]

Display technology gaps used with electro-optic sensors, Jack E. Fulton, Jr., Gail Nicholson, Naval Surface Warfare Ctr. Crane Div. (USA) . . . . . [8042A-23]

Ultra-mobile rugged computing platforms design considerations, Ray Garcia, Mark Wright-Johnson, General Dynamics Itronix Corp. (USA); Reginald Daniels, Air Force Research Lab. (USA) . . . . . [8042A-24]

CLOSING COMMENTS . . . . . Tues. 5:10 to 5:20 pm

Session Chairs: **John Tudor Thomas,** General Dynamics Canada Ltd. (Canada); **Daniel D. Desjardins,** Air Force Research Lab.

Tuesday 26 April 2011 • Part of Proceedings of SPIE Vol. 8042

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Enhanced and Synthetic Vision 2011

Conference Chairs: **Jeff J. Güell,** The Boeing Co.; **Kenneth L. Bernier,** The Boeing Co.

Program Committee: **Jarvis J. Arthur III,** NASA Langley Research Ctr.; **Bernd R. Korn,** Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Christian Pschierer,** Jeppesen GmbH (Germany); **Maarten Uijt de Haag,** Ohio Univ.; **Jacques G. Verly,** Univ. de Liège (Belgium)

Tuesday 26 April

SESSION 7 . . . . . Tues. 1:30 to 3:10 pm

Mission Operations

Session Chairs: **Jarvis J. Arthur III,** NASA Langley Research Ctr.; **Bernd R. Korn,** Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Maarten Uijt de Haag,** Ohio Univ.

Enhanced/synthetic vision and head-worn display technologies for terminal maneuvering area NextGen operations, Jarvis J. Arthur III, Steven P. Williams, Lawrence J. Prinzel III, Randall E. Bailey, Kevin J. Shelton, NASA Langley Research Ctr. (USA) . . . . . [8042B-25]

Helicopter Autonomous Landing System (HALS): an enhanced flight vision system that enables multiship landing, takeoff, and en-route flight in degraded visual environments, Jack Cross, David Howard, Craig Chapman, Sierra Nevada Corp. (USA) . . . . . [8042B-26]

A compact wide-area surveillance system for defence and security applications, James R. E. Sadler, John Davis, Duncan L. Hickman, Waterfall Solutions Ltd. (United Kingdom) . . . . . [8042B-27]

Enhanced and synthetic vision for terminal maneuvering area NextGen operations, Randall E. Bailey, Lynda J. Kramer, Lawrence J. Prinzel III, Kyle Ellis, Kevin J. Shelton, Jarvis J. Arthur III, NASA Langley Research Ctr. (USA) . . . . . [8042B-28]

Next generation EFB applications, Christian Pschierer, Jeppesen GmbH (Germany) . . . . . [8042B-29]

SESSION 8 . . . . . Tues. 3:40 to 5:40 pm

Sensors and Displays

Session Chairs: **Jacques G. Verly,** Univ. de Liège (Belgium); **Christian Pschierer,** Jeppesen GmbH (Germany)

A comparison of synthetic and human observer approaches to multispectral sensor resolution assessment, Alan R. Pinkus, David W. Dommett, Air Force Research Lab. (USA); H. Lee Task, Task Consulting (USA) . . . . . [8042B-30]

Millimeter-wave data acquisition for terrain mapping, obstacle detection, and dust penetrating capability testing, Sven Schmerwitz, Hans-Ullrich Doehler, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Sion A. Jennings, Kristopher Ellis, National Research Council Canada (Canada)[8042B-31]

Small-scale anomaly detection in panoramic imaging using neural models of low-level vision, M. C. Casey, Univ. of Surrey (United Kingdom); Duncan L. Hickman, Waterfall Solutions Ltd. (United Kingdom) . . . . . [8042B-32]

Real-time image registration and fusion in a FPGA architecture (FIRE), Rick Rickman, Toby Waters, Lindsay Swan, Waterfall Solutions Ltd. (United Kingdom) . . . . . [8042B-33]

Investigating attentional tunneling through a flexible experimentation environment and eye tracking, Matthias Wies, Niklas Peinecke, Anne Papenfuss, Christoph Möhlenbrink, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [8042B-34]

Efficient reduction of complex noise in passive millimeter-wavelength video utilizing Bayesian surprise, Terrell N. Mundhenk, Josh Baron, Roy M. Matic, HRL Labs., LLC (USA) . . . . . [8042B-36]

Course of Related Interest

SC159 **Head-Mounted Displays: Design and Applications** (Melzer, Browne)
Wednesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Three-Dimensional Imaging, Visualization, and Display 2011

Conference Chairs: **Bahram Javidi,** Univ. of Connecticut; **Jung-Young Son,** Daegu Univ. (Korea, Republic of)

Conference Co-Chairs: **Manuel Martinez-Corral,** Univ. de València (Spain); **Wolfgang Osten,** Univ. Stuttgart (Germany); **Fumio Okano,** Ultra-Realistic Communications Forum (Japan)

Program Committee: **Amit Ashok,** The Univ. of Arizona; **Saeed Bagheri,** IBM Thomas J. Watson Research Ctr.; **Frank Dubois,** Univ. Libre de Bruxelles (Belgium); **Michael T. Eismann,** Air Force Research Lab.; **Pietro Ferraro,** Istituto Nazionale di Ottica Applicata (Italy); **Thierry Fournel,** Univ. Jean Monnet Saint-Etienne (France); **William E. Higgins,** The Pennsylvania State Univ.; **Yi-Pai Huang,** National Chiao Tung Univ. (Taiwan); **Naomi Inoue,** Advanced Telecommunications Research Institute International (Japan); **Osamu Matoba,** Kobe Univ. (Japan); **Thomas J. Naughton,** National Univ. of Ireland, Maynooth (Ireland); **Takanori Nomura,** Wakayama Univ. (Japan); **Min-Chul Park,** Korea Institute of Science and Technology (Korea, Republic of); **Adrian Stern,** Ben-Gurion Univ. of the Negev (Israel); **Sumio Yano,** NHK (Japan); **Wa James Tam,** Communications Research Ctr. Canada (Canada); **Chao-Hsu Tsai,** Industrial Technology Research Institute (Taiwan); **Edward A. Watson,** Air Force Research Lab.; **Kenji Yamamoto,** National Institute of Information and Communications Technology (Japan); **Zeev Zalevsky,** Bar-Ilan Univ. (Israel)

Wednesday 27 April

SESSION 1 . . . . . Wed. 8:00 to 10:00 am

3D Image Processing

Session Chairs: **Jinwoong Kim,** Electronics and Telecommunications Research Institute (Korea, Republic of); **Touradj Ebrahimi,** Ecole Polytechnique Fédérale de Lausanne (Switzerland)

Towards reliable and reproducible 3D video quality assessment *(Invited Paper)*, Touradj Ebrahimi, Lutz Goldmann, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [8043-01]

Hybrid video encoding schemes for backward-compatible 3DTV services *(Invited Paper)*, Jinwoong Kim, Se-Yoon Jeong, Jin Soo Choi, Electronics and Telecommunications Research Institute (Korea, Republic of) . . . . . [8043-02]

3D video capturing for multiprojection type 3D display *(Invited Paper)*, Masahiro Kawakita, Sabri Gurbuz, Shoichiro Iwasawa, Roberto Lopez-Gulliver, National Institute of Information and Communications Technology (Japan); Sumio Yano, Japan Broadcasting Corp. (Japan) and NHK Science & Technical Research Labs. (Japan); Hiroshi Ando, Naomi Inoue, National Institute of Information and Communications Technology (Japan) . . . . . [8043-03]

Fast and accurate algorithms for quadratic phase integrals in optics and signal processing *(Invited Paper)*, Aykut Koc, Stanford Univ. (USA); Haldun M. Ozaktas, Bilkent Univ. (Turkey); Lambertus Hesselink, Stanford Univ. (USA) . . . . . [8043-04]

SESSION 2 . . . . . Wed. 10:30 am to 12:20 pm

Digital Holography

Session Chairs: **Kenji Yamamoto,** National Institute of Information and Communications Technology (Japan); **Hiroshi Yoshikawa,** Nihon Univ. (Japan)

Research activities on digital holographic 3D displays in Japan *(Invited Paper)*, Hiroshi Yoshikawa, Nihon Univ. (Japan) . . . . . [8043-05]

Development of electronic holography toward ultra-realistic communication *(Invited Paper)*, Kenji Yamamoto, Yasuyuki Ichihashi, Takanori Senoh, Ryutaro Oi, Taiichiro Kurita, National Institute of Information and Communications Technology (Japan) . . . . . [8043-06]

Ray-based and wavefront-based holographic displays for high-density light-field reproduction *(Invited Paper)*, Masahiro Yamaguchi, Tokyo Institute of Technology (Japan) . . . . . [8043-07]

Digitized holography: spatial 3D imaging of virtual and real objects *(Invited Paper)*, Kyoji Matsushima, Yasuaki Arima, Sumio Nakahara, Kansai Univ. (Japan) . . . . . [8043-08]

Lunch/Exhibition Break . . . . . 12:20 to 1:40 pm

Luncheon Dialogue . . . . . Wed. 12:20 to 1:40 pm

The Conference Chairs invite all authors and attendees to meet for discussions during lunch on Wednesday. Two tables will be reserved in the Concessions area for a no-host buffet lunch. Seats at the tables will be available on a first-come, first-served basis.

SESSION 3 . . . . . Wed. 1:40 to 4:20 pm

Integral Imaging

Session Chair: **Manuel Martinez-Corral,** Univ. de València (Spain)

View-dependent lightfield composition, Kei Utsugi, Masami Yamasaki, Takafumi Koike, Michio Oikawa, Hitachi, Ltd. (Japan) . . . . . [8043-09]

Fully programmable display parameters in integral imaging by smart pseudoscopic-to-orthoscopic conversion *(Invited Paper)*, Manuel Martinez-Corral, Hector Navarro, Genaro Saavedra, Univ. de València (Spain); Raul Martinez-Cuenca, Univ. Jaume I (Spain); Bahram Javidi, Univ. of Connecticut (USA) . . . . . [8043-10]

3D integral imaging with unknown sensor positions, Xiao Xiao, Mehdi Daneshpanah, Myungjin Cho, Bahram Javidi, Univ. of Connecticut (USA) . . . . . [8043-11]

Method of enlarging horizontal viewing zone in integral imaging *(Invited Paper)*, Masato Miura, Jun Arai, Makoto Okui, Japan Broadcasting Corp. (Japan); Fumio Okano, Japan Broadcasting Corp. (Japan) and NHK Engineering Services (Japan) . . . . . [8043-12]

Realization of precise depth perception with coarse integral volumetric imaging *(Invited Paper)*, Hideki Kakeya, Shimpei Sawada, Univ. of Tsukuba (Japan) . . . . . [8043-13]

SESSION 4 . . . . . Wed. 4:20 to 6:00 pm

3D Displays and Related Technologies I

Session Chair: **Jung-Young Son,** Daegu Univ. (Korea, Republic of)

Development of three types of multifocus 3D display *(Invited Paper)*, Sung-Kyu Kim, Dong-Wook Kim, Korea Institute of Science and Technology (Korea, Republic of) . . . . . [8043-14]

The effect of stereoscopic display luminance and ambient illuminance on physiological measurement and image quality *(Invited Paper)*, Pei-Chia Wang, Kuan-Yu Chen, Sheue-Ling Hwang, National Tsing Hua Univ. (Taiwan); Chin-Sen Chen, Industrial Technology Research Institute (Taiwan) . . . . . [8043-15]

Field of view extension in integral imaging using frequency division multiple access technique: numerical analysis, Zahra Kavehvash, Khashayar Mehrany, Sharif Univ. of Technology (Iran, Islamic Republic of); Bahram Javidi, Univ. of Connecticut (USA); Saeed Bagheri, IBM Thomas J. Watson Research Ctr. (USA) . . . . . [8043-16]

Bright 3D display, native and integrated on-chip or system-level, Sutherland C. Ellwood, Jr., C. Frank Stirling, Photonica, Inc. (USA) . . . . . [8043-17]

Thursday 28 April

SESSION 5 . . . . . Thurs. 8:00 to 10:00 am

3D Visualization

Session Chair: **Adrian Stern,** Ben-Gurion Univ. of the Negev (Israel)

Application issues in the use of depth from (de)focus analysis methods *(Invited Paper)*, Mehdi Daneshpanah, Kevin G. Harding, Gil Abramovich, GE Global Research (USA); Arun Vemury, U.S. Dept. of Homeland Security (USA) . . . . . [8043-18]

Automated modified composite pattern single image depth acquisition, Charles Casey, Laurence Hassebrook, Univ. of Kentucky (USA) . . . . . [8043-19]

Efficient reconstruction of 3D images from photon starved integral imaging using preconditioned PMLEM *(Invited Paper)*, Doron Aloni, Ben-Gurion Univ. of the Negev (Israel). . . . . [8043-20]

3D sensing and visualization of micro-objects using axially distributed image capture, Donghak Shin, Myungjin Cho, Bahram Javidi, Univ. of Connecticut (USA) . . . . . [8043-21]

Three-dimensional imaging of objects in scattering medium by using statistical image processing, Myungjin Cho, Bahram Javidi, Univ. of Connecticut (USA). . . . . [8043-22]

SESSION 6 . . . . . Thurs. 10:30 to 11:40 am

3D Displays and Related II

Session Chairs: **Ramesh Raskar,** Massachusetts Institute of Technology; **Fumio Okano,** NHK Science & Technical Research Labs. (Japan)

Content-adaptive parallax barriers for optimizing dual-layer 3D displays using low-rank light field factorization *(Invited Paper)*, Douglas R. Lanman, Ramesh Raskar, Massachusetts Institute of Technology (USA). . . . . [8043-23]

Comparisons of perceived images from three different stereo camera arrangements, Jung-Young Son, Seokwon Yeom, Dong-Su Lee, Daegu Univ. (Korea, Republic of); Min-Chul Park, Korea Institute of Science and Technology (Korea, Republic of). . . . . [8043-24]

Compensation of stereoscopic crosstalk in 3D display by equalizing gamma characteristics, Dae-Sik Kim, Sergey A. Chestak, Samsung Electronics Co., Ltd. (Korea, Republic of). . . . . [8043-25]

Lunch/Exhibition Break . . . . . 11:40 am to 12:50 pm

2010 Best Paper Awards . . . . . Thurs. 12:50 to 1:00 pm

Announcement: Three papers will be selected for the 2011 Best Paper Awards among the papers accepted for Three-Dimensional Imaging, Visualization, and Display conference 8043. A panel of experts will evaluate all the papers. The criteria for evaluation will include: 1) innovation; 2) clarity and quality of the manuscript submitted; and 3) the significance and impact of the work reported. In order to be considered for a Best Paper Award, authors must make their oral presentation and submit their manuscript as scheduled. Conference chairs will not participate in the evaluation process of the papers. All decisions regarding selection of the best papers will be made by an evaluation committee.

SESSION 7 . . . . . Thurs. 1:00 to 2:40 pm

3D Displays and Related III

Session Chair: **Thierry Fournel,** Lab. Hubert Curien (France)

Virtual touch on 3D-images based on embedded optical sensor array system *(Invited Paper)*, Yi-Pai Huang, Guo-Zhen Wang, Shan-Yu Tung, Ming-Ching Ma, National Chiao Tung Univ. (Taiwan); Hung-Wei Tseng, Jui-Chi Lo, Chung-Hong Kuo, AU Optronics Corp. (Taiwan) . . . . . [8043-26]

Applications of liquid crystal lens for autostereoscopic 2D/3D display based on tablet personal computer, Sheng-Chi Liu, Chunghwa Picture Tubes, Ltd. (Taiwan). . . . . [8043-27]

A method for taking a right scaled depth sense in multiview autostereoscopy: using a recomposed hybrid object space based on the actual images by both multi Z-depth and common cameras, Kwang-Hoon Lee, Sung-Kyu Kim, Korea Institute of Science and Technology (Korea, Republic of). . . . . [8043-28]

3D imaging and wavefront sensing with a plenoptic objective *(Invited Paper)*, José Manuel Rodríguez-Ramos, Univ. de La Laguna (Spain); Roberto López López, Instituto de Astrofísica de Canarias (Spain); Jonas Philipp Lüke, Jose Gil Marichal-Hernández, Fernando Rosa González, Univ. de La Laguna (Spain) . . . . . [8043-29]

SESSION 8 . . . . . Thurs. 2:40 to 5:50 pm

Digital Holography and Related

Session Chair: **Mehdi Daneshpanah,** Univ. of Connecticut

Inverse problem approach for digital hologram reconstruction *(Invited Paper)*, Corinne Fournier, Univ. Jean Monnet Saint-Etienne (France); Loic Denis, Eric M. Thiebaut, Ctr. de Recherche Astronomique de Lyon (France); Thierry Fournel, Mozhdeh Seifi, Univ. Jean Monnet Saint-Etienne (France). . . . . [8043-30]

Three-dimensional imaging of dynamic phenomena in micro-objects using phase contrast digital holographic interference microscopy *(Invited Paper)*, Arun Anand, Vani Chhaniwal, Maharaja Sayajirao Univ. of Baroda (India); Bahram Javidi, Univ. of Connecticut (USA) . . . . . [8043-31]

Quantitative analysis of three-dimensional biological cells using interferometric microscopy *(Invited Paper)*, Natan T. Shaked, Adam P. Wax, Duke Univ. (USA). . . . . [8043-32]

Integration of microscopic holograms based on view compensation, Ho-Dong Lee, Min-Chul Park, Korea Institute of Science and Technology (Korea, Republic of); Jung-Young Son, Daegu Univ. (Korea, Republic of) . . . . . [8043-33]

Phase contrast imaging using digital holography *(Invited Paper)*, Joby Joseph, Samsheerali Poyithil Thottiparambil, Indian Institute of Technology Delhi (India); Bhargab Das, Univ. of Massachusetts Boston (USA) . . . . . [8043-34]

Dual wavelength digital holography phase unwrapping by linear regression, Alexander T. Khmaladze, Rebecca Matz, Chi Zhang, Joshua Jasensky, Mark Banaszak Holl, Zhan Chen, Univ. of Michigan (USA) . . . . . [8043-35]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

3D abnormal behavior recognition in power generation, Jie Su, Harbin Univ. of Science and Technology (China); Zhenhua Wei, North China Electric Power Univ. (China) . . . . . [8043-36]

Three-dimensional stereoscopic display system on the tabletop, Ki-Hyuk Yoon, Sung-Kyu Kim, Korea Institute of Science and Technology (Korea, Republic of). . . . . [8043-37]

Reconfiguration methods of viewing zone in mobile auto-stereoscopic display, Seon-Kyu Yoon, Sung-Kyu Kim, Korea Institute of Science and Technology (Korea, Republic of) . . . . . [8043-38]

Digital holographic microscopy of optically trapped three-dimensional microstructures, Ali-Reza Moradi, Institute for Advanced Studies in Basic Sciences (Iran, Islamic Republic of) and Zanjan Univ. (Iran, Islamic Republic of); Mohammad Kutub Ali, Institute for Advanced Studies in Basic Sciences (Iran, Islamic Republic of); Mehdi Daneshpanah, Univ. of Connecticut (USA); Arun Anand, Maharaja Sayajirao Univ. of Baroda (India); Bahram Javidi, Univ. of Connecticut (USA). . . . . [8043-39]

Three-dimensional speckle-noise reduction by using computational integral imaging and statistical point estimator, Inkyu Moon, Chosun Univ. (Korea, Republic of); Bahram Javidi, Univ. of Connecticut (USA) . . . . . [8043-40]

Range estimation with stereoscopic passive millimeter-wave imaging and multivariate Gaussian mixture modeling, Seokwon Yeom, Dong-Su Lee, Jung-Young Son, Vladmir P. Guschin, Daegu Univ. (Korea, Republic of) . . . . . [8043-41]

Quantum dot embedded silica aerogels: concept demonstration for multicolor true volumetric displays, Ross Miller, Valery Marinov, Ivan T. Lima, Jr., North Dakota State Univ. (USA) . . . . . [8043-42]

Courses of Related Interest

SC159 **Head-Mounted Displays: Design and Applications** (Melzer, Browne) Wednesday, 8:30 am to 5:30 pm

SC838 **Laser Range Gated Imaging Techniques** (Duncan) Tuesday, 1:30 to 5:30 pm

See full course listing and descriptions on pp. 144-192.

Monday-Tuesday 25-26 April 2011 • Proceedings of SPIE Vol. 8044

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Sensors and Systems for Space Applications IV

Conference Chairs: **Khanh D. Pham,** Air Force Research Lab.; **Henry Zmuda,** Univ. of Florida; **Joseph Lee Cox,** Missile Defense Agency; **Greg J. Meyer,** U.S. Air Force

Program Committee: **Thomas George**, Zyomed Corp.; **Steven C. Gordon,** Georgia Tech Research Institute; **Richard T. Howard,** NASA Marshall Space Flight Ctr.; **Jeffrey L. Janicik,** Innoflight Inc.; **Ou Ma,** New Mexico State Univ.; **Pejmun Motaghedi,** The Boeing Co.

Monday 25 April

SESSION 1 . . . . . Mon. 8:40 to 10:00 am

Data Exploitation

Session Chairs: **Greg J. Meyer,** U.S. Air Force; **Khanh Pham,** Air Force Research Lab.

Ground jammer localization with two satellites based on the fusion of multiple parameters, Zhonghai Wang, Michigan Technological Univ. (USA); Khanh D. Pham, Erik P. Blasch, Air Force Research Lab. (USA); Genshe Chen, DCM Research Resources LLC (USA) . . . . . [8044-01]

ePDAF for tracking a target with nearly deterministic motion in a cluttered environment, Xin Tian, Univ. of Connecticut (USA); Erik P. Blasch, Khanh D. Pham, Air Force Research Lab. (USA); Genshe Chen, DCM Research Resources LLC (USA) . . . . . [8044-02]

Scheduling of a constellation of imaging satellites with usage constraints, Peter J. Shea, Nathan Nasgovitz, Black River Systems Co. (USA). . . . . [8044-03]

Fusion of radar and satellite target measurements, Morton S. Farber, Donald Blaty, Gabriel Moy, Carlton D. Nealy, The Aerospace Corp. (USA) . . . . . [8044-04]

SESSION 2 . . . . . Mon. 10:30 am to 12:10 pm

Space Situational Awareness

Session Chairs: **Khanh Pham,** Air Force Research Lab.; **Greg J. Meyer,** U.S. Air Force

Optical payload for the STARE Mission, Lance M. Simms, Vincent J. Riot, Willem H. De Vries, Brian J. Bauman, Donald W. Phillion, Scot S. Olivier, Alexander J. Pertica, Sergei Nikolaev, Lawrence Livermore National Lab. (USA) . . . . . [8044-05]

Upstream data fusion of multiple optical sensors for improved tracking and discrimination of geosynchronous satellites, Andrew J. Newman, Christopher H. Michaelis, Eric M. Klatt, Nishant L. Mehta, Thomas S. Spisz, Eliezer G. Kahn, The Johns Hopkins Univ. (USA) . . . . . [8044-06]

Compressive sensing for space imaging applications, Sang P. Chin, The Johns Hopkins Univ. Applied Physics Lab. (USA); Lauren Kennell, U.S. Naval Academy (USA); Alison Carr, Dave Blodgett, The Johns Hopkins Univ. Applied Physics Lab. (USA); Trac D. Tran, Dzung T. Nguyen, The Johns Hopkins Univ. (USA) . . . . . [8044-08]

Homography-based change detection for space-based satellite inspection, Ryan Buffington, John E. McInroy, Univ. of Wyoming (USA) . . . . . [8044-09]

Change detection for visual satellite inspection using pose estimation and image synthesis, Ryan Buffington, John E. McInroy, Univ. of Wyoming (USA) . . . . . [8044-10]

Lunch Break . . . . . 12:10 to 2:00 pm

SESSION 3 . . . . . Mon. 2:00 to 3:20 pm

RSO and Collision Avoidance

Session Chairs: **Richard T. Howard,** NASA Marshall Space Flight Ctr.; **Greg J. Meyer,** U.S. Air Force

Pursuit-evasion orbital game for satellite interception and collision avoidance, Dan Shen, DCM Research Resources, LLC (USA); Khanh D. Pham, Air Force Research Lab. (USA); Genshe Chen, DCM Research Resources, LLC (USA); Erik P. Blasch, Air Force Research Lab. (USA) . . . . . [8044-11]

A trust-based sensor allocation algorithm in cooperative space tracking problems, Dan Shen, Genshe Chen, DCM Research Resources, LLC (USA); Khanh Pham, Erik P. Blasch, Air Force Research Lab. (USA). . . . . [8044-12]

Detection and tracking of LEO collision events using space-based sensors, Adel I. El-Fallah, Aleksandar Zatezalo, Scientific Systems Co., Inc. (USA); Ronald Mahler, Lockheed Martin Maritime Systems & Sensors (USA); Khanh Pham, Air Force Research Lab. (USA). . . . . [8044-13]

Sensor management for collision alert in orbital object tracking, Peiran Xu, Huimin Chen, Univ. of New Orleans (USA); Dan Shen, Genshe Chen, I-Fusion, Inc. (USA); Khanh D. Pham, Erik P. Blasch, Air Force Research Lab. (USA). . [8044-14]

SESSION 4 . . . . . Mon. 3:50 to 4:30 pm

Rendezvous and Docking

Session Chairs: **Ou Ma,** New Mexico State Univ.; **Steven C. Gordon,** Georgia Tech Research Institute

Fast relative guidance approach for autonomous rendezvous and docking control, Mike DeVelle, Yunjun Xu, Univ. of Central Florida (USA); Khanh Pham, Air Force Research Lab. (USA); Genshe Chen, DCM Research Resources LLC (USA) . . . . . [8044-15]

Control of an industrial robot for hardware-in-the-loop simulation of satellite docking, Ou Ma, Steven Fillmore, New Mexico State Univ. (USA); Melak Zebenay, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [8044-16]

SESSION 5 . . . . . Mon. 4:30 to 5:40 pm

Spacecraft Structures

Session Chairs: **Ou Ma,** New Mexico State Univ.; **Steven C. Gordon,** Georgia Tech Research Institute

A suborbital flight experiment for validating a satellite inertia identification method *(Invited Paper)*, Gerardo Martinez, Ivann Ferrel, Pu Xie, Ou Ma, New Mexico State Univ. (USA) . . . . . [8044-17]

Spaceborne telescopes on a budget: paradigms for producing high-reliability telescopes, scanners, and EO assemblies using heritage building blocks, Mark Schwalm, L-3 Communications SSG-Tinsley (USA); Tony B. Hull, L-3 Communications Tinsley Labs. Inc. (USA) . . . . . [8044-18]

The isotropic behavior of an anisotropic material: single crystal silicon (SCSi), Roger A. Paquin, Douglas R. McCarter, McCarter Machine, Inc. dba McCarter Technology, Inc. (USA) . . . . . [8044-19]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 6 . . . . . Tues. 10:00 to 11:00 am

Keynote Session

Is space the ultimate high ground? *(Keynote Presentation)*, Greg J. Meyer, U.S. Air Force (USA) . . . . . [8044-20]

SESSION 7 . . . . . Tues. 11:00 am to 12:00 pm

Photonics in Space

Session Chairs: **Henry Zmuda,** Univ. of Florida; **Joseph Lee Cox,** Missile Defense Agency

Narrow ion-beam figuring: an optical figuring tool that enables new optical systems solutions, Ulrich Mueller, Jeff Stone, Bridget Peters, Jay Daniel, L-3 Communications Tinsley Labs. Inc. (USA); Ruslan Belikov, Thomas P. Greene, NASA Ames Research Ctr. (USA); Tony B. Hull, L-3 Communications Tinsley Labs. Inc. (USA) . . . . . [8044-21]

Fiber Bragg-grating true-time delay-based multi-RF-beam steering, Richard J. Black, Behzad Moslehi, Intelligent Fiber Optic Systems Corp. (USA); Azad Siahmakoun, Sergio C. Granieri, Rose-Hulman Institute of Technology (USA) . . . . . [8044-22]

Radiation-resistant fiber optic gyroscope for space applications, Behzad Moslehi, Intelligent Fiber Optic Systems Corp. (USA); Ram Yahalom, InFiber Technology (USA); Richard J. Black, Ferey Faridian, Intelligent Fiber Optic Systems Corp. (USA); Teng Ooi, Aaron Corder, U.S. Army Space and Missile Defense Command (USA) . . . . . [8044-23]

Lunch/Exhibition Break . . . . . 12:00 to 1:30 pm

SESSION 8 . . . . . Tues. 1:30 to 4:20 pm

Space-Based Sensors

Session Chairs: **Joseph Lee Cox,** Missile Defense Agency; **Henry Zmuda,** Univ. of Florida

A thermal infrared hyperspectral imager for small satellites *(Invited Paper)*, Sarah T. Crites, Paul G. Lucey, Robert Wright, Univ. of Hawai'i (USA) . . . [8044-24]

A 30 frames-per-second 18-million pixel image sensor for space applications, Paul P. K. Lee, J. Daniel Newman, Andrew P. Sacco, John A. Nieznanski, ITT Corp. Geospatial Systems (USA) . . . . . [8044-25]

A study of image quality for imagery generated by standard and hybrid intensity interferometers, Jeremy Murray-Krezan, Peter N. Crabtree, Air Force Research Lab. (USA) . . . . . [8044-26]

Holographic weapons sight as a crew optical alignment sight, Nujoud Merancy, Booz Allen Hamilton Inc. (USA); Brian Dehmlow, L-3 Communications EOTech (USA); Jack P. Brazzel, NASA Johnson Space Ctr. (USA) . . . . . [8044-27]

Navigation Doppler lidar sensor for precision altitude and vector velocity measurements: flight test results, Diego F. Pierrottet, Coherent Applications, Inc. (USA); Farzin Amzajerdian, Larry Petway, Bruce Barnes, NASA Langley Research Ctr. (USA); George Lockard, Coherent Applications, Inc. (USA); Glenn Hines, NASA Langley Research Ctr. (USA) . . . . . [8044-28]

POSE algorithms for automated docking *(Invited Paper)*, Richard T. Howard, Andrew Heaton, NASA Marshall Space Flight Ctr. (USA) . . . . . [8044-29]

SESSION 9 . . . . . Tues. 4:20 to 5:20 pm

Extraterrestrial Robotics

Session Chairs: **Steven C. Gordon,** Georgia Tech Research Institute; **Richard T. Howard,** NASA Marshall Space Flight Ctr.

Manipulability analysis of a two-link space robot using differential geometry method, Yanheng Zhang, Hanxu Sun, Qingxuan Jia, Beijing Univ. of Posts and Telecommunications (China) . . . . . [8044-30]

Dynamic analysis of a spherical mobile robot in rough terrains, Tao Yu, Hanxu Sun, Yanheng Zhang, Beijing Univ. of Posts and Telecommunications (China) . . . . . [8044-31]

Mechanical analysis about the spherical mobile robot on the moon environment, Zhao Wei, Hanxu Sun, Yanheng Zhang, Beijing Univ. of Posts and Telecommunications (China) . . . . . [8044-32]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

An active co-phasing imaging testbed with segmented mirrors, Weirui Zhao, Beijing Institute of Technology (China) . . . . . [8044-33]

Performance analysis of ground-to-satellite free-space optical communications, Thomas Benoy, Cochin Univ. of Science & Technology (India) . . . . . [8044-34]

Carbon/carbon for satellite applications, Mustapha M. Meftah, Ctr. National de la Recherche Scientifique (France) . . . . . [8044-35]

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Unmanned Systems Technology XIII

Conference Chairs: **Douglas W. Gage,** XPM Technologies; **Charles M. Shoemaker,** General Dynamics Robotic Systems; **Robert E. Karlsen,** U.S. Army Tank Automotive Research, Development and Engineering Ctr.; **Grant R. Gerhart,** U.S. Army Tank Automotive Research, Development and Engineering Ctr.-Retired

Program Committee: **Stephen Balakirsky,** National Institute of Standards and Technology; **Johann Borenstein,** Univ. of Michigan; **Jonathan A. Bornstein,** U.S. Army Research Lab.; **Rajiv V. Dubey,** Univ. of South Florida; **Hobart R. Everett,** Space and Naval Warfare Systems Ctr. Pacific; **Jared Giesbrecht,** Defence Research and Development Canada (Canada); **David Gorsich,** U.S. Army Tank Automotive Research, Development and Engineering Ctr.; **Susan G. Hill,** U.S. Army Aberdeen Test Ctr.; **Karl D. Iagnemma,** Massachusetts Institute of Technology; **Gene A. Klager,** U.S. Army Night Vision & Electronic Sensors Directorate; **Andreas F. Koschan,** The Univ. of Tennessee; **James H. Lever,** U.S. Army Corps of Engineers; **Larry H. Matthies,** Jet Propulsion Lab.; **Kevin L. Moore,** Colorado School of Mines; **Hoa G. Nguyen,** Space and Naval Warfare Systems Command; **James L. Overholt,** U.S. Army Tank Automotive Research, Development and Engineering Ctr.; **Marc Raibert,** Boston Dynamics; **Klaus-Juergen Schilling,** Julius-Maximilians-Univ. Würzburg (Germany); **Nahid N. Sidki,** SAIC; **Harpreet Singh,** Wayne State Univ.; **Magnús S. H. Snorrason,** Charles River Analytics, Inc.; **Anthony Stentz,** Carnegie Mellon Univ.; **David L. Stone,** Mechatron Consulting; **Venkataraman Sundareswaran,** Teledyne Scientific Co.; **Brian H. Wilcox,** Jet Propulsion Lab.; **Gary Witus,** Turing Associates, Inc.; **Brian M. Yamauchi,** iRobot Corp.

Wednesday 27 April

SESSION 1 . . . . . Wed. 8:00 to 9:40 am

MAST-Navigation

Joint Session with Conference 8031

Session Chairs: **Larry H. Matthies,** Jet Propulsion Lab.; **Joseph N. Mait,** U.S. Army Research Lab.

Results from MAST joint experiment 3.1 *(Invited Paper)*, John G. Rogers III, Georgia Institute of Technology (USA) and Univ. of Pennsylvania (USA); Alex Cunningham, Manohar Paluri, Henrik I. Christensen, Georgia Institute of Technology (USA); Nathan Michael, Vijay Kumar, Univ. of Pennsylvania (USA); Larry H. Matthies, Jeremy Ma, Jet Propulsion Lab. (USA); Frank Dellaert, Georgia Institute of Technology (USA) . . . . . [8031-34]

Autonomous navigation with teams of aerial robots *(Invited Paper)*, Nathan Michael, Univ. of Pennsylvania (USA) . . . . . [8031-35]

Vision-aided landing and ingress of a micro-air-vehicle using a monocular camera *(Invited Paper)*, Roland Brockers, Jet Propulsion Lab. (USA); Patrick Bouffard, Univ. of California, Berkeley (USA); Jeremy Ma, Larry H. Matthies, Jet Propulsion Lab. (USA); Claire Tomlin, Univ. of California, Berkeley (USA) [8031-36]

Estimation of vehicle velocity and proximity via wide-field integration of optic flow *(Invited Paper)*, James S. Humbert, Steven Gerardi, Andrew Hyslop, Univ. of Maryland, College Park (USA) . . . . . [8031-37]

Compact beam scanning 240GHz radar for navigation and collision avoidance *(Invited Paper)*, Kamal Sarabandi, Mehrnoosh Vahidpour, Maysam Moallem, Jack R. East, Univ. of Michigan (USA). . . . . [8031-38]

SESSION 2 . . . . . Wed. 9:40 to 10:00 am

MAST-Communication

Joint Session with Conference 8031

Session Chairs: **William Nothwang,** U.S. Army Research Lab.; **Joseph N. Mait,** U.S. Army Research Lab.

New techniques for efficient flexible wireless transceivers in nanometer CMOS *(Invited Paper)*, Michael Flynn, Univ. of Michigan (USA) . . . . . [8031-39]

SESSION 2A . . . . . Wed. 10:30 to 11:30 am

MAST-Communication

Joint Session with Conference 8031

Session Chairs: **William Nothwang,** U.S. Army Research Lab.; **Joseph N. Mait,** U.S. Army Research Lab.

Reconfigurable firmware-defined radios synthesized from standard digital logic cells *(Invited Paper)*, David D. Wentzloff, Muhammad Faisal, Youngmin Park, Univ. of Michigan (USA) . . . . . [8031-40]

Radio signal strength tracking and control for robotic networks *(Invited Paper)*, Brian M. Sadler, Paul Yu, Jeffrey Twigg, U.S. Army Research Lab. (USA) . . . . . [8031-41]

Enhanced ad hoc wireless connectivity in complex environment using small radio repeater systems *(Invited Paper)*, Kamal Sarabandi, Youngjun Song, Jungsuek Oh, Univ. of Michigan (USA) . . . . . [8031-42]

Lunch/Exhibition Break . . . . . 11:30 am to 1:00 pm

SESSION 3 . . . . . Wed. 1:00 to 3:00 pm

Perception

Session Chairs: **Larry H. Matthies,** Jet Propulsion Lab.; **Magnús S. H. Snorrason,** Charles River Analytics, Inc.

Safe operations of unmanned systems for reconnaissance in complex environments, Joseph Kott III, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); Edward Mottern, General Dynamics Robotic Systems (USA) . . . . . [8045-01]

Stereo vision-based terrain perception using thermal infrared sensors, Arturo L. Rankin, Larry H. Matthies, Andres Huertas, Max Bajracharya, Jet Propulsion Lab. (USA); Gary Sherwin, General Dynamics Robotic Systems (USA) . . [8045-02]

Robot training through incremental learning, Robert E. Karlsen, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); Gary Witus, Wayne State Univ. (USA); Shawn T. Hunt, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA) . . . . . [8045-03]

Safeguarding tele-operation using an automotive radar sensor, Jared Giesbrecht, Defence Research and Development Canada (Canada) . . . . . [8045-04]

High-frequency imaging radar for robotic navigation and situational awareness, David J. Thomas, U.S. Army Tank-Automotive and Armaments Command (USA) . . . . . [8045-05]

Pedestrian and car detection, classification, and tracking for unmanned ground vehicle using 3D lidar and monocular camera, Kuk Cho, Univ. of Science & Technology (Korea, Republic of); Seung-Ho Baeg, Korea Institute of Industrial Technology (Korea, Republic of); Ki Min Lee, Hae Seok Lee, LG Innotek (Korea, Republic of); SangDeok Park, Korea Institute of Industrial Technology (Korea, Republic of). . . . . [8045-06]

SESSION 4 . . . . . Wed. 3:30 to 5:30 pm

Articulation and Manipulation

Session Chairs: **Paul Muench,** U.S. Army Tank Automotive Research, Development and Engineering Ctr.; **Mike Perschbacher,** RovnoTech

Some recent advances and remaining challenges in bipedal walking robots and exoskeletons *(Invited Paper)*, Jerry E. Pratt, Institute for Human and Machine Cognition (USA) . . . . . [8045-07]

Aladdin: a semi-autonomous door opening system for EOD-class robots, Jack Craft, Jack Wilson, Honeybee Robotics (USA); Wesley H. Huang, Mark R. Claffee, Emilie Phillips, iRobot Corp. (USA) . . . . . [8045-08]

Human-like characteristics for high-degree of freedom robotic door opening end effector, Jeremy Gray, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); Frank Campagna, RE2, Inc. (USA) . . . . . [8045-10]

Dexterous manipulation for non-line-of-sight articulated manipulators, John Hu, Yi-Je Lim, Hstar Technologies (USA) . . . . . [8045-12]

Modular intelligent manipulation for high-DOF robotic arms, Jeremy Gray, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); David Rusbarsky, Douglas J. Peters, RE2, Inc. (USA) . . . . . [8045-14]

Sensor-based redundancy resolution for a mobile robotic manipulator, Ning Xi, Michigan State Univ. (USA) . . . . . [8045-15]

Thursday 28 April

SESSION 5 . . . . . Thurs. 8:00 to 10:00 am

Self-Organizing, Collaborative, and Unmanned ISR Robots

Joint Session with Conference 8062

Session Chairs: **Melanie Dumas,** Defense Advanced Research Projects Agency; **Grant R. Gerhart,** U.S. Army Tank Automotive Research, Development and Engineering Ctr.-Retired

Biologically-inspired approaches for self-organization, adaptation, and collaboration of heterogeneous autonomous systems, Marc L. Steinberg, Office of Naval Research (USA). . . . . [8062-16]

Migration strategies for service-enabling ground control stations for unmanned systems, Joseph B. Kroculick, Winifred Associates (USA) . . [8062-17]

JEFX 10 demonstration of cooperative hunter killer UAS and upstream data fusion, Brian K. Funk, Andrew J. Newman, Jonathan C. Castelli, Adam S. Watkins, Christopher B. McCubbin, Jeffrey D. Barton, Cameron K. Peterson, Jonathan T. DeSena, Daniel A. Dutrow, Pedro A. Rodriguez, Steven J. Marshall, The Johns Hopkins Univ. (USA) . . . . . [8045-09]

Dynamic replanning on demand of UAS constellations performing ISR missions, Daniel W. Stouch, Ernest Zeidman, William Callahan, Charles River Analytics, Inc. (USA); Kirk McGraw, U.S. Army Engineer Research and Development Ctr. (USA) . . . . . [8045-11]

All weather sense and avoid system (AWSAS) for all UAS and manned platforms, Vincent M. Contarino, R-Cubed Engineering, LLC (USA). . . . [8045-13]

Autonomous sustain and resupply: What is the future?, Gregory S. Broten, Defence Research and Development Canada (Canada). . . . . [8045-29]

SESSION 6 . . . . . Thurs. 10:30 to 11:50 am

Navigation and Mobility I

Session Chairs: **Robert E. Karlsen,** U.S. Army Tank Automotive Research, Development and Engineering Ctr.; **Brian M. Yamauchi,** iRobot Corp.

Little dog learning tractive and compressive terrain characteristics, Bruce L. Digney, Defence Research and Development Canada (Canada) . . . . . [8045-17]

Driver-assist behaviors for high-speed small UGVs, Brian M. Yamauchi, iRobot Corp. (USA) . . . . . [8045-18]

Fusion of visual odometry and inertial data for enhanced, real-time egomotion estimation, Victor E. Perlin, David B. Johnson, Mitchell M. Rohde, Quantum Signal LLC (USA); Robert E. Karlsen, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA) . . . . . [8045-19]

Design, modelling, implementation, and intelligent fuzzy control of a hovercraft, Wessam M. Hussein, Mahmoud M. Elkhatib, Egyptian Armed Forces (Egypt) . . . . . [8045-20]

Lunch/Exhibition Break . . . . . 11:50 am to 1:00 pm

SESSION 7 . . . . . Thurs. 1:00 to 3:00 pm

Navigation and Mobility II

Session Chairs: **Robert E. Karlsen,** U.S. Army Tank Automotive Research, Development and Engineering Ctr.; **Brian M. Yamauchi,** iRobot Corp.

Human leader and robot follower team without GPS and without line of sight, Surat Kwanmuang, Johann Borenstein, Lauro V. Ojeda, Univ. of Michigan (USA) . . . . . [8045-21]

Methods for UGV teleoperation with high latency communications, Gary Witus, Turing Associates, Inc. (USA); Shawn T. Hunt, Ryan Wolcott, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); Phillip Janicki, Signature Research, Inc. (USA) . . . . . [8045-22]

SUGV waypoint following, David Baran, U.S. Army Research Lab. (USA) . . . . . [8045-24]

Energy efficient path planning for skid-steered autonomous ground vehicles, Nikhil Gupta, Aneesh Sharma, The Florida State Univ. (USA). . . . . [8045-25]

Lessons to improve testing for countermine robotic systems, Isaac Chappell, Franklin L. Moses, Institute for Defense Analyses (USA); Matt Aeillo, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [8045-26]

SESSION 8 . . . . . Thurs. 3:30 to 5:30 pm

Intelligent Behaviors

Session Chairs: **Gregory R. Hudas,** U.S. Army Tank Automotive Research, Development and Engineering Ctr.; **Frank L. Lewis,** The Univ. of Texas at Arlington

A cell decomposition approach to pursuit and evasion with adversarial agents, Greg Foderaro, Brian Bernard, Silvia Ferrari, Duke Univ. (USA) . [8045-27]

Trust dynamics in multi-agent coalition formation, Dariusz G. Mikulski, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA) and Oakland Univ. (USA); Frank L. Lewis, The Univ. of Texas at Arlington (USA); Edward Y. Gu, Oakland Univ. (USA); Gregory R. Hudas, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA). . . . . [8045-28]

An improved particle filter approach for multiple target detection and tracking, Wenjie Lu, Guoxian Zhang, Silvia Ferrari, Duke Univ. (USA); Rafael O. Fierro, Ivana Palunko, The Univ. of New Mexico (USA) . . . . . [8045-16]

X-band radar for UAV-borne MAV target recognition, Allistair Moses, Matthew J. Rutherford, Kimon P. Valavanis, Univ. of Denver (USA) . . . . . [8045-30]

Building entity models through observation and learning, Richard D. Garcia, Motile Robotics Inc. (USA); Robert Kania, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); MaryAnne Fields, U.S. Army Research Lab. (USA); Laura E. Barnes, Univ. of South Florida (USA). . . . . [8045-31]

Neuro-optimal control of helicopter UAVs, David J. Nodland, Missouri Univ. of Science and Technology (USA); Arpita Ghosh, National Metallurgical Lab. (India); Jagannathan Sarangapani, Missouri Univ. of Science and Technology (USA) . . . . . [8045-32]

A structured environment path tracking controller, Kevin L. Moore, Jesse Hulbert, John P. Steele, Colorado School of Mines (USA) . . . . . [8045-23]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Experiments and simulation of wireless communication range for control of small ground robots, Gedalia Kott, Nicholas Fung, Aaron Tucker, U.S. Army Research Lab. (USA) . . . . . [8045-43]

Development of an autonomous positioning and navigation spherical robot, Kang Hou, Hanxu Sun, Qingxuan Jia, Yanheng Zhang, Beijing Univ. of Posts and Telecommunications (China) . . . . . [8045-44]

Friday 29 April

SESSION 9 . . . . . Fri. 8:00 am to 12:10 pm

Special Topics

Session Chairs: **Douglas W. Gage,** XPM Technologies;
Charles M. Shoemaker, General Dynamics Robotic Systems

High-fidelity physics-based simulation of a UGV reconnaissance mission in a complex urban environment, Christopher Goodin, Jody D. Priddy, Christopher L. Cummins, Burhman Q. Gates, Jr., Phillip J. Durst, Taylor R. George, U.S. Army Engineer Research and Development Ctr. (USA) . . . . . [8045-33]

Light weight, portable operator control unit using an Android-enabled mobile phone, Nicholas Fung, U.S. Army Research Lab. (USA) . . . . . [8045-34]

Practical robotic self awareness and self knowledge, Douglas W. Gage, XPM Technologies (USA) . . . . . [8045-35]

Microrobotic surveillance: discrete and continuous starbots, Mohammad Mayyas, Woo Ho Lee, Harry E. Stephanou, The Univ. of Texas at Arlington (USA) . . . . . [8045-36]

Novel locomotion via biological inspiration, Roger D. Quinn, Alexander Boxerbaum, Alexander Hunt, Case Western Reserve Univ. (USA); Luther Palmer, Univ. of South Florida (USA); Hillel Chiel, Case Western Reserve Univ. (USA); Richard Bachmann, BioRobots, LLC (USA); Eric Diller, Case Western Reserve Univ. (USA) . . . . . [8045-37]

Zipper mast for enhanced communications and surveillance, George Woodruff, Geo Systems, Inc. (USA); Gary Witus, Turing Associates, Inc. (USA); Paul Muench, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA). . . . . [8045-38]

Small unmanned aerial platform for geospatial data collection and analysis, Eugene Levin, Aleksandr V. Sergeyev, Michigan Technological Univ. (USA) . . . . . [8045-39]

Laser power beaming for defense and security applications, Thomas Nugent, Jr., Jordin Kare, LaserMotive (USA) . . . . . [8045-40]

Projecting the future of robotics from its past, James D. English, Energid Technologies (USA); Paul Muench, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA) . . . . . [8045-41]

Quantitative investigation of the perception of the technology needs, trends, and future vision for unmanned systems, Ronald F. Storm, Jim Paul, Ricardo Inc. (USA); Corey Clothier, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); Joshua A. Kovac, AeroMech Engineering, Inc. (USA) . . . . . [8045-42]

Taking on the tall poles of autonomous robot navigation, Mark H. Rosenblum, Lockheed Martin Corp. (USA) . . . . . [8045-45]

Courses of Related Interest

SC996 **Introduction to GPS Receivers** (Zhu) Wednesday, 8:30 am to 12:30 pm
SC549 **Incorporating GPS Technology into Commercial and Military Applications** (Zhu) Wednesday, 1:30 to 5:30 pm
SC894 **Introduction to INS and INS-Based Integrated Navigation** (Soloviev) Wednesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

Thursday-Friday 28-29 April 2011 • Proceedings of SPIE Vol. 8046

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Unattended Ground, Sea, and Air Sensor Technologies and Applications XIII

Conference Chair: **Edward M. Carapezza,** Univ. of Connecticut and DARPA

Program Committee: **Jacques Bédard,** Defence Research and Development Canada (Canada); **John G. Blitch,** ARACAR: Alliance for Robot Assisted Crisis Assessment and Response; **John C. Carrano,** Carrano Consulting; **Christina J. Deckard,** Space and Naval Warfare Systems Ctr. Pacific; **Sachi V. Desai,** U.S. Army Armament Research, Development and Engineering Ctr.; **Daniel D. Desjardins,** Air Force Research Lab.; **John S. Eicke,** U.S. Army Research Lab.; **Alan J. Gray,** Defence Science and Technology Lab. (United Kingdom); **Todd M. Hintz,** Space and Naval Warfare Systems Command; **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr.; **Ivan Kadar,** Interlink Systems Sciences, Inc.; **George McNamara,** Naval Undersea Warfare Ctr.; **Tariq Manzur,** Naval Undersea Warfare Ctr.; **Huub A.J.M. van Hoof,** TNO Defence, Security and Safety (Netherlands); **Graeme P. van Voorthuijsen,** TNO Defence, Security and Safety (Netherlands)

Thursday 28 April

SESSION 1 . . . . . Thurs. 8:00 to 10:00 am

Gunfire Detection/Counter Sniper/Beam Forming

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr.; **Sachi V. Desai,** U.S. Army Armament Research, Development and Engineering Ctr.

SESSION 2 . . . . . Thurs. 10:30 to 11:50 am

Unmanned Surveillance Platforms (UUV/UAV)

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr.; **George McNamara,** Naval Undersea Warfare Ctr.

Lunch/Exhibition Break . . . . . 11:50 am to 1:20 pm

SESSION 3 . . . . . Thurs. 1:20 to 3:00 pm

Perimeter Surveillance/Asset Protection

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr.; **George McNamara,** Naval Undersea Warfare Ctr.

SESSION 4 . . . . . Thurs. 3:30 to 4:30 pm

Personnel Detection/Classification

Session Chairs: **Sachi V. Desai,** U.S. Army Armament Research, Development and Engineering Ctr.; **Todd M. Hintz,** Space and Naval Warfare Systems Command

SESSION 5 . . . . . Thurs. 4:30 to 5:50 pm

Distributed Sensor Fields and Networks

Session Chairs: **Sachi V. Desai,** U.S. Army Armament Research, Development and Engineering Ctr.;
Todd M. Hintz, Space and Naval Warfare Systems Command

Fish schools and bird flocks as mobile sensor arrays, Charles S. Bendall, Space and Naval Warfare Systems Ctr. Pacific (USA) . . . . . [8046-20]

Escape and evade control policies for ensuring the physical security of nonholonomic, ground-based, unattended mobile sensor nodes, David Mascarenas, Christopher Stull, Charles R. Farrar, Los Alamos National Lab. (USA) . . . . . [8046-21]

A method for robust adaptation of the configuration of distributed sensor fields, Thomas A. Wettergren, Naval Undersea Warfare Ctr. (USA). . . . . [8046-22]

FIRESTORM: a collaborative network suite application for rapid sensor data processing and precise decisive, Shaji Kaniyantethu, U.S. Army Armament Research, Development and Engineering Ctr. (USA) . . . . . [8046-23]

Friday 29 April

SESSION 6 . . . . . Fri. 8:30 to 11:40 am

EO, Imaging and Communications Technologies

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr.;
Tariq Manzur, Naval Undersea Warfare Ctr.

Detection of electromagnetic waves using MEMS antennas, Panos G. C. Datskos, Oak Ridge National Lab. (USA) . . . . . [8046-24]

An empirical method for dynamic camouflage assessment, John G. Blitch, Colorado State Univ., DoD SMART Program (USA) . . . . . [8046-25]

Relative intensity noise for uncooled silicon carbide mid-wave infrared detectors, Geunsik Lim, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Tariq Manzur, Naval Undersea Warfare Ctr. (USA); Aravinda Kar, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8046-26]

Ultraviolet photodetectors directly integrated on CMOS using low-temperature ZnO nanowire techniques, Robert Olah, Achyut Dutta, Banpil Photonics, Inc. (USA); Deli Wang, Consultant; Tariq Manzur, ... [8046-27]

Nanostructure-based EO/IR focal plane arrays for unattended ground sensor applications, Ashok K. Sood, Magnolia Optical Technologies, Inc. (USA); Tariq Manzur, Naval Undersea Warfare Ctr. (USA); A. F. Mehdi Anwar, Univ. of Connecticut (USA); Nibir K. Dhar, Dennis L. Polla, DARPA (USA); Priyalal S. Wijewarnasuriya, Army Research Lab. (USA) . . . . . [8046-28]

Free-space optical communication links at 1.55 µm for remote operation, John W. Zeller, Naval Undersea Warfare Ctr. (USA) . . . . . [8046-29]

Nighttime camera options for unattended ground sensor (UGS) applications, David C. Hartup, L-3 Communications Nova Engineering (USA); Charles M. Hanson, John W. Glesener, L-3 Electro-Optical Systems (USA) . . . . . [8046-30]

Heading errors in an alignment-based magnetometer, Chris Hovde, Southwest Sciences, Inc. (USA); Brian Patton, Univ. of California, Berkeley (USA); Oscar Versolato, Univ. of Groningen (Netherlands); Eric Corsini, Simon Rochester, Dmitry Budker, Univ. of California, Berkeley (USA). . . . . [8046-31]

Courses of Related Interest

SC996 **Introduction to GPS Receivers** (Zhu) Wednesday, 8:30 am to 12:30 pm
SC549 **Incorporating GPS Technology into Commercial and Military Applications** (Zhu) Wednesday, 1:30 to 5:30 pm
SC894 **Introduction to INS and INS-Based Integrated Navigation** (Soloviev) Wednesday, 8:30 am to 5:30 pm
SC952 **Applications of Detection Theory** (Carrano) Thursday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

Tuesday-Thursday 26-28 April 2011 • Proceedings of SPIE Vol. 8047

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Ground/Air Multisensor Interoperability, Integration, and Networking for Persistent ISR II

Conference Chair: **Michael A. Kolodny,** U.S. Army Research Lab.

Conference Co-Chairs: **Tien Pham,** U.S. Army Research Lab.; **Kevin L. Priddy,** Air Force Research Lab.

Program Committee: **Jacques Bédard,** Defence Research and Development Canada (Canada); **Jeff Houser,** U.S. Army Research Lab.; **Gavin Pearson,** Defence Science and Technology Lab. (United Kingdom); **Stephen G. Perry,** MTC Services Corp; **Ronald B. Sartain,** U.S. Army Research Lab.; **King K. Siu,** U.S. Army Armament Research, Development and Engineering Ctr.; **Raja Suresh,** General Dynamics Advanced Information Systems; **Graeme P. van Voorthuijsen,** TNO Defence, Security and Safety (Netherlands); **Rob Williams,** Air Force Research Lab.

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 1 . . . . . Tues. 10:00 am to 12:00 pm

Interoperability I: Terra Harvest

Session Chairs: **Michael A. Kolodny,** U.S. Army Research Lab.; **Tien Pham,** U.S. Army Research Lab.

Ground/air multisensor interoperability, integration, and networking for persistent ISR: what, why, who, Michael A. Kolodny, U.S. Army Research Lab. (USA) . . . . . [8047-01]

Promoting interoperability within the UGS community and effective acquisition of UGS solutions for the warfighter, Robert Heathcock, U.S. Dept. of Defense (USA) . . . . . [8047-02]

Terra Harvest: an open, integrated battlefield unattended ground sensors (UGS) architecture, Robert Heathcock, U.S. Dept. of Defense (USA); Colson Brasch, Kent Linnebur, MITRE Corp. (USA) . . . . . [8047-03]

Architectural developments for Terra Harvest and the UGS Standards Working Group, Jeff Houser, U.S. Army Research Lab. (USA) . . . . . [8047-04]

After three phases of the Terra Harvest program, what are the lessons learned, and future impacts, Duke Buster, Derick Gerlock, Honeywell, Inc. (USA). . . . . [8047-05]

Terra Harvest open source environment (THOSE): a universal unattended ground-sensor controller, Kevin Klawon, Univ. of Dayton Research Institute (USA); Darren Landoll, Phil M. Hirz, L-3 Communications Nova Engineering (USA) . . . . . [8047-06]

Lunch/Exhibition Break . . . . . 12:00 to 1:30 pm

SESSION 2 . . . . . Tues. 1:30 to 3:10 pm

Interoperability II

Session Chairs: **Jacques Bédard,** Defence Research and Development Canada (Canada); **Jeff Houser,** U.S. Army Research Lab.

Interoperability: a big picture perspective, Michael A. Kolodny, U.S. Army Research Lab. (USA) . . . . . [8047-07]

Integration of current force unattended ground sensors for the Empire Challenge, Gary H. Stolovy, U.S. Army Research Lab. (USA) . . . . . [8047-08]

A packaged native data format for interoperability of unattended ground sensors with a sensorML-enabled controller, Jonathan L. Chambers, Albert J. Brunck, Jr., Northrop Grumman-Xetron (USA) . . . . . [8047-09]

Model-driven SOA for sensor networks, Christopher Gibson, John Ibbotson, David Braines, Tom Klapiscak, IBM United Kingdom Ltd. (United Kingdom); Boleslaw K. Szymanski, Sahin Geyik, Rensselaer Polytechnic Institute (USA) . . . . . [8047-10]

Decentralized operating procedures for orchestrating data and behavior across distributed military systems and assets, Nicholas Peach, PB Partnership Ltd. (United Kingdom) . . . . . [8047-11]

SESSION 3 . . . . . Tues. 3:40 to 5:20 pm

New Technology I

Session Chairs: **King K. Siu,** U.S. Army Armament Research, Development and Engineering Ctr.; **Ronald B. Sartain,** U.S. Army Research Lab.

PILAR gunfire detection system enhancements (GDS), Alain Donzier, 01dB-Metravib (France); Sandra Gomez, U.S. Army Armament Research, Development and Engineering Ctr. (USA) . . . . . [8047-12]

The acoustic vector sensor: a versatile battlefield acoustics sensor, Jelmer Wind, Hans-Elias de Bree, Microflown Technologies (Netherlands) . . . . . [8047-13]

Attenuation of individual seismic-wave types using various architectural enclosures for geophones, Sean Schumer, U.S. Army RDECOM-ARDEC (USA) . . . . . [8047-14]

Embedded real-time classifier for profiling sensors and custom detector configuration, R. Kenny Reynolds, Jr., Srikant K. Chari, The Univ. of Memphis (USA); David J. Russomanno, Indiana Univ.-Purdue Univ. Indianapolis (USA) . . . . . [8047-15]

An assessment of a 360-degree profiling sensor for object classification, Jeremy B. Brown, Srikant K. Chari, Eddie Jacobs, The Univ. of Memphis (USA) . . . . . [8047-16]

Wednesday 27 April

SESSION 4 . . . . . Wed. 8:20 to 10:00 am

New Technology II

Session Chairs: **Rob Williams,** Air Force Research Lab.; **Kevin L. Priddy,** Air Force Research Lab.

SmartPhone innovations for persistent surveillance, Rob Williams, Air Force Research Lab. (USA) . . . . . [8047-17]

TwittINT, Rob Williams, Air Force Research Lab. (USA) . . . . . [8047-18]

Web-based open layered sensing testbed, Rob Williams, Air Force Research Lab. (USA) . . . . . [8047-19]

Virtual world technology for persistent surveillance command and control, Rob Williams, Air Force Research Lab. (USA). . . . . [8047-20]

Adapting persistent surveillance storage innovations for homeland security, Rob Williams, Air Force Research Lab. (USA). . . . . [8047-21]

CROSS-CONFERENCE HOT TOPIC PANEL
Wed. 10:30 am to 12:30 pm

Data to Decisions: "Sensors are No Longer King"

Moderator: **John. M. Pellegrino,** Director, Army Research Lab., Computational and Information Sciences Directorate (CISD)

This cross-conference hot topic provides a unique forum for senior leaders from different organizational perspectives to discuss the shifting paradigm of what is needed to achieve the required situational understanding to make the best actionable battlefield decisions. We need to get away from the "autistic" view of sensing and learn to integrate other non-traditional information sources including HUMINT, cultural understanding, social networks, policies and behavior modeling.

Identifying the Technology Needs from a Holistic Perspective

Lunch/Exhibition Break . . . . . 12:30 to 1:30 pm

SESSION 5 . . . . . Wed. 1:40 to 3:00 pm

Signal Processing and Fusion I

Session Chairs: **Jacques Bédard,** Defence Research and Development Canada (Canada); **Graeme P. van Voorthuijsen,** TNO Defence, Security and Safety (Netherlands)

Semantically enriched data for effective sensor data fusion, Geeth R. de Mel, Univ. of Aberdeen (United Kingdom); Thyagaraju Damarla, Tien Pham, U.S. Army Research Lab. (USA) . . . . . [8047-22]

A flexible data fusion architecture for persistent surveillance using ultra-low-power wireless sensor networks, Jeffrey A. Hanson, Keith L. McLaughlin, Thomas J. Sereno, Jr., SAIC (USA). . . . . [8047-23]

Knowledge-aided multisensor data fusion for maritime surveillance, Giulia Battistello, Martin Ulmke, Wolfgang Koch, Fraunhofer FKIE (Germany). . [8047-24]

Sensor trustworthiness in uncertain time varying stochastic environment, Ajay Verma, Ronald Fernandes, Kalyan Vadakkeveedu, Knowledge Based Systems, Inc. (USA). . . . . [8047-25]

SESSION 6 . . . . . Wed. 3:30 to 4:50 pm

Signal Processing and Fusion II

Session Chairs: **Kevin L. Priddy,** Air Force Research Lab.; **King K. Siu,** U.S. Army Armament Research, Development and Engineering Ctr.

Implementation of a sensor-guided flight algorithm for target tracking by small UAVs, Gaemus E. Collins, Toyon Research Corp. (USA); Jeffrey Liese, California Polytechnic State Univ., San Luis Obispo (USA) . . . . . [8047-27]

Localization using ground- and air-based acoustic arrays, Geoffrey H. Goldman, Christian G. Reiff, U.S. Army Research Lab. (USA) . . . . . [8047-28]

On the detection, classification, and tracking of unmanned air vehicles using low-cost acoustic arrays, Benjamin Ellwood, Sean Schumer, David Grasing, U.S. Army Research, Development and Engineering Command (USA) . . [8047-29]

Integration of a vehicle tracker into the SPADE architecture, Andrew Kondrath, Richard Van Hook, Air Force Research Lab. (USA) . . . . . [8047-30]

Thursday 28 April

SESSION 7 . . . . . Thurs. 8:20 to 10:00 am

Sensor Networking and Communications

Session Chairs: **Graeme P. van Voorthuijsen,** TNO Defence, Security and Safety (Netherlands); **Tien Pham,** U.S. Army Research Lab.

Open-source layered sensing model, Todd V. Rovito, Matthew Lenzo, Matthew McClure, Ritchie D'Alto, Jeff Endicott, Air Force Research Lab. (USA); Curtis Cohenour, Ohio Univ. (USA) . . . . . [8047-31]

Operational information content capacity, Thomas F. La Porta, Aylin Yener, The Pennsylvania State Univ. (USA); Ramesh Govindan, The Univ. of Southern California (USA); Matthew P. Johnson, The Pennsylvania State Univ. (USA); Ram Ramanathan, BBN Technologies (USA) . . . . . [8047-32]

Forecasting routes and self-adaptation in multi-hop wireless sensor networks (WSN), Themistoklis Bourdenas, IBM Thomas J. Watson Research Ctr. (USA) and Imperial College London, (United Kingdom); Flavio Bergamaschi, IBM United Kingdom Ltd. (United Kingdom); David Wood, Petros Zerfos, IBM Thomas J. Watson Research Ctr. (USA); Ananthram Swami, U.S. Army Research Lab. (USA); Morris Sloman, Imperial College London (United Kingdom) . . . . . [8047-33]

Broadcast scheduling with data bundles, Fangfei Chen, Matthew P. Johnson, The Pennsylvania State Univ. (USA); Diego Pizzocaro, Alun Preece, Cardiff Univ. (United Kingdom); Amotz Bar-Noy, The Graduate Ctr. (USA); Thomas F. La Porta, The Pennsylvania State Univ. (USA) . . . . . [8047-34]

Service-oriented reasoning architecture for resource-task assignment in sensor networks, Geeth R. de Mel, Univ. of Aberdeen (United Kingdom); Flavio Bergamaschi, IBM United Kingdom Ltd. (United Kingdom); Tien Pham, U.S. Army Research Lab. (USA); Wamberto Vasconcelos, Univ. of Aberdeen (United Kingdom) . . . . . [8047-35]

SESSION 8 . . . . . Thurs. 10:30 am to 12:10 pm

Sensor Networks and Wide-Area Persistent Surveillance

Joint Session with conference 8062

Session Chairs: **Leo J. Rose,** U.S. Air Force;

Michael A. Kolodny, U.S. Army Research Lab.

Bio-inspired UAV routing, source localization, and acoustic signature classification for persistent surveillance, Jerry A. Burman, Teledyne Scientific Co. (USA); Joao P. Hespanha, Upamanyu Madhow, Daniel J. Klein, Univ. of California, Santa Barbara (USA); Tien Pham, U.S. Army Research Lab. (USA) . . . . . [8047-36]

Trident Spectre 2010: agile integration and demonstration of a multisensor airborne pod, Greg Twaites, Brent Rickenbach, General Dynamics Advanced Information Systems (USA) . . . . . [8062-18]

Discovering geospatial networks from ambiguous track data, James E. Bevington, General Dynamics Advanced Information Systems (USA); Michael Evans, Shashi Shekhar, Univ. of Minnesota, Twin Cities (USA) . . . . . [8062-19]

A Bayesian formulation for auction-based task allocation in heterogeneous, multi-agent teams, Charles E. Pippin, Georgia Tech Research Institute (USA); Henrik I. Christensen, Georgia Institute of Technology (USA) . . . . . [8047-38]

Network exploitation using WAMI tracks, Raymond D. Rimey, Dan Keefe, Jim N. Record, Lockheed Martin Corp. (USA); Levi Kennedy, Christopher E. Cramer, Signal Innovations Group, Inc. (USA) . . . . . [8062-20]

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Monday-Thursday 25-28 April 2011 • Proceedings of SPIE Vol. 8048

Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XVII

Conference Chairs: **Sylvia S. Shen,** The Aerospace Corp.; **Paul E. Lewis,** National Geospatial-Intelligence Agency

Program Committee: **Gail P. Anderson,** Air Force Research Lab.; **Hsiao-hua K. Burke,** MIT Lincoln Lab.; **Chein-I Chang,** Univ. of Maryland, Baltimore County; **Eustace L. Dereniak,** College of Optical Sciences, The Univ. of Arizona; **Michael T. Eismann,** Air Force Research Lab.; **Glenn E. Healey,** Univ. of California, Irvine; **James R. Irons,** NASA Goddard Space Flight Ctr.; **Fred A. Kruse,** Naval Postgraduate School; **David W. Messinger,** Rochester Institute of Technology; **Alan P. Schaum,** U.S. Naval Research Lab.; **James Theiler,** Los Alamos National Lab.; **Grady H. Tuell,** Optech International, Inc.; **Miguel Velez-Reyes,** Univ. de Puerto Rico Mayagüez

Monday 25 April

SESSION 1 . . . . . Mon. 8:30 to 10:00 am

Detection, Identification, and Quantification I

Session Chair: **Sylvia S. Shen,** The Aerospace Corp.

Generalized fusion: a new framework for hyperspectral detection *(Invited Paper)*, Peter Bajorski, Rochester Institute of Technology (USA). [8048-01]

Issues in algorithm fusion, Alan P. Schaum, U.S. Naval Research Lab. (USA) . . . . . [8048-02]

Log-linear Laplacian ratio (LLLR) algorithm for spectral detection using laboratory signatures, Brian J. Daniel, Alan P. Schaum, U.S. Naval Research Lab. (USA) . . . . . [8048-03]

Algorithm for detecting anomaly in hyperspectral imagery using factor analysis, Edisanter Lo, Susquehanna Univ. (USA) . . . . . [8048-04]

SESSION 2 . . . . . Mon. 10:30 am to 12:10 pm

Change Detection

Session Chair: **Paul E. Lewis,** National Geospatial-Intelligence Agency

Extension and implementation of model-based hyperspectral change detection, Joseph Meola, Air Force Research Lab. (USA). . . . . [8048-05]

Hierarchical image segmentation for context-dependent anomalous change detection, James Theiler, Lakshman Prasad, Los Alamos National Lab. (USA) . . . . . [8048-06]

Change detection using mean-shift and outlier-distance metrics, Joshua D. Zollweg, Rochester Institute of Technology (USA); David B. Gillis, U.S. Naval Research Lab. (USA); Ariel Schlamm, David W. Messinger, Rochester Institute of Technology (USA) . . . . . [8048-07]

Graph theoretic metrics for spectral imagery with application to change detection, James A. Albano, David W. Messinger, Ariel Schlamm, William F. Basener, Rochester Institute of Technology (USA) . . . . . [8048-08]

Demonstration of Landsat 5 multispectral change detection uses in treaty support, Michael E. Zelinski, Lawrence Livermore National Lab. (USA) . [8048-09]

Lunch Break . . . . . 12:10 to 1:20 pm

Courses of Related Interest

SC194 **Multispectral and Hyperspectral Image Sensors** (Lomheim) Wednesday, 8:30 am to 12:30 pm

SC995 **Target Detection Algorithms for Hyperspectral Imagery** (Nasrabadi) Thursday, 8:30 am to 5:30 pm

SC158 **Fundamentals of Automatic Target Recognition** (Sadjadi) Thursday, 8:30 am to 5:30 pm

SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Tuesday, 8:30 am to 5:30 pm

SC994 **Multisensor Data Fusion for Object Detection, Classification and Identification** (Klein) Tuesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

SESSION 3 . . . . . Mon. 1:20 to 3:20 pm

Spectral Data Analysis Methodologies I

Session Chair: **Miguel Velez-Reyes,** Univ. de Puerto Rico Mayagüez

Characterization of turbulence in smokestack plumes via imaging Fourier-transform spectroscopy, Jennifer L. Massman, Kevin C. Gross, Air Force Institute of Technology (USA) . . . . . [8048-10]

Anomaly detection of man-made objects using spectro-polarimetric imagery, Brent D. Bartlett, Ariel Schlamm, Carl Salvaggio, David W. Messinger, Rochester Institute of Technology (USA) . . . . . [8048-11]

Selecting training and test images for optimized anomaly detection and material identification algorithms in hyperspectral imagery through robust parameter design, Frank M. Mindrup, Trevor J. Bihl, Kenneth W. Bauer, Air Force Institute of Technology (USA) . . . . . [8048-12]

Target detection using multiple hyperspectral imagers and physics-based models, Emmett Ientilucci, John P. Kerekes, Rochester Institute of Technology (USA); Arnab Shaw, Gitam Technologies (USA) . . . . . [8048-13]

An automated method for identification and ranking of hyperspectral target detections, William F. Basener, Rochester Institute of Technology (USA) . . . . . [8048-14]

Enhancement of flow-like structures in hyperspectral imagery using anisotropic diffusion, Maider Marin-McGee, Miguel Velez-Reyes, Univ. de Puerto Rico Mayagüez (USA) . . . . . [8048-15]

SESSION 4 . . . . . Mon. 3:50 to 5:30 pm

Spectral Methodologies and Applications I

Session Chair: **David Messinger,** Rochester Institute of Technology

Supporting relief efforts of the 2010 Haitian earthquake using an airborne multimodal remote sensing platform, Jason W. Faulring, Donald M. McKeown, Jan W. van Aardt, Rochester Institute of Technology (USA). . . . . [8048-16]

Demonstration of delivery of ortho imagery in near-real-time for local emergency response, Donald M. McKeown, Jason W. Faulring, Stephen A. Cavilia, Robert S. Krzaczek, Jan W. van Aardt, Rochester Institute of Technology (USA) . . . . . [8048-17]

Deepwater horizon oil spill monitoring using airborne multispectral infrared imagery, Sylvia S. Shen, The Aerospace Corp. (USA); Paul E. Lewis, National Geospatial-Intelligence Agency (USA) . . . . . [8048-18]

Spectral performance related to in-road victim operated improvised explosive devices campaign, Andre D. Cropper, ITT Corp. Geospatial Systems (USA) . . . . . [8048-19]

Evaluation of potential emission spectra for the reliable classification of fluorescently coded materials, Siegfried Brunner, Christian M. Kargel, Univ. der Bundeswehr München (Germany). . . . . [8048-20]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 5 . . . . . Tues. 10:00 am to 12:10 pm

Advancements in Spectral Sensor Technologies

Session Chair: **Eustace L. Dereniak,**
College of Optical Sciences, The Univ. of Arizona

Image mapping spectrometry: a novel hyperspectral platform for rapid snapshot imaging *(Invited Paper)*, Tomasz S. Tkaczyk, Rice Univ. (USA) . . . . . [8048-21]

A Fabry-Perot interferometer with a spatially variable resonance gap employed as a Fourier transform spectrometer, Paul G. Lucey, Univ. of Hawai'i (USA); Jason Akagi, Spectrum Photonics, Inc. (USA) . . . . . [8048-22]

The enhanced MODIS airborne simulator hyperspectral imager, Daniel Guerin, Ted Graham, John Fisher, Brandywine Optics, Inc. (USA) . . . . . [8048-23]

An interference microfilter array with tunable spectral response for each pixel, Frida E. Strömqvist Vetelino, Ali A. Abtahi, Aerospace Missions Corp. (USA); Peter B. Griffin, Stanford Univ. (USA); Ricky J. Morgan, Usha Raghuram, Aerospace Missions Corp. (USA); Francisco Tejada, Sensing Machines (USA) . . . . . [8048-24]

Toward integration of AOTF-based hyperspectral imager in visual surveillance applications, Sergiy Fefilatyev, Univ. of South Florida (USA); Ronald G. Rosemeier, Brimrose Corp. of America (USA) . . . . . [8048-25]

Broadband source for multispectral imager characterization, Miguel A. Medina, Jason A. Mazzetta, Stephen D. Scoptaz, Electro Optical Industries, Inc. (USA) . . . . . [8048-26]

Lunch/Exhibition Break . . . . . 12:10 to 1:20 pm

SESSION 6 . . . . . Tues. 1:20 to 3:20 pm

Spectral Data Analysis Methodologies II

Session Chair: **Michael T. Eismann,** Air Force Research Lab.

Hyperspectral processing in graphical processing units, Michael E. Winter, Edwin Winter, Technical Research Associates, Inc. (USA) . . . . . [8048-27]

GPGPU-based real-time conditional dilation for robust target detection in multispectral and hyperspectral imagery, James P. Morgenstern, Vision4ce LLC (USA) . . . . . [8048-71]

Evaluation of the GPU architecture for the implementation of target detection algorithms for hyperspectral imagery, Blas Trigueros-Espinosa, Miguel Velez-Reyes, Nayda G. Santiago-Santiago, Univ. de Puerto Rico Mayagüez (USA) . . . . . [8048-28]

Parallel implementation of nonlinear dimensionality reduction methods using CUDA in GPU architecture, Romel Campana, Vidya B. Manian, Univ. de Puerto Rico Mayagüez (USA) . . . . . [8048-29]

Comparison of subpixel phase correlation methods for image registration, Robert A. Reed, Arnold Engineering Development Ctr. (USA) . . . . . [8048-30]

Real-time georeferencing for an airborne hyperspectral imaging system, Thomas O. Opsahl, Trym V. Haavardsholm, Atle Skaugen, Ingebrigt Winjum, Norwegian Defence Research Establishment (Norway) . . . . . [8048-31]

SESSION 7 . . . . . Tues. 3:50 to 5:30 pm

Spectral Methodologies and Applications II

Session Chair: **Fred A. Kruse,** Naval Postgraduate School

Identification and mapping of night lights signatures using hyperspectral data, Fred A. Kruse, Naval Postgraduate School (USA); Christopher D. Elvidge, National Oceanic and Atmospheric Administration (USA) . . . . . [8048-32]

Ship detection in MODIS imagery, Leidy P. Dorado-Muñoz, Miguel Velez-Reyes, Univ. de Puerto Rico Mayagüez (USA) . . . . . [8048-33]

High-spatial resolution bidirectional reflectance retrieval using satellite data, Richard C. Olsen, Cecelia L. McConnon, Angela M. Kim, Naval Postgraduate School (USA) . . . . . [8048-34]

Multiresolution and directional filtering techniques for detecting dust storm direction in satellite imagery, Mohammed Q. Alkhatib, Sergio D. Cabrera, The Univ. of Texas at El Paso (USA) . . . . . [8048-35]

EO-1 Hyperion capturing seasonal dynamics in spectral properties corresponding to vegetation phenology and CO_2 uptake, Petya Campbell, NASA Goddard Space Flight Ctr. (USA) . . . . . [8048-36]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Hyperspectral imagery based face recognition using spectral and spatial information fusion, Stefan A. Robila, Montclair State Univ. (USA); Nisha D'Amico, Univ. of Maryland, College Park (USA); Marco Chang Reyna, Montclair State Univ. (USA) . . . . . [8048-66]

Hyperspectral band selection using statistical models, Jochen M. Maerker, Alfons Ebert, Wolfgang Middelmann, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [8048-67]

Noise reduction of hyperspectral images by using joint bilateral filter, Ayoung Heo, Jai-Hoon Lee, Eun-Jin Choi, Seo Hyun Kim, Dong-Jo Park, KAIST (Korea, Republic of) . . . . . [8048-68]

High-fidelity spectrum reconstruction for filter-based spectrum sensor using sparse representation, Cheng-Chun Chang, Nan-Ting Lin, National Taipei Univ. of Technology (Taiwan); Umpei Kurokawa, Byung Il Choi, nanoLambda (USA) . . . . . [8048-69]

Subpixel target detection and enhancement in hyperspectral images, Kailash C. Tiwari, Military Engineering Services (India) . . . . . [8048-70]

Wednesday 27 April

SESSION 8 . . . . . Wed. 8:30 to 10:10 am

Clustering and Classification

Session Chair: **Fred A. Kruse,** Naval Postgraduate School

Object classification using discriminating features derived from higher-order spectra of multi- and hyperspectral imagery, Karen N. Zachery, Jiangying Zhou, Yuwei Liao, Teledyne Scientific & Imaging, LLC (USA). . . . . [8048-37]

Trilateral filter on multispectral imagery for classification and segmentation, Weihua Sun, David W. Messinger, Rochester Institute of Technology (USA) . . . . . [8048-38]

Automatic clustering of multispectral imagery by maximization of the graph modularity, Ryan A. Mercovich, Anthony A. Harkin, David W. Messinger, Rochester Institute of Technology (USA) . . . . . [8048-39]

A scalable hierarchical image classification approach, Francis P. Padula, Harry N. Gross, David R. Pogorzala, Integrity Applications, Inc. (USA) . . [8048-40]

Multiclass sub-pixel target detection using functions of multiple instances, Alina Zare, Univ. of Missouri-Columbia (USA); Paul Gader, Univ. of Florida (USA) . . . . . [8048-41]

SESSION 9 . . . . . Wed. 10:40 am to 12:20 pm

Landsat Data Continuity Mission

Session Chair: **Scott Brown,** Rochester Institute of Technology

The operational land imager (OLI) and the thermal infrared sensor (TIRS) on the Landsat Data Continuity Mission (LDCM), Dennis C. Reuter, James R. Irons, NASA Goddard Space Flight Ctr. (USA); Allen Lunsford, The Catholic Univ. of America (USA); Matthew Montanaro, Sigma Space Corp. (USA); Fernando A. Pellerano, Cathleen Richardson, Ramsey Smith, NASA Goddard Space Flight Ctr. (USA); Zelalem Tesfaye, Millenium Engineering and Integration Co. (USA); Kurtis J. Thome, NASA Goddard Space Flight Ctr. (USA) . . . . . [8048-42]

Calibration plan for the thermal infrared sensor on the Landsat Data Continuity Mission, Kurtis J. Thome, NASA Goddard Space Flight Ctr. (USA); Allen Lunsford, Catholic Univ. (USA); Matthew Montanaro, Sigma Space Corp. (USA); Dennis C. Reuter, Ramsey Smith, NASA Goddard Space Flight Ctr. (USA); Zelalem Tesfaye, Johns Hopkins Bayview Medical Ctr. (USA); Brian Wenny, Sigma Space Corp. (USA) . . . . . [8048-43]

Modeling space-based multispectral imaging systems with DIRSIG, Scott Brown, Niek J. Sanders, Adam A. Goodenough, Michael Gartley, Rochester Institute of Technology (USA) . . . . . [8048-44]

Data-driven simulations of the Landsat Data Continuity Mission (LDCM) platform, Aaron D. Gerace, Michael Gartley, Nina Raqueno, Rolando Raqueno, John R. Schott, Rochester Institute of Technology (USA) . . . . . [8048-45]

Spectral requirements analysis of the primary flight focal plane arrays for the thermal infrared sensor, Matthew Montanaro, Sigma Space Corp. (USA); Dennis C. Reuter, Brian L. Markham, Kurtis J. Thome, Allen Lunsford, Murzy D. Jhabvala, Scott Rohrbach, NASA Goddard Space Flight Ctr. (USA); Aaron D. Gerace, Rochester Institute of Technology (USA) . . . . . [8048-46]

Lunch/Exhibition Break . . . . . 12:20 to 1:20 pm

SESSION 10 . . . . . Wed. 1:20 to 3:00 pm

Spectral Data Analysis Methodologies III

Session Chair: **Miguel Velez-Reyes,** Univ. de Puerto Rico Mayagüez

Joint segmentation and reconstruction of hyperspectral images from a single snapshot, Peter Qiang Zhang, Robert J. Plemmons, Wake Forest Univ. (USA); David J. Brady, David Kittle, Duke Univ. (USA) . . . . . [8048-47]

Estimation of low-resolution visible spectra from RGB imagery II: simulation results, Harvey C. Schau, Meridian Systems LLC (USA) . . . . . [8048-48]

A multiband statistical restoration of the Aqua MODIS 1.6 micron band, Irina Gladkova, Michael D. Grossberg, Fazlul Shahriar, George Bonev, The City College of New York (USA). . . . . [8048-49]

Estimating true color imagery for GOES-R, Michael D. Grossberg, Fazlul Shahriar, Irina Gladkova, Paul K. Alabi, The City College of New York (USA); Donald W. Hillger, National Oceanic and Atmospheric Administration (USA) . . . . . [8048-50]

A new deblurring morphological filter for hyperspectral images, Ezz E. Ali, Military Technical College (Egypt) . . . . . [8048-51]

SESSION 11 . . . . . Wed. 3:30 to 4:50 pm

Detection, Identification, and Quantification II

Session Chair: **Sylvia S. Shen,** The Aerospace Corp.

Hyperspectral anomaly detection using sparse kernel-based ensemble learning, Prudhvi Gurram, Heesung Kwon, U.S. Army Research Lab. (USA) . . . . . [8048-52]

Effect of random measurements on the performance of classical hyperspectral target detection algorithms, Yi Chen, The Johns Hopkins Univ. (USA); Nasser M. Nasrabadi, U.S. Army Research Lab. (USA); Trac D. Tran, The Johns Hopkins Univ. (USA) . . . . . [8048-53]

Implications of model mismatch and covariance contamination on chemical detection algorithms, Dimitris Manolakis, Steven E. Golowich, MIT Lincoln Lab. (USA); Sidi Niu, Vinay K. Ingle, Northeastern Univ. (USA) . . . . . [8048-54]

Performance limits of LWIR gaseous plume quantification, Steven E. Golowich, Dimitris Manolakis, MIT Lincoln Lab. (USA) . . . . . [8048-55]

TRACK PLENARY PRESENTATION

Wed. 5:00 to 6:00 pm

Evolution of Airborne Chemical and Radiological Remote Sensing for Emergency and Natural Disaster Response

Presenter: **Paul E. Lewis,** National Geospatial-Intelligence Agency

In 2001 the United States Environmental Protection Agency's (EPA) Airborne Spectral Photometric Environmental Collection Technology (ASPECT) Program became the United States only civil 24/7 operational airborne chemical, radiological, and situational awareness reporting capability. Since 2001 the ASPECT aircraft has completed 107 successful airborne emergency response and homeland security related missions. The ASPECT model of operation combines an airborne operational remote sensing suite with a research and development support team to provide essential situational awareness information to first responders and their local, state and federal lead agencies in accordance with the National Contingency Plan and EPA's responsibility under Emergency Support Function 10 of the National Response Plan. This presentation will showcase the effectiveness and necessity of the ASPECT operational model in meeting the needs of the civil emergency response and homeland security communities. Highlights from a variety of ASPECT airborne missions will be presented including industrial accidents, homeland security situational awareness missions, and natural and anthropogenic disasters such as Hurricane Katrina and the Deepwater Horizon Oil Spill along with issues, and lessons learned.

Thursday 28 April

SESSION 12 . . . . . Thurs. 8:20 to 10:20 am

Spectral Data Analysis Methodologies IV

Session Chair: **David Messinger,** Rochester Institute of Technology

Multi- and hyperspectral scene modeling, Christoph C. Borel, Ronald F. Tuttle, Air Force Institute of Technology (USA) . . . . . [8048-56]

The target implant method for predicting target difficulty and detector performance in hyperspectral imagery, William F. Basener, John P. Kerekes, Rochester Institute of Technology (USA); C. Eric Nance, Raytheon Intelligence & Information Systems (USA) . . . . . [8048-57]

Dynamic dimensionality reduction for hyperspectral imagery, Haleh Safavi, Keng-Hao Liu, Chein-I Chang, Univ. of Maryland, Baltimore County (USA) . . . . . [8048-58]

An empirical estimate of the multivariate normality of spectral image data, Ariel Schlamm, David W. Messinger, Rochester Institute of Technology (USA) . . . . . [8048-59]

Interactive visualization of hyperspectral images on a hyperbolic disk, Adam A. Goodenough, Ariel Schlamm, Rochester Institute of Technology (USA) . . . . . [8048-60]

Realism, utility, and the evolution of simulated remotely sensed imagery, Erin Ontiveros, Michael G. Gartely, Rochester Institute of Technology (USA) . [8048-61]

SESSION 13 . . . . . Thurs. 10:50 am to 12:10 pm

Endmember Extraction and Spectral Unmixing

Session Chair: **Paul E. Lewis,** National Geospatial-Intelligence Agency

Simultaneous sparse recovery for unsupervised hyperspectral unmixing, Dzung T. Nguyen, Yi Chen, Timothy S. Han, Trac D. Tran, The Johns Hopkins Univ. (USA) . . . . . [8048-62]

Joint sparsity for target detection, Yi Chen, The Johns Hopkins Univ. (USA); Nasser M. Nasrabadi, U.S. Army Research Lab. (USA); Trac D. Tran, The Johns Hopkins Univ. (USA) . . . . . [8048-63]

High-spatial resolution hyperspectral spatially adaptive endmember selection and spectral unmixing, Kelly Canham, Ariel Schlamm, William F. Basener, David W. Messinger, Rochester Institute of Technology (USA). [8048-64]

Kernel-based weighted abundance constrained linear spectral mixture analysis, Keng-Hao Liu, Englin Wong, Univ. of Maryland, Baltimore County (USA); Chein-I Chang, Univ. of Maryland, Baltimore County (USA) and National Chung Hsing Univ. (Taiwan) . . . . . [8048-65]

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Automatic Target Recognition XXI

Conference Chairs: **Firooz A. Sadjadi,** Lockheed Martin Maritime Systems & Sensors; **Abhijit Mahalanobis,** Lockheed Martin Missiles and Fire Control

Program Committee: **Mohammad S. Alam,** Univ. of South Alabama; **Farid Amoozegar,** Jet Propulsion Lab.; **Mahmood R. Azimi-Sadjadi,** Colorado State Univ.; **David P. Casasent,** Carnegie Mellon Univ.; **Leon Cohen,** Hunter College; **Frederick D. Garber,** Wright State Univ.; **Guillermo C. Gaunard,** Consultant; **Izidor Gertner,** The City College of New York; **Patti S. Gillespie,** U.S. Army Research Lab.; **Riad I. Hammoud,** Delphi Corp.; **Bahram Javidi,** Univ. of Connecticut; **Ismail I. Jouny,** Lafayette College; **Behzad Kamgar-Parsi,** U.S. Naval Research Lab.; **Timothy J. Klausutis,** Air Force Research Lab.; **Wolfgang Kober,** Data Fusion Corp.; **Aaron D. Lanterman,** Georgia Institute of Technology; **Randolph L. Moses,** The Ohio State Univ.; **Robert R. Muise,** Lockheed Martin Missiles and Fire Control; **Nasser M. Nasrabadi,** U.S. Army Research Lab.; **Les Novak,** Scientific Systems Co., Inc.; **Joseph A. O'Sullivan,** Washington Univ. in St. Louis; **Mubarak Ali Shah,** Univ. of Central Florida; **Bradley C. Wallet,** Automated Decisions LLC; **Edmund Zelnio,** Air Force Research Lab.

Monday 25 April

SESSION 1 . . . . . Mon. 8:30 to 11:40 am

Advanced Sensing and Techniques I

Session Chair: **Carl Holden, Jr.,**
Lockheed Martin Missiles and Fire Control

Object classification using local subspace projection, Jennifer L. Nealy, Univ. of Central Florida (USA); Robert R. Muise, Lockheed Martin Missiles and Fire Control (USA). . . . . [8049-01]

Method of recognition and pose estimation of multiple occurrences of multiple objects in visual images, Deepak Khosla, David Huber, HRL Labs., LLC (USA) . . . . . [8049-02]

Bio-inspired 'surprise' for real-time change detection in visual imagery, David Huber, Deepak Khosla, HRL Labs., LLC (USA). . . . . [8049-03]

Hybrid photometric and correspondence-based georegistration, Scott A. Merritt, Naval Air Warfare Ctr. Weapons Div. (USA) . . . . . [8049-04]

Perspective transformation and image warping for wide-baseline scene matching, Hai-Wen Chen, Michael C. Tarnowski, Craig Stutts, Applied Research Associates, Inc. (USA). . . . . [8049-05]

Non-invasive eye control technology based on single CCD camera, Jie Su, Harbin Univ. of Science and Technology (China); Kai Han, Harbin Engineering Univ. (China) . . . . . [8049-06]

Metal object detection using a forward-looking polarimetric ground penetrating radar, Cornell S. L. Chun, Ethan H. Chun, Physics Innovations Inc. (USA) . . . . . [8049-07]

Polarization-components techniques for automatic target recognition, Brian G. Hoover, Israel J. Vaughn, Roger H. Holten, Advanced Optical Technologies (USA); J. Scott Tyo, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [8049-08]

Lunch Break . . . . . 11:40 am to 1:00 pm

SESSION 2 . . . . . Mon. 1:00 to 3:30 pm

Advanced Sensing and Techniques II

Session Chair: **Leo H. Cohen,**
TNO Defence, Security and Safety (Netherlands)

Informative representation learning for automatic target recognition *(Invited Paper)*, Charles F. Hester, U.S. Army Research, Development and Engineering Command (USA); Kelly K. Dobson, U.S. Army Aviation and Missile Command (USA) . . . . . [8049-09]

Time-dependent moments for a nonstationary noise model, Leon Cohen, Affa Ahmad, Hunter College (USA). . . . . [8049-10]

MaxMin signal design for optimal detection in signal-dependent noise, Brandon Hamschin, Patrick J. Loughlin, Univ. of Pittsburgh (USA) . . . . . [8049-11]

Reverberation probability distribution for intensity, Leon Cohen, Affa Ahmad, Hunter College (USA) . . . . . [8049-12]

Impact of range-dependent propagation on classification of underwater objects by their sonar backscatter, Patrick J. Loughlin, Vikram T. Gomatam, Univ. of Pittsburgh (USA). . . . . [8049-13]

An adaptive algorithm for subpixel target detection using the spectral information divergence measure, Wesam A. Sakla, U.S. Dept. of Defense (USA); Adel A. Sakla, Univ. of South Alabama (USA) . . . . . [8049-14]

Curvilinear target detection using spatial spectroscopy, James M. Coggins, BAE Systems (USA). . . . . [8049-15]

SESSION 3 . . . . . Mon. 4:00 to 5:50 pm

Automatic Human Activity and Behavior Recognition

Session Chair: **Abhijit Mahalanobis,**
Lockheed Martin Missiles and Fire Control

Activity recognition *(Invited Paper)*, Anthony J. Hoogs, Kitware, Inc. (USA) . . . . . [8049-16]

3D object model-based neural network approach for activity recognition, Bing Li, Lockheed Martin Systems Integration-Owego (USA) . . . . . [8049-17]

Superresolution for dismounted human detection at long ranges, Amy Bell, Institute for Defense Analyses (USA). . . . . [8049-18]

Human body tracking using LMS-VSMM from monocular video sequences, Hong Han, Zhichao Chen, Licheng Jiao, Youjian Fan, Xidian Univ. (China) . . . . . [8049-19]

Human detection based on curvelet transform and integrating heterogeneous features, Hong Han, Youjian Fan, Xidian Univ. (China) . [8049-20]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 4 . . . . . Tues. 10:00 am to 12:00 pm

Automatic Human Activity and Behavior Recognition II

Session Chair: **Robert R. Muise,**
Lockheed Martin Missiles and Fire Control

Purposeful interpretation of video *(Keynote Presentation),* Mita D. Desai, Defense Advanced Research Projects Agency (USA). . . . . [8049-21]

Detection and tracking of people and their body parts in infrared, Juengling Kai, Michael Arens, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [8049-22]

An implicit shape-model based approach to identify armed persons, Stefan Becker, Juengling Kai, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [8049-23]

Robust face and automatic target recognition via compressive sensing based multiple descriptions, Widhyakorn Asdornwised, Chulalongkorn Univ. (Thailand). . . . . [8049-24]

Multiframe correlation filtering for activity recognition using quadratic correlation filters, Shih-Chi K. Chen, Steven R. Stanfill, Abhijit Mahalanobis, Lockheed Martin Missiles and Fire Control (USA). . . . . [8049-25]

Lunch/Exhibition Break . . . . . 12:00 am to 1:00 pm

SESSION 5 . . . . . Tues. 1:00 to 4:20 pm

Multisensor and Multidimensional Target Recognition

Session Chair: **Abhijit Mahalanobis,**
Lockheed Martin Missiles and Fire Control

The importance of performance modeling for ATR *(Invited Paper)*, Edmund Zelnio, Air Force Research Lab. (USA) . . . . . [8049-26]

Practical optimal processing in hyperdimensional spaces via domain-reducing mappings, Manuel F. Fernández, Tom Aridgides, Firooz A. Sadjadi, Lockheed Martin Maritime Systems & Sensors (USA) . . . . . [8049-27]

Fast automatic target recognition tailored for cooperative targets in airborne 3D ladar imagery, Simon Roy, Jean Maheux, Defence Research and Development Canada (Canada) . . . . . [8049-28]

Integrating LPR with CCTV systems: problems and solutions, Dmitry O. Gorodnichy, Canada Border Services Agency (Canada) . . . . . [8049-29]

Features useful for classification of three-dimensional point cloud imagery, Antoin L. Baker, Gregory M. Wagner, Arnold C. Williams, Raytheon Missile Systems (USA). . . . . [8049-30]

Anomaly detection in hyperspectral imagery using stable distribution, Suat Mercan, Univ. of Nevada, Reno (USA); Mohammad S. Alam, Univ. of South Alabama (USA) . . . . . [8049-31]

Multisensor ISR in geo-registered contextual visual dataspace (CVD), Kyungnam (Ken) Kim, HRL Labs., LLC (USA) . . . . . [8049-32]

Integration of low-level and ontology derived features for automatic weapon recognition and identification, Nikolay M. Sirakov, Sang Won Suh, Salvatore Attardo, Texas A&M Univ.-Commerce (USA) . . . . . [8049-33]

Wednesday 27 April

SESSION 6 . . . . . Wed. 8:00 to 10:00 am

ATR Performance Evaluations

Session Chair: **Izidor Gertner,** The City College of New York

Predicting new views of an object from an existing image by parametrized predictions on the manifold, Abhijit Mahalanobis, Lockheed Martin Missiles and Fire Control (USA) . . . . . [8049-34]

Redefining automatic target recognition (ATR) performance standards, Donald Waagen, Charles F. Hester, Ben Schmid, Margaret Phillips, M. Shane Thompson, U.S. Army Aviation and Missile Command (USA); Steven Vanstone, U.S. Army Armament Research, Development and Engineering Ctr. (USA); Kelly K. Dobson, U.S. Army Aviation and Missile Command (USA). . . . . [8049-35]

Analytic performance model for grayscale quantization in the presence of additive noise, Adam R. Nolan, George S. Goley, Etegent Technologies, Ltd. (USA) . . . . . [8049-36]

Variability and robustness of scatterers in HRR/ISAR ground target data and its influence on the ATR performance, Rolf Schumacher, Hartmut M. Schimpf, Joachim Schiller, Fraunhofer FHR (Germany). . . . . [8049-37]

The influence of multipath on ship ATR performance, Hartmut M. Schimpf, Fraunhofer FHR (Germany) . . . . . [8049-38]

A comparison of machine learning methods for target recognition using ISAR imagery, Karen D. Uttecht, Cindy X. Chen, Jason C. Dickinson, Thomas M. Goyette, Robert H. Giles, Univ. of Massachusetts Lowell (USA); William E. Nixon, National Ground Intelligence Ctr. (USA) . . . . . [8049-39]

2011 Best Paper Award
Presentation . . . . . Wed. 10:00 to 10:20 am

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Courses of Related Interest

SC158 **Fundamentals of Automatic Target Recognition** (Sadjadi) Thursday, 8:30 am to 5:30 pm

SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Tuesday, 8:30 am to 5:30 pm

SC892 **Infrared Search and Track Systems** (Schwering) Tuesday, 8:30 am to 5:30 pm

SC995 **Target Detection Algorithms for Hyperspectral Imagery** (Nasrabadi) Thursday, 8:30 am to 5:30 pm

SC994 **Multisensor Data Fusion for Object Detection, Classification and Identification** (Klein) Tuesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Signal Processing, Sensor Fusion, and Target Recognition XX

Conference Chair: **Ivan Kadar,** Interlink Systems Sciences, Inc.

Program Committee: **Mark G. Alford,** Air Force Research Lab.; **William D. Blair,** Georgia Tech Research Institute; **Erik P. Blasch,** Air Force Research Lab. and Defence R&D Canada-Valcartier; **Mark J. Carlotto,** General Dynamics Advanced Information Systems; **Kuo-Chu Chang,** George Mason Univ.; **Chee-Yee Chong,** BAE Systems Advanced Information Technologies; **Marvin N. Cohen,** Georgia Tech Research Institute; **Mohammad Farooq,** Royal Military College of Canada (Canada); **Charles W. Glover,** Oak Ridge National Lab.; **I. R. Goodman,** Consultant; **Lynne L. Grewe,** California State Univ., East Bay; **Michael L. Hinman,** Air Force Research Lab.; **Kenneth J. Hintz,** George Mason Univ.; **Jon S. Jones,** Air Force Research Lab.; **Thiagalingam Kirubarajan,** McMaster Univ. (Canada); **Martin E. Liggins II,** MITRE Corp.; **James Llinas,** Univ. at Buffalo; **Ronald P. Mahler,** Lockheed Martin Maritime Systems & Sensors; **Raj P. Malhotra,** Air Force Research Lab.; **Alastair D. McAulay,** Lehigh Univ.; **Raman K. Mehra,** Scientific Systems Co., Inc.; **Harley R. Myler,** Lamar Univ.; **David Nicholson,** BAE Systems (United Kingdom); **Les Novak,** Scientific Systems Co., Inc.; **John J. Salerno, Jr.,** Air Force Research Lab.; **Andrew G. Tescher,** AGT Associates; **Stelios C. A. Thomopoulos,** National Ctr. for Scientific Research Demokritos (Greece); **Wiley E. Thompson,** New Mexico State Univ.; **Pierre Valin,** Defence Research and Development Canada (Canada)

Monday 25 April

SESSION 1 . . . . . Mon. 8:10 to 10:10 am

Multisensor Fusion, Multitarget Tracking, and Resource Management I

Session Chairs: **Ivan Kadar,** Interlink Systems Sciences, Inc.; **Thiagalingam Kirubarajan,** McMaster Univ. (Canada); **Kenneth J. Hintz,** George Mason Univ.

Road network estimation through GMTI track fusion, Mark G. Alford, Maria Scalzo, Adnan Bubalo, Gregory E. Wood, Eric C. Jones, Air Force Research Lab. (USA) . . . . . [8050-01]

Measures of nonlinearity for single target tracking problems, Eric C. Jones, Maria Scalzo, Adnan Bubalo, Mark G. Alford, Benjamin Arthur, Air Force Research Lab. (USA) . . . . . [8050-02]

Toward a computationally efficient approach for improving target tracking using grid-based methods, Mark E. Silbert, The George Washington Univ. (USA) and Naval Air Systems Command (USA); Shahram Sarkani, Thomas Mazzuchi, The George Washington Univ. (USA) . . . . . [8050-03]

The effect of disparate sensors on tracking perfomance, Charles A. Rea, Mark E. Silbert, Naval Air Systems Command (USA) . . . . . [8050-04]

A multiple IMM approach with unbiased mixing for thrusting projectiles, Ting Yuan, Yaakov Bar-Shalom, Peter K. Willett, Univ. of Connecticut (USA); David F. Hardiman, U.S. Army Research, Development and Engineering Command (USA) . . . . . [8050-05]

Tracking system to maximize engagement envelope of a data-linked weapon, James M. Davies, Jason F. Ralph, Univ. of Liverpool (United Kingdom) . . . . . [8050-06]

SESSION 2 . . . . . Mon. 10:40 am to 12:20 pm

Multisensor Fusion, Multitarget Tracking, and Resource Management II

Session Chairs: **Thiagalingam Kirubarajan,** McMaster Univ. (Canada); **Kenneth J. Hintz,** George Mason Univ.; **Erik P. Blasch,** Defence R&D Canada-Valcartier (Canada) and Air Force Research Lab.

Efficiency of the composite position measurements from satellite-based LOS, Richard W. Osborne III, Yaakov Bar-Shalom, Univ. of Connecticut (USA) . . . . . [8050-07]

Multitarget smooth variable structure filter: theory, design, and implementation, Stephen A. Gadsden, Darcy Dunne, Saeid Habibi, Thiagalingam Kirubarajan, McMaster Univ. (Canada) . . . . . [8050-08]

Maximum likelihood probabilistic multihypothesis tracker applied to multistatic sonar data sets, Steven C. Schoenecker, Naval Undersea Warfare Ctr. (USA); Peter K. Willett, Yaakov Bar-Shalom, Univ. of Connecticut (USA) . . . . . [8050-09]

Wide-area video exploitation (WAVE) joint data management for layered sensing, Erik P. Blasch, Defence Research and Development Canada (Canada) and Air Force Research Lab. (USA); Gunasekaran S. Seetharaman, Air Force Research Lab. (USA) . . . . . [8050-10]

Information-theoretic sensor management analysis, Erik P. Blasch, Defence Research and Development Canada (Canada) and Air Force Research Lab. (USA); Ivan Kadar, Interlink Systems Sciences, Inc. (USA); Chun Yang, Sigtem Technology, Inc. (USA) . . . . . [8050-11]

Lunch Break . . . . . 12:20 to 1:30 pm

SESSION 3 . . . . . Mon. 1:30 to 2:50 pm

Multisensor Fusion, Multitarget Tracking, and Resource Management III

Session Chairs: **Kenneth J. Hintz,** George Mason Univ.; **Ivan Kadar,** Interlink Systems Sciences, Inc.; **Thiagalingam Kirubarajan,** McMaster Univ. (Canada)

Optimal threshold policies for radar resource management in GMTI systems, Vikram Krishnamurthy, Erik J. Miehling, The Univ. of British Columbia (Canada); Bhashyam Balaji, Defence Research and Development Canada (Canada)[8050-12]

Efficient exchange of information in a distributed tracking environment, Peter J. Shea, Eric Blake, Black River Systems Co. (USA). . . . . [8050-13]

Optimal update with multiple out-of-sequence measurements, Shuo Zhang, Yaakov Bar-Shalom, Univ. of Connecticut (USA) . . . . . [8050-14]

Stability of out-of-sequence measurement processing: an open problem, Lingji Chen, BAE Systems Advanced Information Technologies (USA); Nima Moshtagh, Scientific Systems Co., Inc. (USA) . . . . . [8050-15]

SESSION 4 . . . . . Mon. 2:50 to 6:20 pm

Multisensor Fusion Methodologies and Applications I

Session Chair: **Ronald P. Mahler,** Lockheed Martin Maritime Systems & Sensors

Bayesian unified registration and tracking, Ronald Mahler, Lockheed Martin Maritime Systems & Sensors (USA); Adel I. El-Fallah, Scientific Systems Co., Inc. (USA) . . . . . [8050-16]

Distributed PHD filter-based bias removal in PCL system, Maheswaran Subramaniam, McMaster Univ. (Canada); Kumaradevan Punithakumar, GE Healthcare (Canada); Ratnasingham Tharmarasa, McMaster Univ. (Canada); Michael McDonald, Defence Research and Development Canada (Canada); Thiagalingam Kirubarajan, McMaster Univ. (Canada). . . . . [8050-17]

Multivehicle decentralized fusion and tracking, Adel I. El-Fallah, Aleksandar Zatezalo, Raman K. Mehra, Scientific Systems Co., Inc. (USA); Ronald P. Mahler, Lockheed Martin Maritime Systems & Sensors (USA) . . . . . [8050-18]

Multimodel filtering of partially observable space object trajectories, Aleksandar Zatezalo, Adel I. El-Fallah, Raman K. Mehra, Scientific Systems Co., Inc. (USA); Ronald P. Mahler, Lockheed Martin Maritime Systems & Sensors (USA); Khanh D. Pham, Air Force Research Lab. (USA) . . . . . [8050-19]

On the differences between the probability hypothesis density (PHD) filter and the multitarget multi-Bernoulli (MeMBer) filter, Daniel E. Clark, Heriot-Watt Univ. (United Kingdom); Trevor Wood, Oxford Univ. (United Kingdom); Ba-Ngu B. Vo, The Univ. of Western Australia (Australia); Branko Ristic, Defence Science and Technology Organisation (Australia); Ba Tuong Vo, The Univ. of Western Australia (Australia). . . . . [8050-20]

On the ordering of the sensors in the iterated-corrector probability hypothesis density (PHD) filter, Sharad Nagappa, Daniel E. Clark, Heriot-Watt Univ. (United Kingdom) . . . . . [8050-21]

A tracker based on a CPHD filter approach for infrared applications, Yohan Petetin, TELECOM & Management SudParis (France); Daniel E. Clark, Heriot-Watt Univ. (United Kingdom); Branko Ristic, Defence Science and Technology Organisation (Australia); Dominique Maltese, Sagem Defense Securite (France) . . . . . [8050-22]

The set IMMJPDA filter for multitarget tracking, Daniel Svensson, Lennart Svensson, Chalmers Univ. of Technology (Sweden); David Crouse, Univ. of Connecticut (USA); Marco Guerriero, Elettronica S.p.A. (Italy); Peter K. Willett, Univ. of Connecticut (USA) . . . . . [8050-23]

Dempster's combination is a special case of Bayes' rule, Ronald P. Mahler, Lockheed Martin Maritime Systems & Sensors (USA) . . . . . [8050-24]

INVITED PANEL DISCUSSION

Mon. 7:15 to 9:40 pm

Real-World Issues and Challenges in Hard and Soft Fusion

Panel Moderators: **Chee-Yee Chong,** BAE Systems Advanced Information Technologies; **Ivan Kadar,** Interlink Systems Sciences, Inc.

Panel Organizer: **Ivan Kadar,** Interlink Systems Sciences, Inc.

Panelists: **Richard Antony,** SAIC, Inc.;
Chee-Yee Chong, BAE Systems Advanced Information Technologies;
Erik Blasch, Air Force Research Lab.;
Ivan Kadar, Interlink Systems Sciences, Inc.;
Thiagalingam Kirubarajan, McMaster Univ. (Canada);
James Llinas, Univ. at Buffalo;
Ronald P. Mahler, Lockheed Martin Maritime Systems and Sensors

The panel will address salient real-world issues and challenges in hard and soft data fusion illuminated by invited experts. Accurate situation assessment sometimes cannot be accomplished using just hard or soft data sources alone. Specifically sources of "hard information" are physics-based sources that provide sensor observables such as radar or video data, while "soft information" is usually provided by human-based sources. Fusion of hard and soft data can provide situation pictures that are better than those using hard or soft data alone. For example, patrol reports provide soft data in addition to hard data from physical sensors in urban operational environments. While algorithms for fusing information from physical sensors has a substantial development history as well as maturity, complex technical issues remain in the representation of human-based information to make it suitable for combining with sensor based information. Conceptual real-world related examples associated with the overall complex problem will be addressed by the panel to highlight issues and challenges. Audience participation is welcomed to provide a forum for exchange of ideas.

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 5 . . . . . Tues. 10:00 am to 12:20 pm

Multisensor Fusion Methodologies and Applications II

Session Chairs: **Michael L. Hinman,** Air Force Research Lab.;
Chee-Yee Chong, BAE Systems Advanced Information Technologies;
Ivan Kadar, Interlink Systems Sciences, Inc.

Acoustic and imagery semantic labeling and fusion of human-vehicle interactions, Amir H. Shirkhodaie, Vinayak Elangovan, Aaron Rababaah, Tennessee State Univ. (USA) . . . . . [8050-25]

Adaptive characterization, tracking, and semantic labeling of human-vehicle interactions via multimodality data fusion techniques, Amir H. Shirkhodaie, Vinayak Elangovan, Aaron Rababaah, Tennessee State Univ. (USA) . . . . [8050-26]

Structure learning of Bayesian network using a cloud-based adaptive immune genetic algorithm, Song Qin, Zhejiang Univ. (China); Feng Lin, Zhejiang Univ. (China) and George Mason Univ. (USA); Kuo-Chu Chang, George Mason Univ. (USA) . . . . . [8050-27]

Study of most probable explanations in hybrid Bayesian networks, Wei Sun, Kuo-Chu Chang, George Mason Univ. (USA) . . . . . [8050-28]

Fusion and Gaussian mixture based-classifiers for SONAR data, Vikas Kotari, Kuo-Chu Chang, George Mason Univ. (USA) . . . . . [8050-29]

Sequential fusion, Mark E. Oxley, Christine M. Schubert Kabban, Air Force Institute of Technology (USA) . . . . . [8050-30]

Regret-based fusion, Mark E. Oxley, Air Force Institute of Technology (USA) . . . . . [8050-31]

Lunch/Exhibition Break . . . . . 12:20 to 1:30 pm

SESSION 6 . . . . . Tues. 1:30 to 3:10 pm

Multisensor Fusion Methodologies and Applications III

Session Chairs: **Chee-Yee Chong,** BAE Systems Advanced Information Technologies; **Michael L. Hinman,** Air Force Research Lab.;
Martin E. Liggins II, MITRE Corp.;
Ivan Kadar, Interlink Systems Sciences, Inc.

Twelve dubious methods to solve a first-order linear (highly) underdetermined PDE for exact particle flow nonlinear filters, Frederick E. Daum, Raytheon Co. (USA) . . . . . [8050-32]

Numerical results for exact particle flow filters, Frederick E. Daum, Jim Huang, Raytheon Co. (USA) . . . . . [8050-33]

The exact fundamental solution for the Benes filter: a Feynman path integral derivation, Bhashyam Balaji, Defence Research and Development Canada (Canada) . . . . . [8050-34]

Impact of radar system parameters on trajectory inference using stochastic context-free grammars, Bhashyam Balaji, Alex Wang, Defence Research and Development Canada (Canada) . . . . . [8050-35]

The multitarget set JPDA filter with target identity, Daniel Svensson, Lennart Svensson, Chalmers Univ. of Technology (Sweden); Marco Guerriero, Elettronica S.p.A. (Italy) . . . . . [8050-36]

SESSION 7 . . . . . Tues. 3:40 to 5:00 pm

Multisensor Fusion Methodologies and Applications IV

Session Chairs: **Erik P. Blasch,** Defence R&D Canada-Valcartier (Canada) and Air Force Research Lab.;
Chee-Yee Chong, BAE Systems Advanced Information Technologies;
Michael L. Hinman, Air Force Research Lab.;
Martin E. Liggins II, MITRE Corp.

Information fusion measures of effectiveness for decision support, Erik P. Blasch, Pierre Valin, Eloi Bossé, Defence Research and Development Canada (Canada) . . . . . [8050-37]

Toward more robust exploitation of the asymmetric threat: binary fusion class extensions, Richard T. Antony, SAIC (USA); Joseph A. Karakowski, U.S. Army CERDEC Intelligence and Information Warfare Directorate (USA). . [8050-38]

Probabilistic programming for assessing capability and capacity, Avi Pfeffer, Scott A. Harrison, Charles River Analytics, Inc. (USA) . . . . . [8050-39]

Effects of operation parameters on multitarget tracking in proximity sensor networks, Qiang Le, Hampton Univ. (USA); Lance M. Kaplan, U.S. Army Research Lab. (USA) . . . . . [8050-40]

SESSION 8 . . . . . Tues. 5:00 to 6:40 pm

Multisensor Fusion Methodologies and Applications V

Session Chairs: **Martin E. Liggins II,** MITRE Corp.; **Michael L. Hinman,** Air Force Research Lab.; **Chee-Yee Chong,** BAE Systems Advanced Information Technologies; **Erik P. Blasch,** Defence R&D Canada-Valcartier (Canada) and Air Force Research Lab.

An information matrix fusion (IMF)-based heterogeneous track-to-track fusion algorithm, Xin Tian, Yaakov Bar-Shalom, Univ. of Connecticut (USA); Erik P. Blasch, Khanh D. Pham, Air Force Research Lab. (USA); Genshe Chen, I-Fusion, Inc. (USA); Yuan Ting, Univ. of Connecticut (USA) . . . . . [8050-41]

Object discovery, identification, and association, Vijay Kumar, Univ. of Missouri-Kansas City (USA); James Metzler, Mark H. Linderman, Jon S. Jones, Mark G. Alford, Adnan Bubalo, Maria Scalzo, Air Force Research Lab. (USA) . . . . . [8050-42]

Target signature agnostic tracking with ad-hoc network of omni-directional sensors, Kalin Atanassov, Qualcomm Inc. (USA); William S. Hodgkiss, Univ. of California, San Diego (USA); Sergio R. Goma, Qualcomm Inc. (USA) . . . [8050-43]

Sensor reduction techniques using Bellman optimal approximations of target and environment dynamics, Brian J. Goode, Philip A. Chin, Michael J. Roan, Virginia Polytechnic Institute and State Univ. (USA) . . . . . [8050-44]

Real-time sensor fusion technique for acoustic and seismic sensors, Mussab Zubair, Klaus Hartmann, Otmar Loffeld, Univ. Siegen (Germany). . . . . [8050-45]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Detecting large frequency weak signal in heavy noise background using nonlinear bi-stable system, Yu Zhang, Yuan Zhao, Yong Zhang, Long Wu, Haifeng Lv, Harbin Institute of Technology (China) . . . . . [8050-67]

Eigenvalue analysis of unresolved radar target responses for perimeter surveillance, Amer Nezirovic, Henrik Petersson, Svante Björklund, Swedish Defence Research Agency (Sweden) . . . . . [8050-68]

Study on recognition method based on distributed optical fiber sensor system, Haiyan Xu, Xiao Qian, Zhong-De Qiao, Hongyan Wu, Fudan Univ. (China) . . . . . [8050-69]

Visualization of hyperspectral images using bilateral filtering with spectral angles, Jai-Hoon Lee, Ayoung Heo, Won-Chul Choi, Seo Hyun Kim, Dong-Jo Park, KAIST (Korea, Republic of) . . . . . [8050-70]

Feynman path integrals, effective action, and metropolis-based Monte-Carlo methods for nonlinear filtering, Bhashyam Balaji, Defence Research and Development Canada (Canada) . . . . . [8050-71]

Target tracking based on video sequences, Yahui Liu, Beijing Univ. of Posts and Telecommunications (China) . . . . . [8050-72]

Multiple model assignment for multipath-assisted multitarget tracking, Maheswaran Subramaniam, McMaster Univ. (Canada); Kumaradevan Punithakumar, GE Healthcare (Canada); Ratnasingham Tharmarasa, McMaster Univ. (Canada); Michael McDonald, Defence Research and Development Canada (Canada); Thiagalingam Kirubarajan, McMaster Univ. (Canada). . . . . [8050-73]

Discussion and application of the homotopy filter, Sora Choi, Peter K. Willett, Univ. of Connecticut (USA); Frederick E. Daum, Jim Huang, Raytheon Co. (USA) . . . . . [8050-74]

Wednesday 27 April

SESSION 9 . . . . . Wed. 8:00 to 10:00 am

Signal and Image Processing, and Information Fusion Applications I

Session Chairs: **Lynne L. Grewe,** California State Univ., East Bay;
Alastair D. McAulay, Lehigh Univ.;
Mark G. Alford, Air Force Research Lab.

Sub-pixel registration of moving objects in visible and thermal imagery with adaptively thresholded segmentation, Stephen M. Won, Susan S. Young, U.S. Army Research Lab. (USA); Gunasekaran S. Seetharaman, Air Force Research Lab. (USA); Kannappan Palaniappan, Univ. of Missouri-Columbia (USA) [8050-46]

Interactive target recognition in images using machine-learning techniques, Ariel Michaeli, Irit Camon, Rafael Advanced Defense Systems Ltd. (Israel) . . . . . [8050-47]

Optimal detection of objects in images and videos using electroencephalography (EEG), Deepak Khosla, Rajan Bhattacharyya, Penn Tasinga, David Huber, HRL Labs., LLC (USA) . . . . . [8050-48]

Improved classification using image data fused via nonlinear dimensionality reduction, Colin C. Olson, Jonathan M. Nichols, K. Peter Judd, Frank Bucholtz, U.S. Naval Research Lab. (USA) . . . . . [8050-49]

Shape and texture fused recognition of flying targets, Levente Kovács, Ákos Utasi, Andrea Kovács, Tamás Szirányi, Computer and Automation Research Institute (Hungary) . . . . . [8050-50]

Millimeter-wavelength radar improves target identification, Alastair D. McAulay, Lehigh Univ. (USA). . . . . [8050-51]

Courses of Related Interest

SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Tuesday, 8:30 am to 5:30 pm

SC158 **Fundamentals of Automatic Target Recognition** (Sadjadi) Thursday, 8:30 am to 5:30 pm

SC995 **Target Detection Algorithms for Hyperspectral Imagery** (Nasrabadi) Thursday, 8:30 am to 5:30 pm

SC994 **Multisensor Data Fusion for Object Detection, Classification and Identification** (Klein) Tuesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

SESSION 10 . . . . . Wed. 10:30 to 11:50 am

Signal and Image Processing, and Information Fusion Applications II

Session Chairs: **Lynne L. Grewe,** California State Univ., East Bay;
Alastair D. McAulay, Lehigh Univ.;
Mark G. Alford, Air Force Research Lab.

An optical tracker for the maritime environment, Asheer K. Bachoo, Francois P. J. Le Roux, Council for Scientific and Industrial Research (South Africa); Fred Nicolls, Univ. of Cape Town (South Africa) . . . . . [8050-52]

Lane detection using road planar information, Qiang He, Mississippi Valley State Univ. (USA); Chee-Hung Chu, Univ. of Louisiana at Lafayette (USA) . . . . . [8050-53]

Detection and classification of poorly known aircraft with a low-resolution infrared sensor, Sidonie Lefebvre, ONERA (France); Stéphanie Allassonnière, Ecole Polytechnique (France); Gérard Durand, ONERA (France); Jérémie Jakubowicz, Eric Moulines, Telecom ParisTech (France); Antoine Roblin, ONERA (France) . . . . . [8050-54]

Detection and classification of moving objects from UAVs with optical and IR sensors, Michael Teutsch, Wolfgang Krüger, Norbert F. Heinze, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . [8050-55]

Lunch/Exhibition Break. . . . . 11:50 pm to 1:20 am

SESSION 11 . . . . . Wed. 1:20 to 3:00 pm

Signal and Image Processing, and Information Fusion Applications III

Session Chairs: **Alastair D. McAulay,** Lehigh Univ.;
Mark G. Alford, Air Force Research Lab.;
Lynne L. Grewe, California State Univ., East Bay

Adaptive statistical inferential methods for detection and classification in sensing systems, Xinjia Chen, Ernest L. Walker, Southern Univ. and A&M College (USA) . . . . . [8050-56]

Channel-aware distributed classification using binary local decisions, Mohammad Fanaei, Matthew C. Valenti, Natalia A. Schmid, Vinod K. Kulathumani, West Virginia Univ. (USA) . . . . . [8050-57]

Benchmark for detection algorithms of target signal observables with significant temporal characteristic, Nathan Levy, Israel Ministry of Defense (Israel); Gil A. Tidhar, Optigo Systems, Ltd. (Israel); Avy Louski, Raanan Schlisselberg, Israel Ministry of Defense (Israel) . . . . . [8050-58]

Interacting multiple model estimators for tracking thousands of interacting, small targets in a complex plasma, Neil Oxtoby, Jason F. Ralph, Céline Durniak, Dmitry Samsonov, Univ. of Liverpool (United Kingdom) . . . . . [8050-59]

Diversity detection in non-Gaussian noise employing the generalized approach to signal processing in noise with fading diversity channels, Vyacheslav P. Tuzlukov, Kyungpook National Univ. (Korea, Republic of) [8050-60]

SESSION 12 . . . . . Wed. 3:30 to 5:30 pm

Signal and Image Processing, and Information Fusion Applications IV

Session Chairs: **Mark G. Alford,** Air Force Research Lab.;
Alastair D. McAulay, Lehigh Univ.;
Lynne L. Grewe, California State Univ., East Bay

A survey of imagery techniques for semantic labeling of human-vehicle interactions in persistent surveillance systems, Vinayak Elangovan, Amir H. Shirkhodaie, Tennessee State Univ. (USA) . . . . . [8050-61]

A new research tool for hybrid Bayesian networks using script language, Wei Sun, Cheol-Young Park, Rommel Carvalho, George Mason Univ. (USA). [8050-62]

Indoor localization of medication packages using RFID, Stelios A. Mitilineos, George E. Vastianos, Olga E. Segou, Dimitris M. Kyriazanos, Stelios C. A. Thomopoulos, National Ctr. for Scientific Research Demokritos (Greece)[8050-63]

GPS signal modeling for location estimation in indoor environments using GPS repeaters, Dionysia K. Petraki, Stelios A. Mitilineos, Stelios C. A. Thomopoulos, National Ctr. for Scientific Research Demokritos (Greece)[8050-64]

Low-power, real-time digital video stabilization using the HyperX parallel processor, Martin A. Hunt, Lin Tong, Keith Bindloss, Stephen Lim, Coherent Logix, Inc. (USA); Paul D. Willson, U.S. Army Armament Research, Development and Engineering Ctr. (USA) . . . . . [8050-65]

Adaptive event detection for nonintrusive load monitoring, Yuanwei Jin, Eniye Tebekaemi, Univ. of Maryland Eastern Shore (USA); Mario Berges, Carnegie Mellon Univ. (USA). . . . . [8050-66]

Wednesday-Thursday 27-28 April 2011 • Proceedings of SPIE Vol. 8051

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Algorithms for Synthetic Aperture Radar Imagery XVIII

Conference Chairs: **Edmund Zelnio,** Air Force Research Lab.; **Frederick D. Garber,** Wright State Univ.

Program Committee: **David Blacknell,** Defence Science and Technology Lab. (United Kingdom); **Mujdat Cetin,** Sabanci Univ. (Turkey); **Gil J. Ettinger,** BAE Systems Advanced Information Technologies; **Charles V. Jakowatz, Jr.,** Sandia National Labs.; **Eric R. Keydel,** SAIC; **Jian Li,** Univ. of Florida; **Michael Minardi,** Air Force Research Lab.; **Randolph L. Moses,** The Ohio State Univ.; **Les Novak,** Scientific Systems Co., Inc.; **Lee Potter,** The Ohio State Univ.; **Brian D. Rigling,** Wright State Univ.; **Timothy D. Ross,** Air Force Research Lab.; **Michael A. Saville,** Air Force Institute of Technology; **Gerard W. Titi,** BAE Systems Advanced Information Technologies

Innovative Format

Once again, this conference will follow a "Briefing, Poster Workshop, Panel Discussion" format. During the first sessions of each day, authors will highlight the results for their work in 10 minute oral briefings. After the presentations, these same authors will be available for in-depth discussions in an extended poster session setting, which will be held in or near the conference room. After the Poster Workshop, there will be a Panel Discussion where experts and audience will address pressing issues from the sessions that day.

Wednesday 27 April

SESSION 1 . . . . . Wed. 8:00 to 10:00 am

Advanced SAR Imaging I

Session Chair: **Charles V. Jakowatz, Jr.,** Sandia National Labs.

Fast synthetic aperture radar imaging with a streamlined 2D fractional Fourier transform, Matthew P. Pepin, Majeed M. Hayat, The Univ. of New Mexico (USA) . . . . . [8051-01]

A comparison of SAR imaging algorithms for high-squint angle trajectories, Matt Horvath, Brian D. Rigling, Wright State Univ. (USA) . . . . . [8051-02]

Extensions to polar formatting with spatially variant post filtering, Wendy L. Garber, Robert W. Hawley, Matrix Research Inc. (USA) . . . . . [8051-03]

A butterfly algorithm for synthetic apeture ragar imaging, Laurent Demanet, Massachusetts Institute of Technology (USA); Matthew Ferrara, Nicholas Maxwell, Jack Poulson, Matrix Research Inc. (USA); Lexing Ying, The Univ. of Texas at Austin (USA) . . . . . [8051-04]

Ultrasonic tomographic imaging using a propagation and backpropagation method, Yuanwei Jin, Chengdong Dong, Univ. of Maryland Eastern Shore (USA); Matthew Ferrara, Kevin L. Priddy, Air Force Research Lab. (USA) . . . . . [8051-05]

Aperture weighting technique for video synthetic aperture radar imaging, Robert W. Hawley, Wendy L. Garber, Matrix Research Inc. (USA) . . . . . [8051-06]

Video-like image exploitation for MISAR image sequences taken from small UAVs, Günter M. Saur, Norbert F. Heinze, Wolfgang Krüger, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [8051-07]

3D ISAR imaging of objects through 2D rotations, Zhijun Qiao, Guillermo Garza, Jaime Lopez, The Univ. of Texas-Pan American (USA) . . . . . [8051-08]

An algorithm for wide aperture 3D SAR imaging with measured data, Forest A. Lee-Elkin, Lee Potter, The Ohio State Univ. (USA) . . . . . [8051-09]

Sparse near-field radar imagery for quick RCS analysis, Françios Giraud, Pierre Minvielle, Commissariat à l'Énergie Atomique (France); Jean-Francois Giovanelli, Univ. Bordeaux 1 (France); Pierre Del Moral, INRIA Bordeaux Suf-Ouest (France) . . . . . [8051-41]

Computationally efficient FBP-type direct segmentation of synthetic aperture radar images, Huseyin C. Yanik, Zhengmin Li, Birsen Yazici, Rensselaer Polytechnic Institute (USA) . . . . . [8051-10]

Compressive RF tomography, Matthew Ferrara, Lee Patton, Jason Parker, Matrix Research Inc. (USA) . . . . . [8051-11]

SESSION 2 . . . . . Wed. 10:30 am to 12:30 pm

Advanced SAR Imaging II

Session Chair: **Lee Potter,** The Ohio State Univ.

Performance analysis of sparse 3D SAR imaging, Christian Austin, Randolph L. Moses, The Ohio State Univ. (USA) . . . . . [8051-12]

Toeplitz embedding for fast iterative regularized imaging, Rizwan Ahmad, Lee Potter, The Ohio State Univ. (USA) . . . . . [8051-13]

Doppler synthetic aperture radar imaging, Ling Wang, Nanjing Univ. of Aeronautics and Astronautics (China); Birsen Yazici, Rensselaer Polytechnic Institute (USA) . . . . . [8051-14]

Combining synthetic aperture radar and space-time adaptive processing using a single-receive channel, Christie Bryant, Matrix Research Inc. (USA); Emre Ertin, Lee Potter, The Ohio State Univ. (USA) . . . . . [8051-15]

Observations of clutter suppression in bistatic VHF/UHF-band synthetic-aperture radar, Lars Ulander, Björn Flood, Per-Olov Frölind, Anders Gustavsson, Tommy Jonsson, Björn Larsson, Daniel Murdin, Rolf Ragnarsson, Gunnar Stenström, Swedish Defence Research Agency (Sweden); Remi Baqué, Hubert Cantalloube, Philippe Dreuillet, Olivier Ruault du Plessis, ONERA (France) . . . . . [8051-16]

Spatially variant interference suppression method based on superresolution algorithm for synthetic aperture radar, Kei Suwa, Toshio Wakayama, Mitsubishi Electric Corp. (Japan) . . . . . [8051-17]

High-resolution interrupted SAR imaging via iterative adaptive techniques, Duc Vu, Luzhou Xu, Jian Li, Univ. of Florida (USA) . . . . . [8051-18]

CBP-based multichannel autofocus for near-field SAR imaging, Hyun Jeong Cho, David C. Munson, Jr., Univ. of Michigan (USA) . . . . . [8051-19]

Windowing functions for focused range-Doppler imaging, Patrick R. Williams, Raytheon Co. (USA) . . . . . [8051-20]

A transformation between on-center and off-center point scatterers for circular synthetic aperture radar, Linda J. Moore, Air Force Research Lab. (USA) . . . . . [8051-21]

Two-stage backprojection on synthetic apeture radar data using multiple GPUs, William Chapman, Sanjay Ranka, Sartaj Sahni, Mark S. Schmalz, Univ. of Florida (USA); Bracy Elton, Uttam Majumder, Linda J. Moore, Air Force Research Lab. (USA) . . . . . [8051-22]

InSAR processing using a GPGPU, Aaron Rogan, Richard Carande, Neva Ridge Technologies, Inc. (USA) . . . . . [8051-40]

Lunch/Exhibition Break . . . . . 12:30 to 1:40 pm

POSTER SESSION. . . . . Wed. 1:40 to 3:30 pm

DISCUSSION/WORKSHOP. . . . . Wed. 4:00 to 5:00 pm

Thursday 28 April

SESSION 3 . . . . . Thurs. 9:00 to 10:10 am

Advance Motion Processing

Session Chair: **Michael A. Saville,** Air Force Institute of Technology

Synthetic aperture radar moving target indication using a variation of the notching technique, Ross W. Deming, Air Force Research Lab. (USA) . [8051-23]

Ground moving target indication via multichannel airborne SAR, Duc Vu, Bin Guo, Luzhou Xu, Jian Li, Univ. of Florida (USA) . . . . . [8051-24]

Adaptive tracking of targets in SAR imagery with posterior models, Gregory E. Newstadt, Univ. of Michigan (USA); Edmund Zelnio, Air Force Research Lab. (USA); Alfred O. Hero III, Univ. of Michigan (USA). . . . . [8051-25]

Analysis of SAR moving grid processing for focusing and detection of ground moving targets, Daniel E. Hack, Michael A. Saville, Air Force Institute of Technology (USA) . . . . . [8051-26]

Waveform-diverse moving-target spotlight SAR, Margaret Cheney, Rensselaer Polytechnic Institute (USA); Brett Borden, Naval Postgraduate School (USA) . . . . . [8051-27]

Passive imaging of moving targets using distributed apertures in multiple-scattering environments, Ling Wang, Nanjing Univ. of Aeronautics and Astronautics (China); Birsen Yazici, Rensselaer Polytechnic Institute (USA) . . . . . [8051-28]

The physics of vibrating scatterers in SAR imagery, Daniel B. Andre, David Blacknell, Darren B. Muff, Matthew Nottingham, Defence Science and Technology Lab. (United Kingdom). . . . . [8051-29]

SESSION 4 . . . . . Thurs. 10:40 am to 12:20 pm

Automatic Target Detection/Processing/Recognition

Session Chair: **David Blacknell,**
Defence Science and Technology Lab. (United Kingdom)

Low-complexity, rate-efficient SAR raw data compression, Shantanu Rane, Petros T. Boufounos, Anthony Vetro, Mitsubishi Electric Research Labs. (USA); Yu Okada, Mitsubishi Electric Corp. (Japan). . . . . [8051-30]

Feature phenomenology and feature extraction of civilian vehicles from SAR images, Christopher Paulson, Univ. of Florida (USA); Edmund Zelnio, LeRoy Gorham, Air Force Research Lab. (USA); Dapeng Wu, Univ. of Florida (USA) . . . . . [8051-31]

Comparison of the HRRP phase gradient statistics between ships and sea surfaces using alpha-stable distribution, Dan Jiang, Xiaojian Xu, BeiHang Univ. (China) . . . . . [8051-32]

Prediction of coherent change detection performance in synthetic aperture imagery, David Blacknell, Daniel B. Andre, Defence Science and Technology Lab. (United Kingdom). . . . . [8051-33]

Predicting the effectiveness of SAR imagery for target detection, Daniel Gutchess, Charles River Analytics, Inc. (USA); John M. Irvine, Draper Lab. (USA); Magnús S. H. Snorrason, Charles River Analytics, Inc. (USA) . . . . . [8051-34]

Derived operating conditions for ATR performance understanding, Joshua Blackburn, Air Force Institute of Technology (USA); John Mossing, Adam R. Nolan, Timothy D. Ross, Edmund Zelnio, Air Force Research Lab. (USA) [8051-35]

Joint sparse representation-based automatic target recognition in SAR images, Haichao Zhang, Univ. of Illinois at Urbana-Champaign (USA); Nasser M. Nasrabadi, U.S. Army Research Lab. (USA); Thomas Huang, Univ. of Illinois at Urbana-Champaign (USA); Yanning Zhang, Northwestern Polytechnical Univ. (China) . . . . . [8051-36]

Target classification in synthetic aperture radar using map-seeking circuit technology, Cameron K. Peterson, Patricia Murphy, Pedro A. Rodriguez, The Johns Hopkins Univ. (USA) . . . . . [8051-37]

Radar target classification using morphological image processing, Julie A. Jackson, Air Force Institute of Technology (USA); Patrick Brady, Cedarville Univ. (USA) . . . . . [8051-38]

Automatic target recognition from highly incomplete SAR data, Chaoran Du, Gabriel Rilling, Michael E. Davies, Bernard Mulgrew, The Univ. of Edinburgh (United Kingdom). . . . . [8051-39]

Lunch/Exhibition Break . . . . . 12:20 to 1:30 pm

POSTER SESSION. . . . . Thurs. 1:30 to 3:30 pm

DISCUSSION/WORKSHOP. . . . . Thurs. 4:00 to 5:00 pm

Courses of Related Interest

SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Tuesday, 8:30 am to 5:30 pm

SC1031 **Radar Micro-Doppler Signatures - Principles and Applications** (Chen, Tahmoush) Monday, 1:30 to 5:30 pm

See full course listing and descriptions on pp. 144-192.

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Acquisition, Tracking, Pointing, and Laser Systems Technologies XXV

Conference Chairs: **William E. Thompson,** New Mexico Institute of Mining and Technology; **Paul F. McManamon,** Exciting Technology, LLC

Conference Co-Chair: **Ali T. Alouani,** Tennessee Technological Univ.

Program Committee: **William D. Blair,** Georgia Tech Research Institute; **David Blacknell,** Defence Science and Technology Lab. (United Kingdom); **Gillian K. Groves,** Raytheon Space & Airborne Systems; **Dan C. Herrick,** Air Force Research Lab.; **James M. Hilkert,** Alpha-Theta Technologies; **Paul S. Idell,** The Boeing Co.; **Eric Kaltenbacher,** SRI St. Petersburg; **Christopher J. Musial,** Boeing-SVS, Inc.; **Kevin Probst,** Core Group, Inc.; **Jim F. Riker,** Air Force Research Lab.; **Michael C. Roggemann,** Michigan Technological Univ.; **Juan R. Vasquez,** Numerica Corp.; **Matthew R. Whiteley,** MZA Associates Corp.

Monday 25 April

SESSION 1 . . . . . Mon. 8:30 am to 12:00 pm

Requirements and System-Level Applications

Session Chairs: **Paul F. McManamon,** Exciting Technology, LLC; **Dan C. Herrick,** Air Force Research Lab.

Requirements on active (laser) tracking and imaging from a technology perspective *(Invited Paper)*, Jim F. Riker, Air Force Research Lab. (USA) . . . . . [8052-01]

HEL-JTO beam control technology research and development programs *(Invited Paper)*, Dan C. Herrick, Air Force Research Lab. (USA) . . . . . [8052-02]

Improved mission effectiveness of HEL systems with phased array beam control *(Invited Paper)*, Kevin Probst, Core Group, Inc. (USA) . . . . . [8052-03]

Conformal apertures: concepts and requirements *(Invited Paper)*, Edward A. Watson, Air Force Research Lab. (USA) . . . . . [8052-04]

Influence of aero-optical disturbances on acquisition, tracking, and pointing performance characteristics in laser systems *(Invited Paper)*, Matthew R. Whiteley, MZA Associates Corp. (USA). . . . . [8052-05]

Multi-aperture coherent imaging *(Invited Paper)*, Nicholas Miller, Ladar and Optical Communications Institute (USA). . . . . [8052-06]

Lunch Break . . . . . 12:00 to 1:30 pm

SESSION 2 . . . . . Mon. 1:30 to 5:20 pm

Image and Signal Processing for Target Tracking Applications

Session Chair: **Ali T. Alouani,** Tennessee Technological Univ.

Preliminary performance comparison of a synchronous and an asynchronous multisensor tracker *(Invited Paper)*, Ali T. Alouani, Tennessee Technological Univ. (USA). . . . . [8052-07]

Track initialization for multistatic active sonar systems, Christian G. Hempel, Tod Luginbuhl, Steven C. Schoenecker, Naval Undersea Warfare Ctr. (USA) . . . . . [8052-08]

Algorithms for image-based detection and tracking of high-speed objects, Christopher R. Volpe, Stephen Snarski, Alberico Menozzi, Hai-Wen Chen, Applied Research Associates, Inc. (USA). . . . . [8052-09]

Simulations of a hybrid active-segmentation and Fitts correlator tracker *(Invited Paper)*, Joseph Riley, MZA Associates Corp. (USA). . . . . [8052-10]

HEL-generated extinction effects and degradation of USAF BILL/TILL-ATR multispectral infrared algorithms (case study GHADR 110), Clifford A. Paiva, BSM Research Associates (USA) . . . . . [8052-11]

Performance analysis of embedded real-time video tracking systems, Douglas A. Scott, Olegs Mise, GE Intelligent Platforms (United Kingdom)[8052-12]

Passive ranging of dynamic rocket plumes using infrared and visible oxygen attenuation, Robert A. Vincent, Michael R. Hawks, Air Force Institute of Technology (USA) . . . . . [8052-13]

Quantitative analysis of the improvement in high-zoom maritime tracking due to real-time image enhancement, Asheer K. Bachoo, Jason P. de Villiers, Council for Scientific and Industrial Research (South Africa) . . . . . [8052-14]

Quantitative analysis of the improvement in omnidirectional maritime surveillance and tracking due to real-time image enhancement, Jason P. de Villiers, Asheer K. Bachoo, Council for Scientific and Industrial Research (South Africa) . . . . . [8052-15]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 3 . . . . . Tues. 10:00 am to 12:00 pm

Control Systems and Components

Session Chair: **William E. Thompson,** New Mexico Institute of Mining and Technology

New generation inductive position encoding techniques for EOI, radar, and missile systems, Mark A. Howard, Zettlex UK Ltd. (United Kingdom) . . [8052-16]

A reduced-order disturbance observer applied to inertially stabilized line-of-sight control, James M. Hilkert, Alpha-Theta Technologies (USA); Brian Pautler, Raytheon Network Centric Systems (USA) . . . . . [8052-17]

Calibaration of VISSTA pointing control system, Justin Teuscher, Rees Fullmer, Robert T. Pack, Utah State Univ. (USA) . . . . . [8052-18]

Dynamic performance of a two-axis gimbaled pedestal in keyhole gimbal-lock conditions, James DeBruin, IJK Controls, LLC (USA) . . . . . [8052-19]

Predicting and preventing reaction torque coupling in gimbal system mounts, Gunnar Ristroph, James DeBruin, IJK Controls, LLC (USA) . . . [8052-20]

Optomechanically linking the imager's optical axis to the laser and the gyroscope in finite element models, Alson E. Hatheway, Alson E. Hatheway Inc. (USA) . . . . . [8052-21]

Lunch/Exhibition Break . . . . . 12:00 to 1:00 pm

SESSION 4 . . . . . Tues. 1:00 to 5:30 pm

Rapid Beam Steering

Session Chairs: **Paul F. McManamon,** Exciting Technology, LLC; **Edward A. Watson,** Air Force Research Lab.

Non-mechanical conformal beam steering system with an 80 degree × 80 degree field of regard *(Invited Paper)*, Steven A. Serati, Boulder Nonlinear Systems, Inc. (USA); Jihwan Kim, Michael J. Escuti, North Carolina State Univ. (USA); Lance Hosting, Boulder Nonlinear Systems, Inc. (USA) . . . . . [8052-22]

MWIR wide-area step and stare imager *(Invited Paper)*, Joseph R. Buck, Steven A. Serati, RoyInn Serati, Hugh Masterson, Boulder Nonlinear Systems, Inc. (USA) . . . . . [8052-23]

Optical characterization of MEMS micromirror arrays using digital holographic Shack-Hartmann wavefront sensor: a new technique, Igor Anisimov, Sarah B. Dooley, Air Force Research Lab. (USA) . . . . . [8052-24]

Beam shape of coherently-combined optical array *(Invited Paper)*, Irl W. Smith, Raytheon Co. (USA) . . . . . [8052-25]

Embedded FPGA platform for fast steering mirror and optical inertial reference unit applications, Steven R. Wasson, Felix E. Morgan, Dan Eckelkamp-Baker, Applied Technology Associates (USA) . . . . . [8052-26]

Courses of Related Interest

SC160 **Precision Stabilized Pointing and Tracking Systems** (Hilkert) Tuesday, 8:30 am to 5:30 pm

SC158 **Fundamentals of Automatic Target Recognition** (Sadjadi) Thursday, 8:30 am to 5:30 pm

SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Tuesday, 8:30 am to 5:30 pm

SC892 **Infrared Search and Track Systems** (Schwering) Tuesday, 8:30 am to 5:30 pm

SC1035 **Military Laser Safety** (Marshall) Wednesday, 8:30 am to 5:30 pm

SC997 **High Power Laser Beam Quality** (Ross) Wednesday, 1:30 to 5:30 pm

See full course listing and descriptions on pp. 144-192.

Thursday-Friday 28-29 April 2011 • Proceedings of SPIE Vol. 8053

Geospatial InfoFusion Systems and Solutions for Defense and Security Applications

Conference Chairs: **Matthew F. Pellechia,** ITT Corp. Geospatial Systems; **Richard Sorensen,** U.S. Air Force

Conference Co-Chairs: **Shiloh L. Dockstader,** ITT Corp. Geospatial Systems; **Rudy G. Benz II,** ITT Corp. Geospatial Systems; **Bernard V. Brower,** ITT Corp. Geospatial Systems

Program Committee: **Erik P. Blasch,** Air Force Research Lab.; **Jason S. Brown,** Schafer Corp.; **Hui Cheng,** Sarnoff Corp.; **Paul B. Deignan,** L-3 Communications Integrated Systems; **Dan Edwards,** National Geospatial-Intelligence Agency; **Michael E. Gangl,** MacAulay-Brown, Inc.; **Robert Gillen,** Univ. of Dayton Research Institute; **Arun Hampapur,** IBM Thomas J. Watson Research Ctr.; **James H. Kasner,** WISC Enterprises LLC; **Eric R. Keydel,** SAIC Corp.; **James Llinas,** Univ. at Buffalo; **Charles Mondello,** Pictometry International Corp.; **Kannappan Palaniappan,** Univ. of Missouri-Columbia; **Carlo Regazzoni,** Univ. degli Studi di Genova (Italy); **Gunasekaran S. Seetharaman,** Air Force Institute of Technology; **Mubarak Ali Shah,** Univ. of Central Florida; **Christopher P. Stauffer,** BAE Systems; **Bradford C. Tousley,** Logos Technologies, Inc.; **Pramod Kumar Varshney,** Syracuse Univ.; **Karmon M. Vongsy,** Air Force Institute of Technology; **Robb Wilcox,** Office of Naval Research Global

Thursday 28 April

SESSION 1 . . . . . Thurs. 8:00 to 11:10 am

Architectures for Geospatial Collection Sensors

Session Chair: **Kannappan Palaniappan,** Univ. of Missouri-Columbia

A MEMS-based spectral-polarimetric imaging and target tracking architecture for airborne broad-area search, J. Daniel Newman, Bernard V. Brower, Paul P. K. Lee, Andre D. Cropper, Matthew F. Pellechia, Mark C. Gibney, ITT Corp. Geospatial Systems (USA) . . . . . [8053-01]

Techniques for high-performance processing of large image collections into tiled image sets, John T. Sample, Elias Z. Ioup, U.S. Naval Research Lab. (USA) . . . . . [8053-02]

Indoor localization for GIS using acoustic wireless sensor network, Pratikkumar U. Desai, Nicholas A. Baine, Kuldip S. Rattan, Wright State Univ. (USA) . . . . . [8053-03]

Reconfigurable real-time distributed processing network, Scott F. Page, Richard Seely, Duncan L. Hickman, Waterfall Solutions Ltd. (United Kingdom) . . . . . [8053-04]

MapSnap system to perform vector-to-raster fusion, Boris Kovalerchuk, Central Washington Univ. (USA); Peter J. Doucette, Integrity Applications, Inc. (USA); Gamal Seedahmed, NG4 (USA); Jerry Tagestad, Pacific Northwest National Lab. (USA); Sergei Kovalerchuk, BKF Systems (USA); Brian Graff, Army Geospatial Ctr. (USA) . . . . . [8053-05]

Spatio-temporal analysis framework, Arun Hampapur, Xuan Liu, Shilpa Mahatma, Tarun Kumar, IBM Thomas J. Watson Research Ctr. (USA) . . [8053-06]

Hierarchical scale-space representation of high-resolution remote sensing images, Abdul H. Syed, Eli Saber, David Messinger, Rochester Institute of Technology (USA) . . . . . [8053-07]

KOLAM: an open, extensible framework for interactive visualization of high-resolution, high-throughput imagery, Anoop Haridas, Joshua Fraser, Kannappan Palaniappan, Univ. of Missouri-Columbia (USA); Gunasekaran S. Seetharaman, Air Force Research Lab. (USA) . . . . . [8053-08]

Lunch/Exhibition Break . . . . . 12:10 to 1:40 pm

SESSION 2 . . . . . Thurs. 1:40 to 2:00 pm

Geospatial Information Application Needs and Challenges

Session Chair: **Michael E. Gangl,** MacAulay-Brown, Inc.

Urban event detection for wide field-of-view (WFOV) operations, Edward E. Huling, U.S. Air Force (USA) . . . . . [8053-09]

PANEL DISCUSSION. . . . . Thurs. 2:00 to 3:00 pm

Contemporary Concerns in Geographical/Geospatial Information Sysems (GIS) Processing

Moderator: **Michael E. Gangl,** MacAulay-Brown, Inc.

Panelists: **Erik P. Blasch, Gunasekaran Seetharaman,** Air Force Research Lab.; **Jason S. Brown,** Schafer Corp.; **Matthew Pellechia, Shiloh L. Dockstader,** ITT Corp. Geospatial Systems; **Paul B. Deignan,** L-3 Communications Integrated Systems; **Kannappan Palaniappan,** Univ. of Missouri-Columbia

With the advent of advances in Geospatial Information System (GIS), there is a need to determine the areas of research concern and new tools available for GIS systems. GIS consists of the collection, integration, storage, exploitation, and visualization of geographic and contextual data and information. This paper brings together panelists to assess the current directions of GIS research. The consolidated areas discussed by the panelists give a general direction of GIS needs, techniques, models, and standards. The summary of selected areas include: use of information fusion, support of meta-data, production of challenge problems, adherence to open standards, generation of architectures, and detailed standards and metrics.

SESSION 3 . . . . . Thurs. 3:30 to 4:50 pm

Data Standards, Formats, and Interoperability

Session Chair: **Robert Gillen,** Univ. of Dayton Research Institute

Formatting research and development sensors for data interoperability and fusion with GIS, Karmon M. Vongsy, Air Force Institute of Technology (USA); Eric Cincotta, ITT Corp. Geospatial Systems (USA); Tom Jones, ITT Visual Information Solutions (USA) . . . . . [8053-10]

Standards to improve tracking, Scott Randall, H. Jim Antonisse, Booz Allen Hamilton Inc. (USA) . . . . . [8053-11]

Delivery methods for LVSD systems, James H. Kasner, WiSC Enterprises, LLC. (USA); Bernard V. Brower, ITT Corp. Geospatial Systems (USA) . . . . . [8053-12]

The standard exchange of features in feature-based tracking, H. Jim Antonisse, Booz Allen Hamilton Inc. (USA) and Harris Corp. (USA); Scott Randall, Booz Allen Hamilton Inc. (USA) . . . . . [8053-13]

Friday 29 April

SESSION 4 . . . . . Fri. 8:00 to 11:30 am

Geospatial Data Processing Algorithms and Techniques

Session Chair: **Paul B. Deignan,**
L-3 Communications Integrated Systems

Monday-Tuesday 25-26 April 2011 • Proceedings of SPIE Vol. 8054

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Enabling Photonics Technologies for Defense, Security, and Aerospace Applications VII

Conference Chairs: **Michael J. Hayduk,** Air Force Research Lab.; **Peter J. Delfyett,** CREOL, The College of Optics and Photonics, Univ. of Central Florida

Conference Co-Chairs: **Andrew R. Pirich,** ACP Consulting; **Eric Donkor,** Univ. of Connecticut

Program Committee: **H. John Caulfield,** Diversified Research Corp.; **Reinhard K. Erdmann,** Air Force Research Lab.; **Michael L. Fanto,** Air Force Research Lab.; **Sangyoun Gee,** Gwangju Institute of Science and Technology (Korea, Republic of); **Bahram Javidi,** Univ. of Connecticut; **Robert L. Kaminski,** Air Force Research Lab.; **Guifang Li,** CREOL, The College of Optics and Photonics, Univ. of Central Florida; **Joseph M. Osman,** Air Force Research Lab.; **Edward W. Taylor,** International Photonics Consultants, Inc.; **Henry Zmuda,** Univ. of Florida

Monday 25 April

SESSION 1 . . . . . Mon. 10:30 am to 12:20 pm

Photonic Devices and Components

Session Chair: **Michael J. Hayduk,** Air Force Research Lab.

Multimaterial optical fibers: fabrication and applications *(Invited Paper)*, Ayman F. Abouraddy, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [8054-01]

Theoretical study of spur-free dynamic range of a semiconductor resonant cavity linear interferometric intensity modulator *(Invited Paper)*, Nazanin Hoghooghi, Sharad P. Bhooplapur, Peter J. Delfyett, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [8054-02]

Plasmonic crystals: a new platform to enhance photodetector performance *(Invited Paper)*, Hooman Mohseni, Northwestern Univ. (USA) . . . . . [8054-03]

Large scale micro-Fabry-Perot optical filter arrays, Ali A. Abtahi, Aerospace Missions Corp. (USA); Peter B. Griffin, Stanford Univ. (USA); Ricky J. Morgan, Usha Raghuram, Aerospace Missions Corp. (USA); Francisco Tejada, Sensing Machines (USA); Frida S. Vetelino, Aerospace Missions Corp. (USA) . . . [8054-04]

Lunch Break . . . . . 12:20 to 1:30 pm

SESSION 2 . . . . . Mon. 1:30 to 3:10 pm

VCSELs and Quantum Dots

Session Chair: **Peter J. Delfyett,** CREOL, The College of Optics and Photonics, Univ. of Central Florida

Multimode 40Gbps CWDM transceivers for optical backplanes *(Invited Paper)*, Tyler J. Eustis, Mitch Harris, Vincent Cheung, Sven Mahnkopf, Duane Louderback, OptiComp Corp. (USA). . . . . [8054-05]

Record performance levels in quantum dot lasers with applications to 1.3 and 1.55 µm wavelengths *(Invited Paper)*, Dennis Deppe, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Sabine Freisem, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) and sdPhotonics LLC (USA); Guowei Zhao, Long Wang, Abdullah Demir, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8054-06]

Rapidly reconfigurable pulse-shaping using injection-locked VCSELs, Sharad P. Bhooplapur, Nazanin Hoghooghi, Peter J. Delfyett, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [8054-07]

New VCSEL technology with scalability for single mode operation and densely integrated arrays, Guowei Zhao, Abdullah Demir, Sabine Freisem, Yu Zhang, Xiaohang Liu, Dennis Deppe, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8054-08]

SESSION 3 . . . . . Mon. 3:40 to 5:20 pm

Ultrashort Pulsed Lasers and Optical Switching

Session Chair: **Michael L. Fanto,** Air Force Research Lab.

Coupled optoelectronic oscillator with 1000 finesse intracavity etalon, Ibrahim T. Ozdur, Josue Davila-Rodriguez, Dimitrios Mandridis, Peter J. Delfyett, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8054-09]

Injection locked coupled opto-electronic oscillator for optical frequency comb generation, Charles G. Williams, Dimitrios Mandridis, Josue Davila-Rodriguez, Peter J. Delfyett, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [8054-10]

A passively mode-locked SOA laser with tunable pulse-repetition frequency based on normal mode splitting of the SOA amplified spontaneous emission spectrum, Eric Donkor, Univ. of Connecticut (USA); Suvhasis Mukhopadhyay, TranSwitch Corp. (USA) . . . . . [8054-11]

Design of cascaded plasmon resonances for ultrafast nonlinear optical switching, Seyfollah Toroghi, Pieter G. Kik, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8054-12]

Next generation liquid crystal devices for advance photonic applications, Robert A. Ramsey, Meadowlark Optics, Inc. (USA) . . . . . [8054-13]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 4 . . . . . Tues. 10:00 am to 12:00 pm

Emitter and Detector Technology

Session Chair: **Guifang Li,** CREOL, The College of Optics and Photonics, Univ. of Central Florida

An etalon stabilized 10 GHz comb source using a slab coupled waveguide amplifier, Josue Davila-Rodriguez, Ibrahim Ozdur, Charles G. Williams, Dimitrios Mandridis, Peter J. Delfyett, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [8054-14]

Temporal shaping of ultrafast chirped pulses with 27 dB extinction ratio using an arbitrary waveform generator, Dat Nguyen, Mohamad Umar Piracha, Dimitrios Mandridis, Peter J. Delfyett, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8054-15]

Semiconductor-based low-noise 100 MHz chirped pulse laser source based on a theta cavity design with an intra-cavity etalon and long-term stabilization *(Invited Paper)*, Dimitrios Mandridis, Charles G. Williams, Ibrahim Ozdur, Anthony Klee, Peter J. Delfyett, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8054-16]

Long-range high-resolution lidar for velocity and distance measurements,

Mohamad Umar Piracha, Dat Nguyen, Ibrahim T. Ozdur, Peter J. Delfyett, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . [8054-17]

25Gbps 850nm photodiode for emerging 100Gb ethernet applications *(Invited Paper)*, Donald A. Becker, Abhay Joshi, Shubhasish Datta, Jim Rue, Discovery Semiconductors, Inc. (USA) . . . . . [8054-18]

Lunch/Exhibition Break . . . . . 12:00 to 1:30 pm

SESSION 5 . . . . . Tues. 1:30 to 2:10 pm

Keynote Session

Session Chair: **Eric Donkor,** Univ. of Connecticut

Coherent optical communications and imaging *(Keynote Presentation)***,** Guifang Li, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8054-19]

SESSION 6 . . . . . Tues. 2:10 to 3:10 pm

Optical Communication Systems and Technology I

Session Chair: **Peter J. Delfyett,** CREOL, The College of Optics and Photonics, Univ. of Central Florida

Free-space optical communication link using spatial optical encryption, Syed H. Murshid, William Howard, Florida Institute of Technology (USA) . . . . [8054-20]

Optical encryption as a function of polarization in optical fiber communications, Syed H. Murshid, Haripriya Muralikrishnan, Jayachandran Tamilarasan, Florida Institute of Technology (USA); H. John Caulfield, Diversified Research Corp. (USA) . . . . . [8054-21]

A method of hardware support for high-speed data capture at 40 Gbps and beyond, Joshua S. White, Adam W. Pilbeam, Everis, Inc. (USA) . . . . . [8054-22]

SESSION 7 . . . . . Tues. 3:40 to 4:40 pm

Optical Communication Systems and Technology II

Session Chair: **Michael J. Hayduk,** Air Force Research Lab.

An analysis of coupling attacks in high-speed fiber optic networks, Joshua S. White, Adam W. Pilbeam, Everis, Inc. (USA) . . . . . [8054-23]

Attenuation and bit error rate for four copropagating spatially multiplexed optical communication channels of exactly same wavelength in step index multimode fibers, Syed H. Murshid, Abhijit Chakravarty, Florida Institute of Technology (USA) . . . . . [8054-24]

Nonlinearity compensation for dispersion managed fiber-optic transmission systems, Likai Zhu, Guifang Li, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8054-25]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Mode-locked fiber laser using SU-8 resist incorporating carbon nanotubes, Ivan Hernandez-Romano, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Dimitrios Mandridis, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Daniel A. May-Arrioja, Univ. Autónoma de Tamaulipas (Mexico); Jose J. Sanchez-Mondragon, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Peter J. Delfyett, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8054-26]

Impairment compensation for unrepeatered fiber transmission with distributed Raman amplification, Likai Zhu, Eduardo F. Mateo, Guifang Li, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8054-27]

Description of various test scenarios for temporary blinding of pilots by means of bright optical radiation during darkness, Hans-Dieter Reidenbach, Fachhochschule Köln (Germany) . . . . . [8054-28]

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Thursday-Friday 28-29 April 2011 • Proceedings of SPIE Vol. 8055

Optical Pattern Recognition XXII

Conference Chairs: **David P. Casasent,** Carnegie Mellon Univ.; **Tien-Hsin Chao,** Jet Propulsion Lab.

Program Committee: **Mohammad S. Alam,** Univ. of South Alabama; **Don A. Gregory,** The Univ. of Alabama in Huntsville; **Bahram Javidi,** Univ. of Connecticut; **B. V. K. Vijaya Kumar,** Carnegie Mellon Univ.; **Yunlong Sheng,** Univ. Laval (Canada); **Robert C. Stirbl,** Jet Propulsion Lab.; **Ashit Talukder,** Jet Propulsion Lab.; **Shizhuo Yin,** The Pennsylvania State Univ.; **Rupert C. D. Young,** Univ. of Sussex (United Kingdom)

Thursday 28 April

SESSION 1 . . . . . Thurs. 8:30 to 10:30 am

Invited Session

Session Chair: **David P. Casasent,** Carnegie Mellon Univ.

Autonomous learning approach for automatic target recognition processor *(Invited Paper)*, Tien-Hsin Chao, Thomas Lu, Jet Propulsion Lab. (USA) . [8055-01]

Tracking illegally parked vehicles using correlation of multiscale difference of Gaussian filtered patches *(Invited Paper)*, Bhargav K. Mitra, Waqas Hassan, Nagachetan Bangalore, Philip M. Birch, Rupert C. D. Young, Chris Chatwin, Univ. of Sussex (United Kingdom) . . . . . [8055-02]

Remote sensing of cardiopulmonary activity using Doppler radar *(Invited Paper)*, Jesmin F. Khan, Gregory V. Murphy, Sharif M. A. Bhuiyan, Tuskegee Univ. (USA); Mohammad S. Alam, Univ. of South Alabama (USA). . . . . [8055-03]

ATR using passive 3D photon counting images *(Invited Paper, Presentation Only)*, Abhijit Mahalanobis, Lockheed Martin Missiles and Fire Control (USA); Bahram Javidi, Univ. of Connecticut (USA). . . . . [8055-04]

SESSION 2 . . . . . Thurs. 11:00 to 11:40 am

Optical Spectral Processing and Hardware

Session Chair: **Tien-Hsin Chao,** Jet Propulsion Lab.

Monolithic liquid crystal waveguide Fourier transform spectrometer for gas species sensing, Tien-Hsin Chao, Thomas Lu, Michael Boesen, Didier Keymeulen, Jet Propulsion Lab. (USA); Scott R. Davis, George Farca, Vescent Photonics Inc. (USA) . . . . . [8055-05]

Feasibility breadboard demonstration of an imaging Fourier transform spectrometer using solid state time delay, Tien-Hsin Chao, Thomas Lu, Jet Propulsion Lab. (USA) . . . . . [8055-06]

Lunch/Exhibition Break . . . . . 11:40 am to 1:20 pm

SESSION 3 . . . . . Thurs. 1:20 to 3:20 pm

Novel Correlation and Distortion Invariant Pattern Recognition Filters

Session Chair: **Rupert C. D. Young,** Univ. of Sussex (United Kingdom)

Parameter optimization of the Optimal Trade-off Maximum Average Correlation Height filter (OT-MACH) for FLIR imaging in high clutter environments, Ahmad T. Alkandri, Univ. of Sussex (United Kingdom) and Kuwait Naval Force (Kuwait); Akber A. Gardezi, Rupert C. D. Young, Philip M. Birch, Chris Chatwin, Univ. of Sussex (United Kingdom) . . . . . [8055-07]

Enhancement of the speed of space-variant correlation filter implementations by using low-pass pre-filtering for kernel placement and applications to real-time security monitoring, Akber A. Gardezi, Ahmad T. Alkandri, Philip M. Birch, Rupert C. D. Young, Chris Chatwin, Univ. of Sussex (United Kingdom). . . . . [8055-08]

Multifeature constellation correlation filters, Charles Casey, Laurence Hassebrook, Aaron Davidson, Eli Crane, Univ. of Kentucky (USA). . . . . [8055-09]

Distortion-invariant color pattern recognition using multiple phase-shifted-reference-based joint transform correlation incorporating synthetic discriminant function, Mohammed Nazrul Islam, Farmingdale State College (USA); Mohammad A. Karim, Old Dominion Univ. (USA) . . . . . [8055-10]

Automatic angle measurement of a 2D object using optical correlator-neural networks hybrid system, Nadarajah Manivannan, Brunel Univ. (United Kingdom); Mark A. Neil, Imperial College London (United Kingdom). . . . . [8055-11]

Wide-area surveillance with multiple cameras using distributed compressive imaging, Christopher Huff, Univ. of Central Florida (USA); Robert R. Muise, Lockheed Martin Missiles and Fire Control (USA) . . . . . [8055-30]

SESSION 4 . . . . . Thurs. 3:50 to 4:50 pm

Feature Extraction and Tracking for Pattern Recognition

Session Chairs: **Mohammad S. Alam,** Univ. of South Alabama; **Tien-Hsin Chao,** Jet Propulsion Lab.

Optimization of nonlinear kernel PCA feature extraction algorithms for automatic target recognition, Seth Winger, Stanford Univ. (USA); Tien-Hsin Chao, Thomas Lu, Jet Propulsion Lab. (USA). . . . . [8055-13]

Moving object tracking by using a novel real-time 2D image processing method, Chialun J. Hu, Southern Illinois Univ. Carbondale (USA) . . . . . [8055-14]

A compressed sensing method with analytical results for lidar feature classification based on height gradient density features, Josef D. Allen, Harris Corp. (USA); Xiuwen Liu, The Florida State Univ. (USA); Mark D. Rahmes, Harris Corp. (USA) . . . . . [8055-15]

SESSION 5 . . . . . Thurs. 4:50 to 5:30 pm

Photorefractive Optical Pattern Recognition

Session Chairs: **Mohammad S. Alam,** Univ. of South Alabama; **Tien-Hsin Chao,** Jet Propulsion Lab.

Optical correlation via dynamic range compression using organic photorefractive materials, Bahareh Haji-saeed, Jed Khoury, Charles L. Woods, Air Force Research Lab. (USA); John Kierstead, Solid State Scientific Corp. (USA) . . . . . [8055-16]

Optical dynamic range compression deconvolution and correlation using organic photorefractive materials, Jed Khoury, Bahareh Haji-saeed, Charles L. Woods, Air Force Research Lab. (USA) . . . . . [8055-17]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Kernel and stochastic expectation maximization fusion for target detection in hyperspectral imagery, Mohamed I. Elbakary, Mohammad S. Alam, Univ. of South Alabama (USA) . . . . . [8055-25]

Spectral pattern recognition of controlled substances in street samples using artificial neural network system, Larisa Porovkina, Valeri Aleksejev, Sergey M. Babichenko, Laser Diagnostic Instruments AS (Estonia). . . . . [8055-26]

Study on the relationship between image features and detection probability based on psychology experiments, Wei Lin, Canbao Engineering Design & Research Institute of Beijing (China) and Beijing Institute of Technology (China); Yu-Hua Chen, Ji-yuan Wang, Hongsheng Gao, Wei Mao, Jijun Wang, Ronghua Su, Canbao Engineering Design & Research Institute of Beijing (China) . [8055-27]

The concept models and implementations of multiport neural net associative memory for 2D patterns, Vladimir G. Krasilenko, Vinnitsa Social Economy Institute (Ukraine); Aleksandr I. Nikolskyy, Vinnytsia National Technical Univ. (Ukraine); Rimma A. Yatskovskaya, Victor I. Yatskovsky, Vinnitsa State Agrarian Univ. (Ukraine) . . . . . [8055-28]

Text encryption via double-random phase encoding, Jun Sang, Shenggui Ling, Chongqing Univ. (China); Mohammad S. Alam, Univ. of South Alabama (USA) . . . . . [8055-29]

Friday 29 April

SESSION 6 . . . . . Fri. 9:00 to 10:00 am

Pattern Recognition Applications I

Session Chair: **Rupert C. D. Young,** Univ. of Sussex (United Kingdom)

Robust human intrusion detection techniques using intensity and hue-saturation histograms, Waqas Hassan, Bhargav K. Mitra, Nagachetan Bangalore, Philip M. Birch, Rupert C. D. Young, Chris Chatwin, Univ. of Sussex (United Kingdom). . . . . [8055-18]

Accurate, fast, and secure biometric recognition system utilizing sensor fusion of same pattern, Salim Alsharif, Aed M. El-Saba, Univ. of South Alabama (USA) . . . . . [8055-19]

Arabic handwritten optical character recognition using hidden Markov models, Mohammed M. Olama, Oak Ridge National Lab. (USA); Muhannad Aulama, Asem Natsheh, Gheith Abandah, The Univ. of Jordan (Jordan) . [8055-20]

SESSION 7 . . . . . Fri. 10:30 to 11:50 am

Pattern Recognition Applications II

Session Chair: **Rupert C. D. Young,** Univ. of Sussex (United Kingdom)

Noise removal from color image employing a BEMD based multiscale image filtering, Sharif M. A. Bhuiyan, Jesmin F. Khan, Tuskegee Univ. (USA); Mohammad S. Alam, Univ. of South Alabama (USA) . . . . . [8055-21]

Error correction in image registration using POCS, Prakash Duraisamy, Univ. of North Texas (USA); Mohammad S. Alam, Univ. of South Alabama (USA) . . . . . [8055-22]

Sampling balanced system for point target detection, Yochay Danziger, Rafael Advanced Defense Systems Ltd. (Israel). . . . . [8055-23]

A novel bag of visual words approach for geospatial object recognition, Caglar Aytekin, Aydin A. Alatan, Middle East Technical Univ. (Turkey) . . [8055-24]

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Tuesday-Wednesday 26-27 April 2011 • Proceedings of SPIE Vol. 8056

Visual Information Processing XX

Conference Chairs: **Zia-ur Rahman,** NASA Langley Research Ctr.; **Stephen E. Reichenbach,** Univ. of Nebraska-Lincoln; **Mark A. Neifeld,** The Univ. of Arizona

Program Committee: **Gary W. Euliss,** MITRE Corp.; **Amit Ashok,** The Univ. of Arizona; **Richard D. Juday,** NASA Johnson Space Ctr.; **Ram M. Narayanan,** The Pennsylvania State Univ.; **John M. Pellegrino,** U.S. Army Research Lab.; **Robert A. Schowengerdt,** The Univ. of Arizona; **Joseph van der Gracht,** HoloSpex, Inc.

IN MEMORIAM:

Zia-ur Rahman,
Research Engineer at NASA Langley Research Center

Dr. Zia-ur Rahman, age 48, passed away on December 16th, 2010 in a tragic car accident near Lexington, Virginia.

A Williamsburg resident, Rahman was originally from Pakistan. He was awarded a Bachelor's Degree from Ripon College, Wisconsin, and an M.S. and Ph.D. from the University of Virginia.

Rahman was a research scientist with NASA Langley Research Center. He was previously an Associate Professor at Old Dominion University and at the College of William & Mary.

An SPIE member, Rahman was very active with the Society, serving as chair or co-chair of the Visual Information Processing Conference held annually at the SPIE Defense, Security, and Sensing meeting. He also presented papers at other SPIE meetings, including SPIE/IS&T Electronic Imaging, and SPIE Photonics West, and authored several SPIE journal papers.

Dr. Rahman is survived by his wife Katherine, and his three sons: Haroun, Camran, and Noor.

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan
Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 1 . . . . . Tues. 10:30 to 11:50 am

Image Enhancement, Noise, Etc.

Lunch/Exhibition Break. . . . . 11:50 am to 1:20 pm

SESSION 2 . . . . . Tues. 1:20 to 3:00 pm

Applications I

Session Chair: **Stephen E. Reichenbach,** Univ. of Nebraska-Lincoln

SESSION 3 . . . . . Tues. 3:30 to 5:30 pm

Superresolution Algorithms/System Design

Session Chair: **Mark A. Neifeld,** The Univ. of Arizona

Digital zoom algorithm with context derived basis functions, Harvey C. Schau, Meridian Systems LLC (USA) . . . . . [8056-10]

Super-resolution of time-lapse seismic images, Sergio E. Zarantonello, Algorithmica LLC (USA) and Santa Clara Univ. (USA); Bonnie J. Smithson, Santa Clara Univ. (USA); Dimitri Bevc, 3DGeo Development, Inc. (USA); Youli Quan, Jerry M. Harris, Stanford Univ. (USA); Sally L. Wood, Santa Clara Univ. (USA) . . . . . [8056-11]

On the restoration of the microscanned images captured from unmanned airborne vehicles, Amr H. Yousef, Old Dominion Univ. (USA); Zia-ur Rahman, NASA Langley Research Ctr. (USA) . . . . . [8056-12]

Continuous quantification of uniqueness and stereoscopic vision, Val Petran, Artificial Perception Technologies Inc. (USA) and Case Western Reserve Univ. (USA); Frank L. Merat, Case Western Reserve Univ. (USA) . . . . . [8056-13]

Big-data feature screening using Bregman divergence, Jie Cheng, Univ. of Hawai'i (USA); Mehdi R. Zargham, Qiang Cheng, Southern Illinois Univ. Carbondale (USA) . . . . . [8056-15]

Creating bespoke COTS solutions for image processing applications, Duncan L. Hickman, Moira Smith, Scott F. Page, James R. E. Sadler, Waterfall Solutions Ltd. (United Kingdom) . . . . . [8056-16]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Generalized accelerated hyperspectral, and multiframe algorithm for nondestructive micro-electromechanical systems (MEMS) microscope metrology, Wojtek J. Walecki, Fanny Szondy, Sunrise Optical LLC (USA) . . . . . [8056-35]

Objective measurement of grain size in MgO-Y_2O_3 nanocomposites, Thomas J. Sadowski, Christopher Lepensky, Jacquelynn Garafano, John S. DaPonte, Christine Caragianis-Broadbridge, Southern Connecticut State Univ. (USA) . . . . . [8056-36]

The new image segmentation algorithm using adaptive evolutionary programming and fuzzy c-means clustering, Fang Liu, Beijing Univ. of Technology (China) and Tsinghua Univ. (China); Qionghai Dai, Tsinghua Univ. (China) . . . . . [8056-37]

Review of metropolis Monte Carlo image enhancement, Abolfazl M. Amini, Southern Univ. and A&M College (USA) . . . . . [8056-38]

A system for airport surveillance: detection of people running, abandoned objects and pointing gestures, Samuel Foucher, Marc Lalonde, Langis Gagnon, CRIM (Canada) . . . . . [8056-39]

Wednesday 27 April

SESSION 4 . . . . . Wed. 8:20 to 10:00 am

Image Analysis

Automatic detection for aircraft emergency landing sites, Yu-Fei Shen, Old Dominion Univ. (USA); Zia-ur Rahman, NASA Langley Research Ctr. (USA) . . . . . [8056-18]

Context-based semantic labeling of human-vehicle interactions in persistent surveillance systems, Amir H. Shirkhodaie, Vinayak Elangovan, Tennessee State Univ. (USA) . . . . . [8056-19]

Image understanding algorithm for segmentation evaluation and region-of-interest identification using Bayesian networks, Mustafa Jaber, Eli Saber, Rochester Institute of Technology (USA) . . . . . [8056-20]

Fast motion prediction algorithm for multiview video coding, Abdelrahman Abdelazim, Yao Guang Zhang, Stephen J. Mein, Martin R. Varley, Univ. of Central Lancashire (United Kingdom); Djamel Ait-Boudaoud, Univ. of Portsmouth (United Kingdom) . . . . . [8056-21]

SESSION 5 . . . . . Wed. 10:30 to 11:50 am

Modeling

Session Chair: **Amit Ashok,** The Univ. of Arizona

Improved neural network modeling of inverse lens distortion, Jason P. de Villiers, Council for Scientific and Industrial Research (South Africa) . . . . [8056-22]

Novel adaptive kernels for image sharpening in the presence of noise, David C. Bamber, Waterfall Solutions Ltd. (United Kingdom); Paul K. Kimber, SELEX Galileo Ltd. (United Kingdom) . . . . . [8056-23]

Information theoretic analysis of canny edge detection in visual communication, Bo Jiang, Old Dominion Univ. (USA); Zia-ur Rahman, NASA Langley Research Ctr. (USA) . . . . . [8056-24]

Local color transfer based on dark-channel dehazing for visible/infrared image fusion, Bei Zhang, Lingxue Wang, Beijing Institute of Technology (China) . . . . . [8056-25]

Lunch/Exhibition Break . . . . . 11:50 am to 1:10 pm

SESSION 6 . . . . . Wed. 1:10 to 4:00 pm

Computational Imaging

Session Chair: **Amit Ashok,** The Univ. of Arizona

Space-time compressive imaging, Vicha Treeaporn, Amit Ashok, Mark A. Neifeld, The Univ. of Arizona (USA) . . . . . [8056-26]

Adaptive multiscale resolution enhancement for compressive imaging *(Invited Paper)*, Abhijit Mahalanobis, Lockheed Martin Missiles and Fire Control (USA) . . . . . [8056-27]

Novel helical point spread functions for 3D imaging *(Invited Paper)*, Sean Quirin, Rafael Piestun, Univ. of Colorado at Boulder (USA). . . . . [8056-29]

Unconventional optical system design *(Invited Paper)*, Joseph Ford, Eric J. Tremblay, Univ. of California, San Diego (USA) . . . . . [8056-30]

Image formation challenges in the MOSAIC platform *(Invited Paper)*, Michael E. Gehm, The Univ. of Arizona (USA); David J. Brady, Duke Univ. (USA). [8056-31]

SESSION 7 . . . . . Wed. 4:00 to 5:00 pm

Applications II

On grey levels in random CAPTCHA generation, Michael A. Kouritzin, Fraser Newton, Samira Sadeghi, Univ. of Alberta (Canada) . . . . . [8056-32]

A simplified rate control algorithm for H.264/SVC, Yao Guang Zhang, Abdelrahman Abdelazim, Stephen J. Mein, Martin R. Varley, Univ. of Central Lancashire (United Kingdom); Djamel Ait-Boudaoud, Univ. of Portsmouth (United Kingdom) . . . . . [8056-33]

On the design of joint perceptual encryption and blind watermarking scheme compliant with JPEG compression standard, Muhammad Imran Khan, Univ. Teknologi Petronas (Malaysia). . . . . [8056-34]

Course of Related Interest

SC838 **Laser Range Gated Imaging Techniques** (Duncan) Tuesday, 1:30 to 5:30 pm

See full course listing and descriptions on pp. 144-192.

Thursday-Friday 28-29 April 2011 • Proceedings of SPIE Vol. 8057

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Quantum Information and Computation IX

Conference Chairs: **Eric Donkor,** Univ. of Connecticut; **Andrew R. Pirich,** ACP Consulting; **Howard E. Brandt,** U.S. Army Research Lab.

Program Committee: **Paul M. Alsing,** Air Force Research Lab.; **Reinhard K. Erdmann,** Air Force Research Lab.; **Michael R. Frey,** Bucknell Univ.; **Michael J. Hayduk,** Air Force Research Lab.; **Louis H. Kauffman,** Univ. of Illinois at Chicago; **Vladimir E. Korepin,** Stony Brook Univ.; **Samuel J. Lomonaco, Jr.,** Univ. of Maryland, Baltimore County; **John M. Myers,** Harvard Univ.; **Alexander V. Sergienko,** Boston Univ.; **Tai Tsun Wu,** Harvard Univ.

Thursday 28 April

SESSION 1 . . . . . Thurs. 8:00 to 8:30 am

Invited Session

Session Chair: **Howard E. Brandt,** U.S. Army Research Lab.

Quantum braids and their applications *(Invited Paper)*, Samuel J. Lomonaco, Jr., Univ. of Maryland, Baltimore County (USA); Louis H. Kauffman, Univ. of Illinois at Chicago (USA) . . . . . [8057-01]

SESSION 2 . . . . . Thurs. 8:30 to 10:10 am

Quantum States and Quantum Logic

Session Chairs: **John M. Myers,** Harvard Univ.; **Louis H. Kauffman,** Univ. of Illinois at Chicago

Bright photon pair source with high spectral and spatial purity, Warren P. Grice, Ryan S. Bennink, Philip G. Evans, Travis S. Humble, Oak Ridge National Lab. (USA); Jason Schaake, The Univ. of Tennessee (USA) . . . . . [8057-02]

Entangled photons produced by interactions with quantum wells and quantum dots, Michael N. Leuenberger, Mikhail V. Erementchouk, Univ. of Central Florida (USA) . . . . . [8057-03]

Multiple-entangled photon spontaneous parametric down-conversion source, Michael L. Fanto, Reinhard K. Erdmann, Paul M. Alsing, Air Force Research Lab. (USA); Enrique J. Galvez, Colgate Univ. (USA); Corey Peters, Air Force Research Lab. (USA) . . . . . [8057-04]

Proposals to produce entangled states of spatial modes of light, Enrique J. Galvez, Colgate Univ. (USA) . . . . . [8057-05]

Experimental consideration of local realism with entangled photon pairs, Reinhard K. Erdmann, Michael L. Fanto, Paul M. Alsing, Corey Peters, Air Force Research Lab. (USA); Enrique J. Galvez, Colgate Univ. (USA); Warner A. Miller, Florida Atlantic Univ. (USA) . . . . . [8057-06]

SESSION 3 . . . . . Thurs. 10:40 am to 12:00 pm

Quantum Imaging and Quantum Memory

Session Chairs: **Paul M. Alsing,** Air Force Research Lab.; **Reinhard K. Erdmann,** Air Force Research Lab.

Generation and detection of quantum entangled states and quantum imaging, James F. Smith III, U.S. Naval Research Lab. (USA) . . . . . [8057-07]

Resolution enhancement of imaging systems by quantum phase amplification, Yanchun Yin, Doug French, Igor Jovanovic, The Pennsylvania State Univ. (USA) . . . . . [8057-08]

All-optical flip-flop memory for quantum computing, Eric Donkor, Univ. of Connecticut (USA) . . . . . [8057-09]

Entangled photon holes and nonclassical interferomtery, Junlin Liang, James D. Franson, Todd B. Pittman, Univ. of Maryland, Baltimore County (USA)[8057-10]

Lunch/Exhibition Break . . . . . 12:00 to 1:30 pm

SESSION 4 . . . . . Thurs. 1:30 to 3:10 pm

Quantum Algorithms

Session Chairs: **Samuel J. Lomonaco, Jr.,** Univ. of Maryland, Baltimore County; **Michael J. Hayduk,** Air Force Research Lab.

Grover's search algorithm with an entangled database state, Paul M. Alsing, Nathan McDonald, Air Force Research Lab. (USA) . . . . . [8057-11]

Analytical calculation of the dynamics of Shor state verification in the presence of non-equiprobable errors, Gerald N. Gilbert, Yaakov S. Weinstein, MITRE Corp. (USA) . . . . . [8057-12]

Unitary quantum lattice gas representation of 2D quantum turbulence, Bo Zhang, George Vahala, The College of William & Mary (USA); Linda L. Vahala, Old Dominion Univ. (USA); Jeffrey Yepez, Air Force Research Lab. (USA) . . . [8057-13]

Prime number decomposition with the hyperbolic function, Gauss sums and interference, Vincenzo Tamma, Heyi Zhang, Xuehua He, Univ. of Maryland, Baltimore County (USA); Augusto Garuccio, Univ. degli Studi di Bari (Italy); Wolfgang P. Schleich, Univ. Ulm (Germany); Yanhua Shih, Univ. of Maryland, Baltimore County (USA) . . . . . [8057-14]

Using the Mathematica package Qucalc to simulate quantum algorithms and games, David A. Bolívar, Univ. EAFIT (Colombia) . . . . . [8057-15]

SESSION 5 . . . . . Thurs. 3:40 to 5:20 pm

Quantum Game Theory, Cryptography, and Measurements

Session Chairs: **Eric Donkor,** Univ. of Connecticut; **Paul M. Alsing,** Air Force Research Lab.

Causal connectivity, Howard E. Brandt, U.S. Army Research Lab. (USA) . . . . . [8057-16]

Wonderful world of weak values, John C. Howell, Curtis J. Broadbent, Andrew N. Jordan, David J. Starling, Benjamin Dixon, Univ. of Rochester (USA) . [8057-17]

A statistical and comparative study of quantum walks under weak measurements and weak values regimes, Debabrata Ghoshal, George Mason Univ. (USA); Marco O. Lanzagorta, ITT Advanced Engineering & Sciences (USA); Salvador E. Venegas-Andraca, Tecnologico de Monterrey (Mexico) . . . . [8057-18]

Quantum spread spectrum communication, Travis S. Humble, Oak Ridge National Lab. (USA) . . . . . [8057-19]

Nash equilibrium in quantum superpositions, Faisal S. Khan, Khalifa Univ. of Science, Technology and Research (United Arab Emirates) . . . . . [8057-20]

Friday 29 April

SESSION 6 . . . . . Fri. 8:00 to 10:20 am

Quantum Computing

Session Chairs: **Samuel J. Lomonaco, Jr.,** Univ. of Maryland, Baltimore County; **Louis H. Kauffman,** Univ. of Illinois at Chicago

Implementing an optical CNOT using spatial parity qubits, Kumel H. Kagalwala, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Giovanni Di Giuseppe, Univ. degli Studi di Camerino (Italy); Ayman F. Abouraddy, Bahaa E. A. Saleh, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [8057-21]

Quantum cellular automata without quiescent states, Howard A. Blair, Robert J. Irwin, Syracuse Univ. (USA). . . . . [8057-22]

Rhythms essential to logical communication, John M. Myers, Harvard Univ. (USA); Frederick H. Madjid, Consultant (USA) . . . . . [8057-23]

Quantum computing with induced dipole-dipole forbidden transitions, Eric Donkor, Univ. of Connecticut (USA) . . . . . [8057-24]

A theoretical model of multi-agent quantum computing, Fabian M. Mihelic, Light Consulting (USA) . . . . . [8057-25]

Encoding qubits into the spatial distribution of single photons and entangled photon pairs, Ayman F. Abouraddy, Bahaa E. A. Saleh, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [8057-26]

Quantum computing in a piece of glass, Warner A. Miller, Florida Atlantic Univ. (USA); Paul M. Alsing, Jonathan R. McDonald, Air Force Research Lab. (USA); Christopher C. Tison, Florida Atlantic Univ. (USA) . . . . . [8057-27]

SESSION 7 . . . . . Fri. 10:50 am to 12:30 pm

Quantum Information Theory

Session Chairs: **Howard E. Brandt,** U.S. Army Research Lab.; **John M. Myers,** Harvard Univ.

Random gauge theory, John E. Gray, Naval Surface Warfare Ctr. Dahlgren Div. (USA) . . . . . [8057-28]

Quantizing knots, groups and graphs, Louis H. Kauffman, Univ. of Illinois at Chicago (USA); Samuel J. Lomonaco, Jr., Univ. of Maryland, Baltimore County (USA) . . . . . [8057-29]

Possible quantum algorithms for generalized turaev-viro invariants of 3-manifolds, Juan F. Ospina, Univ. EAFIT (Colombia). . . . . [8057-30]

A combinatorial approach to the optical random walk, Scott E. Spence, Naval Surface Warfare Ctr. Dahlgren Div. (USA). . . . . [8057-31]

Two-spectral yang-baxter operators in topological quantum computation, William F. Sánchez, Univ. EAFIT (Colombia). . . . . [8057-32]

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Independent Component Analyses, Wavelets, Neural Networks, Biosystems, and Nanoengineering IX

Conference Chair: **Harold Szu,** U.S. Army Night Vision & Electronic Sensors Directorate

Conference Co-Chair: **Liyi Dai,** U.S. Army Research Office

Program Committee: **Shun-ichi Amari,** RIKEN (Japan); **Hamid Bolouri,** California Institute of Technology; **Kenneth A. Byrd,** U.S. Army Night Vision & Electronic Sensors Directorate; **Chee-Hung Chu,** Univ. of Louisiana at Lafayette; **Kai-Dee Chu,** U.S. Dept. of Homeland Security; **Wen-Yan Danny Chung,** Chung Yuan Christian Univ. (Taiwan); **Andrzej S. Cichocki,** Telcordia Technologies, Inc.; **Ronald R. Coifman,** Yale Univ.; **John Daugman,** Univ. of Cambridge (United Kingdom); **Qian Du,** Mississippi State Univ.; **Glenn R. Easley,** System Planning Corp.; **John E. Gray,** Naval Surface Warfare Ctr. Dahlgren Div.; **Fredric M. Ham,** Florida Institute of Technology; **Yutaka Hata,** Univ. of Hyogo (Japan); **Charles C. Hsu,** Trident Systems Inc.; **Diana L. Huffaker,** Univ. of California, Los Angeles; **Tzyy-Ping Jung,** Univ. of California, San Diego; **Joseph Landa,** BriarTek, Inc.; **Te-Won Lee,** Univ. of California, San Diego; **Kevin W. Lyons,** National Institute of Standards and Technology; **Uwe Meyer Baese,** The Florida State Univ.; **Francesco Carlo Morabito,** Univ. Mediterranea di Reggio Calabria (Italy); **Hairong Qi,** The Univ. of Tennessee; **Horacio Lamela,** Univ. Carlos III de Madrid (Spain); **Jan-Olov Stromberg,** Royal Institute of Technology (Sweden); **Mladen Victor Wickerhauser,** Washington Univ. in St. Louis; **Olaf Wolkenhauer,** Univ. Rostock (Germany); **Donald C. Wunsch II,** Missouri Univ. of Science and Technology; **Ning Xi,** Michigan State Univ.

Wednesday 27 April

WAVELET PIONEER AWARD . . . . . Wed. 8:00 to 8:40 am

Wavelet Pioneer Award for Elucidation of Wavelet Frames for Sensing Applications

Presented to
Prof. John. J. Benedetto, Univ. of Maryland, College Park

Intrinsic wavelet and frame applications *(Invited Paper)*, John J. Benedetto, Univ. of Maryland, College Park (USA). . . . . [8058-01]

PANEL DISCUSSION. . . . . Wed. 8:40 to 9:00 am

The R/D/A Future of Wavelets

Panel Moderators: **Harold Szu,** U.S. Army Night Vision & Electronic Sensors Directorate; **John J. Benedetto,** Univ. Maryland, College Park; **Mark J. T. Smith,** Purdue Univ.; **Ronald R. Coifman,** Yale Univ.; **Jan-Olov Stroemberg,** Royal Institute of Technology (Sweden)

SESSION 2 . . . . . Wed. 9:00 to 10:20 am

Wavelets Applications I

Session Chairs: **John J. Benedetto,** Univ. of Maryland, College Park; **Ronald R. Coifman,** Yale Univ.

Adaptive supermother wavelet for compressive sensing, Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Ming-Kai Hsu, Ting Lee, The George Washington Univ. (USA) . . . . . [8058-02]

Classification of transient signals using sparse representations over adaptive dictionaries, Daniela I. Moody, Los Alamos National Lab. (USA) and Univ. of Maryland, College Park (USA); Steven P. Brumby, Kary L. Myers, Norma H. Pawley, Los Alamos National Lab. (USA) . . . . . [8058-03]

Fractional wavelet transform using an unbalanced lifting structure, Kivanc Kose, Enis A. Cetin, Bilkent Univ. (Turkey) . . . . . [8058-04]

Anomaly recovery from compressive sensed spectral image sequences via low-rank matrix minimization, Ana Ramirez, Henry Arguello, Gonzalo Arce, Univ. of Delaware (USA) . . . . . [8058-05]

SESSION 3 . . . . . Wed. 10:40 am to 12:20 pm

Wavelets Applications and 3D Shearlets

Session Chairs: **Harold Szu,** U.S. Army Night Vision & Electronic Sensors Directorate; **John J. Benedetto,** Univ. of Maryland, College Park

Optimally sparse shearlet approximations of 3D data, Demetrio Labate, Univ. of Houston (USA); Kanghui Guo, Missouri State Univ. (USA) . . . . . [8058-06]

Three-dimensional shearlet edge analysis, David A. Schug, Univ. of Maryland, College Park (USA); Glenn R. Easley, System Planning Corp. (USA); Dianne P. O'Leary, Univ. of Maryland, College Park (USA) . . . . . [8058-07]

An analytic wavelet shrinkage function based on elliptically contoured-model of Pearson system, Widhyakorn Asdornwised, Pichid Kittisuwan, Chulalongkorn Univ. (Thailand) . . . . . [8058-08]

Denoising medical imagery using a novel framework, Samuel P. Kozaitis, Jharana Mehta, Shreya Ponkia, Florida Institute of Technology (USA). . . [8058-09]

Application of wavelet transforms in de-noising optical emission transient signals generated from microsamples introduced into microplasmas and comparison with Fourier-transform and Hartley-transform signal processing noise-filtering methods, Vassili Karanassios, David Hunter, Univ. of Waterloo (Canada) . . . . . [8058-10]

Lunch/Exhibition Break . . . . . 12:20 to 1:20 pm

ICA Unsupervised Learning Award . Wed. 1:20 to 2:00 pm

Session Chairs: **Soo-Young Lee,** KAIST (Korea, Republic of); **Tzyy-Ping Jung,** Univ. of California, San Diego

ICA Unsupervised Learning Pioneer Award for Blind Demixing of Acoustic Signals

Presented to **Prof. Hyung-Min Park,** Sogang Univ. (Korea, Republic of)

Filterbank-based independent component analysis for acoustic mixtures *(Invited Paper)*, Hyung-Min Park, Sogang Univ. (Korea, Republic of) [8058-11]

PANEL DISCUSSION. . . . . Wed. 2:00 to 2:20 pm

Advances of ICA

Panel Moderators: **Soo-Young Lee,** KAIST (Korea, Republic of); **Takeshi Yamakawa,** Kyushu Institute of Technology (Japan); **Harold Szu,** U.S. Army Night Vision & Electronic Sensors Directorate; **Tzyy-Ping Jung,** Univ. of California, San Diego

SESSION 5 . . . . . Wed. 2:20 to 3:40 pm

Unsupervised Learning and ICA

Session Chairs: **Soo-Young Lee,** KAIST (Korea, Republic of); **Hyung-Min Park,** Sogang Univ. (Korea, Republic of)

Imposing constraints on extracting filters to extract specific sources from convolutive mixtures, Jae-Kwon Yoo, Choong Hwan Choi, Soo-Young Lee, KAIST (Korea, Republic of) . . . . . [8058-12]

Robust speech recognition using missing feature theory and target speech enhancement based on degenerate unmixing and estimation technique, Minook Kim, Ji-Seon Kim, Hyung-Min Park, Sogang Univ. (Korea, Republic of) . . . . . [8058-13]

Bioimaging and biospectra analysis by means of ICA: experimental results, Qun Zhao, Jason Langley, Joonsang Lee, Justin Abell, Yiping Zhao, The Univ. of Georgia (USA) . . . . . [8058-14]

Stability analysis of minimum free energy equilibrium prediction, Balvinder Kaur, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . [8058-15]

SESSION 6 . . . . . Wed. 4:00 to 6:00 pm

Applications and Neural Network Learning

Session Chairs: **Takeshi Yamakawa,** Kyushu Institute of Technology (Japan); **Soo-Young Lee,** KAIST (Korea, Republic of)

Understanding human implict intention from physiological and behavioral data, Soo-Young Lee, Suhyeon Dong, Dae-shik Kim, KAIST (Korea, Republic of) . . . . . [8058-16]

Estimation of the magnetic flux induced by human motion, Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Jeff Willey, U.S. Naval Research Lab. (USA) . . . . . [8058-18]

Generative and discriminant feature extraction with supervised learning, Chandra S. Dhir, Soo-Young Lee, KAIST (Korea, Republic of) . . . . . [8058-19]

Development of artificial neural networks for spectral interference correction in optical emission spectrometry, Zhimin Li, Vassili Karanassios, Univ. of Waterloo (Canada) . . . . . [8058-20]

A new approach for neural network training and evaluation, Xinjia Chen, Ernest L. Walker, Southern Univ. and A&M College (USA) . . . . . [8058-21]

Generalized statistics framework for lagrange constraint neural networks, Ravi C. Venkatesan, Systems Research Corp. (India); Arun Sharma, SecureALL Corp. (USA) . . . . . [8058-22]

Thursday 28 April

Nano-engineering Award . . . . . Thurs. 8:00 to 8:40 am

Nano-engineering Award for his contribution of stability of micro and nano manipulator

Presented to

Prof. Metin Sitti, Carnegie Mellon Univ. (USA)

Tip-based nanorobotic manipulation systems *(Invited Paper)*, Metin Sitti, Carnegie Mellon Univ. (USA) . . . . . [8058-23]

PANEL DISCUSSION. . . . . Thurs. 8:40 to 9:00 pm

Micron-Nano-Engineering

Panel Moderators: **F. Jack Agee,** Rice Univ.; **Ning Xi,** Michigan State Univ.; **Metin Sitti,** Carnegie Mellon Univ.; **Harold Szu,** U.S. Army Night Vision & Electronic Sensors Directorate; **Kitt C. Reinhardt,** Air Force Office of Scientific Research

SESSION 8 . . . . . Thurs. 9:00 to 10:20 am

Nano-engineering

Session Chairs: **F. Jack Agee,** Rice Univ.; **Ning Xi,** Michigan State Univ.

Infrared imaging using carbon nanotube-based detector *(Invited Paper)*, Ning Xi, Michigan State Univ. (USA) . . . . . [8058-24]

Catalytic nanomotors: challenges and opportunities, Yiping Zhao, The Univ. of Georgia (USA) . . . . . [8058-25]

Adaptive hyperspectral sensing with carbon nanotubes, Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Yin-Lin Shen, Kenneth H. Ou, The George Washington Univ. (USA); Reinhardt Kit, Air Force Office of Scientific Research (USA) . . . . . [8058-26]

SESSION 9 . . . . . Thurs. 10:20 am to 12:35 pm

Presistent Surveillance

Session Chairs: **Kai-Dee Chu,** U.S. Dept. of Homeland Security; **Charles Hsu,** Trident Systems Inc.

How to build a smart sensing surveillance net, Kai-Dee Chu, U.S. Dept. of Homeland Security (USA); Charles Hsu, Trident Systems Inc. (USA) . . . . [8058-27]

What is a missing link among a persistent surveillance?, Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Charles Hsu, Trident Systems Inc. (USA); Jerry Wu, WJ Associates (USA) . . . . . [8058-28]

How to sequentially update eigen face, Charles C. Hsu, Trident Systems Inc. (USA); Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [8058-29]

What is a good biometrics at distance?, Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Charles Hsu, Trident Systems Inc. (USA); Ira Kohlberg, Institute for Defense Analyses (USA) . . . . . [8058-30]

A review of the current state-of-the-art in crowd behavior analysis and simulation, Kenneth A. Byrd, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [8058-31]

Distributed signal decorrelation in wireless sensor networks using the sparse matrix transform, Leonardo R. Bachega, Purdue Univ. (USA); Srikanth Hariharan, The Ohio State Univ. (USA); Charles A. Bouman, Purdue Univ. (USA); Ness Shroff, The Ohio State Univ. (USA) . . . . . [8058-32]

Real-world Nyquist sampling rate (of facial ordering), Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Ming-Kai Hsu, The George Washington Univ. (USA) . . . . . [8058-33]

Lunch/Exhibition Break . . . . . 12:40 to 1:40 pm

Biomedical Wellness Award. . . . . Thurs. 1:40 to 2:00 pm

Biomedical Wellness Award for Applying Computational Intelligence to Image Diagnosis

Session Chairs: **Takeshi Yamakawa,** Kyushu Institute of Technology (Japan); **Soo-Young Lee,** KAIST (Korea, Republic of)

Presented to

Dr. Hiroshi Nakajima, OMRON Corp. (Japan) for Contribution to Effective Monitoring and Smart Processing Devices

Smart health management technology and its applications *(Invited Paper)*, Hiroshi Nakajima, OMRON Corp. (Japan) . . . . . [8058-34]

PANEL DISCUSSION. . . . . Thurs. 2:00 to 2:20 pm

Biomedical Wellness for Aging Global Village

Panel Moderators: **Dr. Hiroshi Nakajima,** OMRON Corp. (Japan); **Soo-Young Lee,** KAIST (Korea, Republic of); **Takeshi Yamakawa,** Kyushu Institute of Technology (Japan); **Yutaka Hata,** Univ. of Hyogo (Japan); **Harold Szu,** U.S. Army Night Vision & Electronic Sensors Directorate

SESSION 11 . . . . . Thurs. 2:20 to 5:30 pm

Biomedical Wellness Applications

YURAGI: analysis for detecting heart-rate by mat-type sensor in bed, Yutaka Hata, Kiyotaka Ho, Kei Kuramoto, Syoji Kobashi, Univ. of Hyogo (Japan); Naoki Tsuchiya, Hiroshi Nakajima, OMRON Corp. (Japan). . . . . [8058-35]

Visceral fat estimation method by bio-impedance and causal analysis, Hiroshi Nakajima, Hiroshi Tasaki, Naoki Tsuchiya, OMRON Corp. (Japan); Takehiro Hamaguchi, Toshikazu Shiga, OMRON Healthcare Co., Ltd. (Japan) . . . [8058-36]

Mulitscale edge detection for small blood vessel segmentation in magnetic resonance angiograpy, Rakesh Chandramohan, Samuel P. Kozaitis, Florida Institute of Technology (USA) . . . . . [8058-37]

Heart-rate monitoring by air pressure and causal analysis, Naoki Tsuchiya, Hiroshi Nakajima, OMRON Corp. (Japan); Yutaka Hata, Univ. of Hyogo (Japan). . . . . [8058-38]

Biomedical wellness by tai chi and sports, Daniel C. Chin, The Johns Hopkins Univ. Applied Physics Lab. (USA); Amita G. Chin, Virginia Commonwealth Univ. (USA) . . . . . [8058-39]

YURAGI: analysis for trans-skull brain visualizing by ultrasonic array probe, Naomi Yagi, Yoshitetsu Oshiro, Osamu Ishikawa, Ishikawa Hospital (Japan); Yutaka Hata, Univ. of Hyogo (Japan); Yuri T. Kitamura, Toshio Yanagida, Osaka Univ. (Japan) . . . . . [8058-52]

Biometrics security by dynamics of left and right sole pressure while walking, Takahiro Takeda, Kei Kuramoto, Syoji Kobashi, Yutaka Hata, Univ. of Hyogo (Japan) . . . . . [8058-57]

A fuzzy automated object classification by infrared laser camera, Seigo Kanazawa, Univ. of Hyogo (Japan); Kazuhiko Tanigushi, Kinden Corp. (Japan); Asari Kazunari, Kansai Electric Power Co., Inc. (Japan); Kei Kuramoto, Shoji Kobashi, Yutaka Hata, Univ. of Hyogo (Japan). . . . . [8058-58]

Friday 29 April

SESSION 12 . . . . . Fri. 8:00 to 10:00 am

System Biology Imaging Processing

Session Chairs: **Chee-Hung Chu,** Univ. of Louisiana at Lafayette;
Jide Familoni, U.S. Army Night Vision & Electronic Sensors Directorate

Defense-related insights and solutions from neuroscience and neuroengineering, Gerwin Schalk, New York State Dept. of Health (USA) and Albany Medical College (USA) and Univ. of New York at Albany (USA); Aysegul Gunduz, Peter Brunner, New York State Dept. of Health (USA) and Albany Medical College (USA). . . . . [8058-40]

Wavelets for full reconfigurable ECG signal acquisition system, Diego P. Morales, Antonio García, Encarnación Castillo, Univ. de Granada (Spain); Uwe Meyer Baese, The Florida State Univ. (USA); Alberto J. Palma, Univ. de Granada (Spain) . . . . . [8058-41]

Wavelet domain analysis of EEG data for emotion recognition: evaluation of recoursing energy efficiency, Theus Aspiras, Vijayan K. Asari, Univ. of Dayton (USA) . . . . . [8058-42]

Gaussian graphical models reveal specific lipid correlations in glioblastoma cells, Nikola S. Mueller, Max-Planck-Institut für Biochemie (Germany); Jan Krumsiek, Helmholtz Zentrum München GmbH (Germany); Anke D. Meyer-Bäse, The Florida State Univ. (USA); Fabian Theis, Helmholtz Zentrum München GmbH (Germany) . . . . . [8058-43]

Gut feeling is electric, Jide Familoni, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8058-44]

Reconstruction algorithms for optoacoustic imaging based on fiber optic detectors, Daniel C. Gallego, Horacio Lamela, Rebeca Gutiérrez, Univ. Carlos III de Madrid (Spain); Alexander A. Oraevsky, TomoWave Labs., Inc. (USA) [8058-45]

SESSION 13 . . . . . Fri. 10:20 am to 12:20 pm

Engineering System of Systems and Application

NIOS II processor-based acceleration of motion compensation techniques, Diego González Rodríguez, Univ. Complutense de Madrid (Spain); Guillermo Botella Juan, Uwe Meyer Baese, Anke D. Meyer-Bäse, The Florida State Univ. (USA) . . . . . [8058-46]

PCA method for automated detection of mispronounced words, Zhenhao Ge, Sudhendu R. Sharma, Mark J. T. Smith, Purdue Univ. (USA). . . . . [8058-47]

Applying genetic algorithm to optimization parameters of robust optical flow system, Olmo Zavala, Guillermo Botella Juan, Anke D. Meyer-Bäse, Uwe Meyer Baese, The Florida State Univ. (USA) . . . . . [8058-48]

Intellectual property protection (IPP) using lossless obfuscation in C, VHDL, and Verilog coding, Uwe Meyer Baese, Guillermo Botella Juan, The Florida State Univ. (USA); Encarnación Castillo, Antonio García, Univ. de Granada (Spain) . . . . . [8058-49]

Polarimetric detection for slowly moving/stationary targets in inhomogeneous environments, Charles Hsu, Howard B. Mendelson, Albert Burgstahler, Dan Hibbard, James Faist, Trident Systems Inc. (USA) . . . . [8058-50]

Independent component analysis (ICA) of fused wavelet coefficients of thermal and visual images for human face recognition, Mrinal K. Bhowmik, Debotosh Bhattacharjee, Dipak K. Basu, Jadavpur Univ. (India) . . . . . [8058-17]

Lunch Break . . . . . 12:20 to 1:20 pm

SESSION 14 . . . . . Fri. 1:20 to 2:00 pm

System Biology Pioneer Award for the Excellence in the Field of System Biology Science for receptor-mediated regulation in systems biology

Presented to

Prof. Douglas A. Lauffenburger,
Massachusetts Institute of Technology

Receptor-mediated regulation in biology *(Invited Paper)*, Douglas A. Lauffenburger, Massachusetts Institute of Technology (USA). . . . . [8058-51]

PANEL DISCUSSION. . . . . Fri. 2:00 to 2:20 pm

System of Systems Computational Intelligence

Panel Moderators: **Nadarajen A. Vydelingum,**
National Institute of Health;
Jide Familoni, U.S. Army Night Vision & Electronic Sensors Directorate;
Takeshi Yamakawa, Kyushu Institute of Technology (Japan);
Soo-Young Lee, KAIST(Korea, Republic of);
Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate

SESSION 15 . . . . . Fri. 2:20 to 4:20 pm

Wellness Smart Sensors

Session Chairs: **Yutaka Hata,** Univ. of Hyogo (Japan);
Takeshi Yamakawa, Kyushu Institute of Technology (Japan)

Biomedical wellness (BMW) concerns, Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [8058-53]

Solving channel assignment problems using local search methods and simulated annealing, Lipo Wang, Nanyang Technological Univ. (Singapore) . . . . . [8058-54]

Reverse engineering cellular decisions for hybrid reconfigurable network modeling, Howard A. Blair, Syracuse Univ. (USA) . . . . . [8058-55]

Approximate nearest neighbors in high-dimensional vector spaces via dictionary learning, Anoop Cherian, Vassilios Morellas, Nikos Papanikolopoulos, Univ. of Minnesota, Twin Cities (USA). . . . . [8058-56]

The golden ratio in peripheral monochromatic and central chromatic vision, Jeffrey C. Jenkins, Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8058-59]

CLOSING REMARKS. . . . . Fri. 4:20 to 4:40 pm

Session Chair: **Harold Szu,**
U.S. Army Night Vision & Electronic Sensors Directorate

Evolutionary and Bio-Inspired Computation: Theory and Applications V

Conference Chairs: **Misty Blowers,** Air Force Research Lab.; **Teresa H. O'Donnell,** Air Force Research Lab.; **Olga Mendoza-Schrock,** Air Force Research Lab.

Program Committee: **Peter M. LaMonica,** Air Force Research Lab.; **Leonid I. Perlovsky,** Air Force Research Lab.; **Michael R. Peterson,** Univ. of Hawai'i; **Alex F. Sisti,** Air Force Research Lab.; **Hugh L. Southall,** Air Force Research Lab.; **John Spina,** Air Force Research Lab.

Wednesday 27 April

SESSION 1 . . . . . Wed. 1:30 to 2:10 pm

Keynote Session I

Session Chair: **Misty Blowers,** Air Force Research Lab.

Using concepts from biology to improve problem-solving methods *(Keynote Presentation),* Erik Goodman, Michigan State Univ. (USA). [8059-01]

SESSION 2 . . . . . Wed. 2:10 to 5:00 pm

Layered-Sensing Intelligence

Session Chair: **Olga Mendoza-Schrock,** Air Force Research Lab.

PADF RF localization experiments with multi-agent caged-MAV platforms, Christopher Barber, Miguel Gates, Louisiana Tech Univ. (USA); Huthaifa Alissa, Univ. of Dayton (USA); Atindra K. Mitra, Air Force Research Lab. (USA); Rastko R. Selmic, Louisiana Tech Univ. (USA); Raul Ordonez, Univ. of Dayton (USA) . . . . . [8059-02]

Discriminative feature sets for object detection in layered sensing environments, Michael P. Dessauer, Louisiana Tech Univ. (USA). . . . . [8059-03]

Multisensor registration using correlation-based, mutual information-based and scale invariant feature transform (SIFT) algorithms, Yang Xu, Wright State Univ. (USA) . . . . . [8059-04]

Boresight calibration of the aerial multi-head camera system, Alper Yilmaz, Young-Jin Lee, The Ohio State Univ. (USA) . . . . . [8059-05]

Initial data sampling in high dimensional design optimization, Hugh L. Southall, Teresa H. O'Donnell, Air Force Research Lab. (USA) . . . . . [8059-06]

A robust regularization algorithm for polynomial networks for machine learning, Holger M. Jaenisch, Licht Strahl Engineering, Inc. (USA) and The Johns Hopkins Univ. (USA); James W. Handley, Licht Strahl Engineering, Inc. (USA) . . . . . [8059-07]

A scaled, performance driven evaluation of the layered-sensing framework utilizing polarimetric infrared imagery, Hamilton S. Clouse, Hamid Krim, North Carolina State Univ. (USA); Olga Mendoza-Schrock, Air Force Research Lab. (USA) . . . . . [8059-08]

Thursday 28 April

SESSION 3 . . . . . Thurs. 8:20 to 9:00 am

Keynote Session II

Session Chair: **Misty Blowers,** Air Force Research Lab.

The knowledge instinct and the mathematical implementation of the mechanisms of the mind *(Keynote Presentation),* Leonid I. Perlovsky, Air Force Research Lab. (USA) . . . . . [8059-09]

SESSION 4 . . . . . Thurs. 9:00 to 11:30 am

Knowledge Extraction

Session Chairs: **John Spina,** Air Force Research Lab.; **Peter M. LaMonica,** Air Force Research Lab.

Categorification of the layered sensing construct, Jared L. Culbertson, Air Force Research Lab. (USA); Mark E. Oxley, Air Force Institute of Technology (USA); Steven K. Rogers, Air Force Research Lab. (USA); Kirk Sturtz, Universal Mathematics (USA) . . . . . [8059-10]

Cross layers decision fusion model in layered sensing systems, Saleh Zein-Sabatto, Sachin Shetty, Abduliqadir Khoshnaw, Tennessee State Univ. (USA) . . . . . [8059-11]

Wide-threat detection: recognition of adversarial missions and activity patterns in Empire Challenge 2009, Georgiy M. Levchuk, Charlotte Shabarekh, Caitlin Furjanic, Aptima Inc. (USA) . . . . . [8059-12]

Layered learning approach for event detection, Misty Blowers, Air Force Research Lab. (USA) . . . . . [8059-13]

Intelligent information dissemination to hand-held devices, John Spina, Air Force Research Lab. (USA) . . . . . [8059-14]

Wavelet-based polarimetry image analysis, Olga Mendoza-Schrock, Air Force Research Lab. (USA); Albert Ngo, Soundararajan Ezekiel, Indiana Univ. of Pennsylvania (USA) . . . . . [8059-15]

SESSION 5 . . . . . Thurs. 11:30 am to 12:10 pm

Medical Imaging

Session Chair: **Frank W. Moore,** Univ. of Alaska Anchorage

Graph-visualization techniques for representing glycomic response in GSC11 glioblastoma cells, Anke D. Meyer-Bäse, The Florida State Univ. (USA). . . . . [8059-16]

Improved computer-aided diagnosis for breast lesions in DCE-MRI based on motion artifact removal and integration of morphologic and dynamic information, Anke D. Meyer-Bäse, The Florida State Univ. (USA). . . . . [8059-17]

Lunch/Exhibition Break . . . . . 12:10 to 1:40 am

SESSION 6 . . . . . Thurs. 1:40 to 3:00 pm

Image Intelligence

Session Chair: **Frank W. Moore,** Univ. of Alaska Anchorage

Evolving wavelet and scaling numbers for optimized image compression: forward, inverse, or both? A comparative study, Frank W. Moore, Brendan J. Babb, Shawn Aldridge, Univ. of Alaska Anchorage (USA); Michael R. Peterson, Univ. of Hawai'i (USA) . . . . . [8059-18]

Evolving matched filter transform pairs for satellite image processing, Michael R. Peterson, Toby Horner, Univ. of Hawai'i (USA); Frank W. Moore, Univ. of Alaska Anchorage (USA) . . . . . [8059-19]

Image sets for satellite image processing systems, Michael R. Peterson, Toby Horner, Asael Temple, Univ. of Hawai'i (USA). . . . . [8059-20]

Evolving point-cloud features for gender discrimination, Brittany Keen, Aaron Fouts, Mateen M. Rizki, Louis A. Tamburino, Wright State Univ. (USA); Olga Mendoza-Schrock, Air Force Research Lab. (USA) . . . . . [8059-21]

SESSION 7 . . . . . Thurs. 3:30 to 4:30 pm

Computer/Network Security

Session Chair: **Misty Blowers,** Air Force Research Lab.

Behavioral analysis of malicious code through network traffic and system call monitoring, André R. A. Gregio, Dario S. Fernandes Filho, Vitor M. Afonso, Ctr. de Tecnologia da Informação Renato Archer (Brazil) and Univ. Estadual de Campinas (Brazil); Rafael D. Coelho dos Santos, Instituto Nacional de Pesquisas Espaciais (Brazil); Mario Jino, Paulo L. de Geus, Univ. Estadual de Campinas (Brazil) . . . . . [8059-22]

An adaptive neural swarm approach for intrusion defense in ad hoc networks, James D. Cannady, Nova Southeastern Univ. (USA) . . . . . [8059-23]

Combined bio-inspired/evolutionary computational methods in cross-layer protocol optimization for wireless ad hoc sensor networks, William S. Hortos, Jr., Associates in Communications Engineering Research and Technology (USA) . . . . . [8059-24]

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Modeling and Simulation for Defense Systems and Applications VI

Conference Chair: **Eric J. Kelmelis,** EM Photonics, Inc.

Program Committee: **James N. Elele,** Naval Air Systems Command; **Susan Harkrider,** U.S. Army Night Vision & Electronic Sensors Directorate; **Alex F. Sisti,** Air Force Research Lab.; **David J. Thornley,** Imperial College London (United Kingdom); **Dawn A. Trevisani,** Air Force Research Lab.

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 1 . . . . . Tues. 10:30 to 11:50 am

Tools and Techniques

Session Chair: **Ahmed S. Sharkawy,** Lumilant, Inc.

A high-performance computing framework for physics-based modeling and simulation of the mobility of military ground vehicles, Dan Negrut, Univ. of Wisconsin-Madison (USA); David Lamb, David Gorsich, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA). . . . . [8060-01]

Rolling partial prefix-sums to speedup evaluation of uniform and affine recurrence equations, Narayan Ganesan, Univ. of Delaware (USA) and Washington Univ. in St. Louis (USA); Roger D. Chamberlin, Jeremy Buhler, Washington Univ. in St. Louis (USA); Michela Taufer, Univ. of Delaware (USA). . . . [8060-02]

Accelerating sparse linear algebra using graphics processing units, Kyle Spagnoli, EM Photonics, Inc. (USA) . . . . . [8060-03]

High-level GPU computing with jacket: for MATLAB and C/C++, Gallagher Pryor, Brett Lucey, Pavan Yalamanchili, Chris McClanahan, James Malcolm, AccelerEyes LLC (USA). . . . . [8060-04]

Lunch/Exhibition Break . . . . . 11:50 am to 1:30 pm

SESSION 2 . . . . . Tues. 1:30 to 3:10 pm

Sensors and Imaging

Session Chair: **Narayan Ganesan,** Univ. of Delaware

Roles and assessment methods for models of sensor data exploitation algorithms, Adam R. Nolan, Etegent Technologies, Ltd. (USA); Timothy D. Ross, Lloyd G. Clark, Air Force Research Lab. (USA). . . . . [8060-05]

Multiframe atmospheric compensation under moving camera conditions, Aaron L. Paolini, Daniel Price, Fernando Ortiz, EM Photonics, Inc. (USA) [8060-06]

Power versus performance tradeoffs of GPU-accelerated backprojection-based synthetic aperture radar image processing, Ricardo Portillo, Sarala Arunagiri, Patricia Teller, The Univ. of Texas at El Paso (USA); Joseph C. Deroba, U.S. Army CERDEC Intelligence and Information Warfare Directorate (USA); Lam H. Nguyen, Song J. Park, Dale R. Shires, U.S. Army Research Lab. (USA) . . . . . [8060-07]

A hardware-in-the-loop simulation program for ground-based radar, Eric P. Lam, Thales-Raytheon Systems Co. LLC (USA). . . . . [8060-08]

An agile acquisition decision-support workbench for evaluating ISR effectiveness, Daniel W. Stouch, Charles River Analytics, Inc. (USA); Valerie Champagne, PatchPlus Consulting (USA); Christopher P. Mow, Brad Rosenberg, Charles River Analytics, Inc. (USA) . . . . . [8060-09]

SESSION 3 . . . . . Tues. 3:40 to 5:00 pm

Physics-Based Simulations

Session Chair: **Aaron L. Paolini,** EM Photonics, Inc.

Electrically tuned slow light-based coupled photonic crystal waveguides using a laterally doped p-i-n junction, Ahmed S. Sharkawy, Lumilant, Inc. (USA); Mathew J. Zablocki, David Grund, Dennis W. Prather, Univ. of Delaware (USA) . . . . . [8060-10]

Modeling of hybrid organic/inorganic dual RF-photonic slot waveguide modulator, Shouyuan Shi, Univ. of Delaware (USA); Ahmed S. Sharkawy, Lumilant, Inc. (USA); Mathew J. Zablocki, Lumilant. Inc. (USA); Dennis W. Prather, Univ. of Delaware (USA) . . . . . [8060-11]

Reconfigurable chip-scale optical router, Ahmed S. Sharkawy, Lumilant, Inc. (USA); Mathew J. Zablocki, Dennis W. Prather, Univ. of Delaware (USA) [8060-12]

Advances in computational fluid dynamics solvers for the GPU, Dan Hertenstein, John R. Humphrey, Jr., EM Photonics, Inc. (USA) . . . . . [8060-13]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Naval Electronic Warfare Simulation for effectiveness assessment and softkill programmability facility, Fabienne Lancon, SAGEM SA (France) . . . . . [8060-22]

Implementation and research of the linkage IDS based on Windows XP, Peili Qiao, Harbin Univ. of Science and Technology (China) . . . . . [8060-23]

An efficient geometric computation for ladar simulation, Seran Hwang, Seongjoon Kim, Impyeong Lee, The Univ. of Seoul (Korea, Republic of). [8060-24]

Network M&S techniques based on the interworking of real systems for the interoperability T&E, Sangheun Shim, Agency for Defense Development (Korea, Republic of) . . . . . [8060-25]

Wednesday 27 April

SESSION 4 . . . . . Wed. 8:20 to 10:00 am

Battlefield Simulation and Cyber Warfare

Session Chair: **Daniel Mackrides,** Phase Sensitive Innovations, Inc.

Automation of air defence commander using Bayesian decision trees, Ali Hilal Ali, Garik Markarian, Lancaster Univ. (United Kingdom); Alex Tarter, Ultra Electronics (United Kingdom); Rainer Koelle, European Organisation for the Safety of Air Navigation (Belgium). . . . . [8060-14]

Improving representation of situational awareness in constructive combat simulation, Kangjin D. Lee, Micheal Colony, Decisive Analytics Corp. (USA) . . . . . [8060-15]

Simulating cyber warfare and cyber defenses: information value considerations, Martin R. Stytz, Sheila B. Banks, Calculated Insight (USA) . . . . . [8060-16]

Advancing bot army simulation techniques for simulation environments, Sheila B. Banks, Martin R. Stytz, Calculated Insight (USA) . . . . . [8060-17]

The National Operational Environment Model (NOEM), John J. Salerno, Jr., Brian C. Romano, Warren Geiler, Air Force Research Lab. (USA) . . . . . [8060-18]

SESSION 5 . . . . . Wed. 10:30 to 11:30 am

Verification, Validation and Accreditation

Session Chair: **John J. Salerno, Jr.,** Air Force Research Lab.

Applying risk-based M&S VV&A techniques to test and laboratory facilities, David Hall, Survice Engineering Co. (USA); James N. Elele, Jeremy S. Smith, Naval Air Systems Command (USA) . . . . . [8060-19]

Lessons learned in the process of conducting the verification and validation of live virtual and constructive distributed environment (LVC-DE), James N. Elele, Naval Air Systems Command (USA); David Turner, SURVICE Engineering Co. (USA) . . . . . [8060-20]

Utility of information, David J. Thornley, Imperial College London (United Kingdom) . . . . . [8060-21]

PANEL DISCUSSION. . . . . Wed. 11:30 am to 12:10 pm

Verification, Validation and Accreditation

Panel Moderators: **James N. Elele,** Naval Air Systems Command; **David J. Thornley,** Imperial College London (United Kingdom)

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Thursday-Friday 28-29 April 2011 • Proceedings of SPIE Vol. 8061

Wireless Sensing, Localization, and Processing VI

Conference Chairs: **Sohail A. Dianat,** Rochester Institute of Technology; **Michael D. Zoltowski,** Purdue Univ.

Program Committee: **Moeness G. Amin,** Villanova Univ.; **John W. Nieto,** Harris Corp.; **Raghuveer M. Rao,** Rochester Institute of Technology; **Yimin D. Zhang,** Villanova Univ.

Thursday 28 April

SESSION 1 . . . . . Thurs. 8:30 to 10:10 am

Sensor Networks

Session Chair: **John W. Nieto,** Harris Corp.

Wireless sensor network for sniper detection: experiment and simulation, Armin L. Schneider, Martin Laurenzis, Sébastien Hengy, Institut Franco-Allemand de Recherches de Saint-Louis (France) . . . . . [8061-01]

Ant-based power efficient, adaptive, reliable, and load balanced (A-PEARL) routing for smart metering networks, Rajani Muraleedharan-Sreekumaridevi, Syracuse Univ. (USA) . . . . . [8061-02]

Optimization of the relay position and resource allocation in cooperative broadcast wireless networks, Ying Jin, Yimin D. Zhang, Villanova Univ. (USA) . . . . . [8061-03]

Adaptive beamforming and rate control in real-time wireless sensor networks for QoS optimization, William S. Hortos, Jr., Associates in Communications Engineering Research and Technology (USA) . . . . . [8061-04]

Sensor deployment optimization based on optimal recovery interpolation, Sergio D. Cabrera, Veenarai Moram, Jose G. Rosiles, The Univ. of Texas at El Paso (USA) . . . . . [8061-05]

SESSION 2 . . . . . Thurs. 10:40 am to 12:00 pm

Modulation and Channel Estimation

Session Chair: **Sohail A. Dianat,** Rochester Institute of Technology

Performance evaluation of CCI on the reverse CDMA channel, Salim Alsharif, Mohammad S. Alam, Univ. of South Alabama (USA) . . . . . [8061-06]

Equalisation for continuous phase modulation using basis functions, Colin Brown, Phil Vigneron, Communications Research Ctr. Canada (Canada) [8061-07]

Iterative detection of continuous phase modulation on multipath channels, John W. Nieto, Harris Corp. (USA) . . . . . [8061-08]

Application and analysis of rake receiver to hybrid CPM modulation, James A. Norris, Harris Corp. (USA) . . . . . [8061-09]

Lunch/Exhibition Break . . . . . 12:00 to 1:30 pm

SESSION 3 . . . . . Thurs. 1:30 to 3:10 pm

Detection and Localization I

Session Chair: **Yimin D. Zhang,** Villanova Univ.

Location-dependent RF geotags for positioning and security, Di Qiu, Sigtem Technology, Inc. (USA); Robert S. Lynch, Jr., Naval Undersea Warfare Ctr. (USA); Chun Yang, Sigtem Technology, Inc. (USA) . . . . . [8061-10]

Single-node MMSE for MMSE cooperative positioning, Songnan Xi, Michael D. Zoltowski, Purdue Univ. (USA); Yao Zhao, Liang Dong, Western Michigan Univ. (USA) . . . . . [8061-11]

A novel grid density-based geolocation algorithm for noncooperative radio emitters using power difference of arrival, Shanzeng Guo, Brad R. Jackson, Sichun Wang, Defence Research and Development Canada (Canada); William Arnold, Univ. of Waterloo (Canada); Robert Inkol, Defence Research and Development Canada (Canada) . . . . . [8061-12]

Low-complexity narrowband adaptive beamforming based on symmetrically distributed arrays, Lei Zhang, Wei Liu, Richard J. Langley, The Univ. of Sheffield (United Kingdom). . . . . [8061-13]

A spatial filtering approach to electronic wideband beam steering, Wei Liu, The Univ. of Sheffield (USA); Dennis R. Morgan, Alcatel-Lucent Bell Labs. (USA) . . . . . [8061-14]

SESSION 4 . . . . . Thurs. 3:40 to 4:20 pm

Detection and Localization II

Session Chair: **Raghuveer M. Rao,** Rochester Institute of Technology

Source location detection using unique characterizations of multipath propagation in an urban environment, Brian R. Phelan, Ram M. Narayanan, Erik H. Lenzing, The Pennsylvania State Univ. (USA). . . . . [8061-15]

Accurate position service based on interacting multiple model with enhanced Kalman filter, Jun Li, Yuan Cao, Nan Wu, Nanjing Univ. (China); Xiangdong Li, New York City College of Technology (USA) . . . . . [8061-16]

Friday 29 April

SESSION 5 . . . . . Fri. 8:30 to 10:10 am

Implementation and Application

Session Chair: **Fred C. Kellerman,** Harris Corp.

Navigation of robotic systems using cricket motes, Yogendra Patil, Kuldip S. Rattan, Wright State Univ. (USA). . . . . [8061-17]

An improved antenna circuit model utilizing a transmission line, Allen Hollister, Physical Optics Corp. (USA); John T. Armstrong, Probe Science, Inc. (USA) . . . . . [8061-18]

Robust visible light communications system using filter-based sensor array, Cheng-Chun Chang, Yuan-Jun Su, National Taipei Univ. of Technology (Taiwan); Umpei Kurokawa, Byung Il Choi, nanoLambda (USA) . . . . . [8061-19]

INS aided by an acoustic wireless sensor network and magnetometer, Nicholas A. Baine, Pratikkumar U. Desai, Kuldip S. Rattan, Wright State Univ. (USA) . . . . . [8061-20]

Performance of concatenated convolutional codes with differential modulations: coherent versus non-coherent, Fred C. Kellerman, Harris Corp. (USA) . . . . . [8061-21]

SESSION 6 . . . . . Fri. 10:40 to 11:20 am

Diversity and Multicarrier Techniques

Session Chair: **Michael D. Zoltowski,** Purdue Univ.

Sensing using eigenchannels in RF MIMO communication systems, Nicolas Bikhazi, Sandia National Labs. (USA); William F. Young, National Institute of Standards and Technology (USA); Hung D. Nguyen, Sandia National Labs. (USA) . . . . . [8061-22]

Computation-efficient blind estimation of OFDM signal parameters for interception and data recovery, Qian Chen, Xianbin Wang, Dian Fan, The Univ. of Western Ontario (Canada); Shanzeng Guo, Defence Research and Development Canada (Canada) . . . . . [8061-23]

Wednesday-Thursday 27-28 April 2011 • Proceedings of SPIE Vol. 8062

Defense Transformation and Net-Centric Systems 2011

Conference Chair: **Raja Suresh,** General Dynamics Advanced Information Systems

Program Committee: **Keith Arthur,** U.S. Army Aviation Applied Technology Directorate; **Vasu D. Chakravarthy,** Air Force Research Lab.; **Melanie Dumas,** Defense Advanced Research Projects Agency; **John S. Eicke,** U.S. Army Research Lab.; **Paul Gaertner,** Embassy of Australia; **Gayle D. Grant,** U.S. Army Communications-Electronics Command; **Michael A. Kolodny,** U.S. Army Research Lab.; **James R. Milligan,** Air Force Research Lab.; **Leo J. Rose,** U.S. Air Force; **Larry B. Stotts,** Defense Advanced Research Projects Agency; **Venkataraman Sundareswaran,** Teledyne Scientific Co.; **Guy Vézina,** Defence Research and Development Canada (Canada)

Wednesday 27 April

SESSION 1 . . . . . Wed. 8:20 to 10:00 am

Net-Centric Architectures and Information Management Services

Session Chairs: **James R. Milligan,** Air Force Research Lab.; **Paul Gaertner,** Embassy of Australia

VFILM: a value function driven approach to information lifecycle management, Jeffrey Cleveland, Joseph P. Loyall, Jonathan Webb, BBN Technologies (USA); James Hanna, Air Force Research Lab. (USA) . . . . [8062-01]

Evaluating QoS-enabled information management services in a Navy operational context, Aaron Paulos, Joseph P. Loyall, Matthew Gillen, BBN Technologies (USA); Asher Sinclair, Air Force Research Lab. (USA) . . . . [8062-02]

An enterprise service set for adaptive role-relevant operational displays, John D. Zaientz, Soar Technology, Inc. (USA); Michael Hultner, Lockheed Martin Orincon (USA); David Ray, Laura Hamel, Soar Technology, Inc. (USA) . . [8062-03]

Net-centric interoperability, Mark T. Sevening, The Boeing Co. (USA) . [8062-04]

SMASHUP: secure mashup for defense transformation and net-centric systems, Mark D. Heileman, Modus Operandi, Inc. (USA); Gregory L. Heileman, The Univ. of New Mexico (USA); Matthew P. Shaver, Air Force Research Lab. (USA); Mike D. Gilger, Modus Operandi, Inc. (USA); John Benner, Jr., Booz Allen Hamilton Inc. (USA) . . . . . [8062-05]

CROSS-CONFERENCE HOT TOPIC PANEL
Wed. 10:30 am to 12:30 pm

Data to Decisions: "Sensors are No Longer King"

Moderator: **John. M. Pellegrino,** Director, Army Research Lab., Computational and Information Sciences Directorate (CISD)

This cross-conference hot topic provides a unique forum for senior leaders from different organizational perspectives to discuss the shifting paradigm of what is needed to achieve the required situational understanding to make the best actionable battlefield decisions. We need to get away from the "autistic" view of sensing and learn to integrate other non-traditional information sources including HUMINT, cultural understanding, social networks, policies and behavior modeling.

Identifying the Technology Needs from a Holistic Perspective

Lunch/Exhibition Break . . . . . 12:30 to 1:30 pm

SESSION 2 . . . . . Wed. 1:30 to 5:40 pm

ISR Systems and Fusion

Session Chairs: **Raja Suresh,** General Dynamics Advanced Information Systems; **Larry B. Stotts,** Defense Advanced Research Projects Agency

Issues in defense innovation *(Invited Paper)*, Arun Seraphin, Office of Science and Technology Policy (USA) . . . . . [8062-06]

Gotcha radar update *(Invited Paper)*, Michael L. Bryant, Air Force Research Lab. (USA) . . . . . [8062-07]

Adaptive radar *(Invited Paper)*, Muralidhar Rangaswamy, Air Force Research Lab. (USA) . . . . . [8062-08]

Developing an open architecture (OA) roadmap and defining OA levels *(Invited Paper)*, Megan Cramer, U.S. Navy (USA); Brett Cordes, Naval Surface Warfare Ctr. Panama City Div. (USA); Jason R. Stack, Office of Naval Research (USA) . . . . . [8062-09]

Improving network utilization over heterogeneous airborne networks, Brent Rickenbach, General Dynamics Advanced Information Systems (USA). . [8062-10]

Vision and critical challenges in exploiting distributed data for distributed decision making, Gavin Pearson, Defence Science and Technology Lab. (United Kingdom) . . . . . [8062-11]

A multi-agent infrastructure for hard and soft information fusion, Jeffrey C. Rimland, David L. Hall, The Pennsylvania State Univ. (USA) . . . . . [8062-12]

3DSF: three-dimensional spatiotemporal fusion, Richard L. Tutwiler, Donald J. Natale, Matthew S. Baran, David L. Hall, The Pennsylvania State Univ. (USA) . . . . . [8062-13]

A new synthetic dataset for evaluating soft and hard fusion algorithms, Jake Graham, David L. Hall, Jeffrey C. Rimland, The Pennsylvania State Univ. (USA) . . . . . [8062-14]

JDL level 0 and 1 algorithms for processing and fusion of hard sensor data, Jeffrey C. Rimland, Ganesh M. Iyer, Rachana R. Agumamidi, Soumya V. Pisupati, Jake Graham, The Pennsylvania State Univ. (USA) . . . . . [8062-15]

Thursday 28 April

SESSION 3 . . . . . Thurs. 8:00 to 10:00 am

Self-Organizing, Collaborative, and Unmanned ISR Robots

Joint Session with Conference 8045

Session Chairs: **Melanie Dumas,** Defense Advanced Research Projects Agency; **Grant R. Gerhart,** U.S. Army Tank Automotive Research, Development and Engineering Ctr.-Retired

Biologically-inspired approaches for self-organization, adaptation, and collaboration of heterogeneous autonomous systems, Marc L. Steinberg, Office of Naval Research (USA). . . . . [8062-16]

Migration strategies for service-enabling ground control stations for unmanned systems, Joseph B. Kroculick, Winifred Associates (USA) . . [8062-17]

JEFX 10 demonstration of cooperative hunter killer UAS and upstream data fusion, Brian K. Funk, Andrew J. Newman, Jonathan C. Castelli, Adam S. Watkins, Christopher B. McCubbin, Jeffrey D. Barton, Cameron K. Peterson, Jonathan T. DeSena, Daniel A. Dutrow, Pedro A. Rodriguez, Steven J. Marshall, The Johns Hopkins Univ. (USA) . . . . . [8045-09]

Dynamic replanning on demand of UAS constellations performing ISR missions, Daniel W. Stouch, Ernest Zeidman, William Callahan, Charles River Analytics, Inc. (USA); Kirk McGraw, U.S. Army Engineer Research and Development Ctr. (USA) . . . . . [8045-11]

All weather sense and avoid system (AWSAS) for all UAS and manned platforms, Vincent M. Contarino, R-Cubed Engineering, LLC (USA). . . . [8045-13]

Autonomous sustain and resupply: what is the future?, Gregory S. Broten, Defence Research and Development Canada (Canada). . . . . [8045-29]

SESSION 4 . . . . . Thurs. 10:30 am to 12:10 pm

Sensor Networks and Wide Area Persistent Surveillance

Joint Session with Conference 8047

Session Chairs: **Leo J. Rose,** U.S. Air Force;
Michael A. Kolodny, U.S. Army Research Lab.

Bio-inspired UAV routing, source localization, and acoustic signature classification for persistent surveillance, Jerry A. Burman, Teledyne Scientific Co. (USA); Joao P. Hespanha, Upamanyu Madhow, Daniel J. Klein, Univ. of California, Santa Barbara (USA); Tien Pham, U.S. Army Research Lab. (USA) . . . . . [8047-36]

Trident Spectre 2010: agile integration and demonstration of a multisensor airborne pod, Greg Twaites, Brent Rickenbach, General Dynamics Advanced Information Systems (USA) . . . . . [8062-18]

Discovering geospatial networks from ambiguous track data, James E. Bevington, General Dynamics Advanced Information Systems (USA); Michael Evans, Shashi Shekhar, Univ. of Minnesota, Twin Cities (USA) . . . . . [8062-19]

A Bayesian formulation for auction-based task allocation in heterogeneous, multi-agent teams, Charles E. Pippin, Georgia Tech Research Institute (USA); Henrik I. Christensen, Georgia Institute of Technology (USA) . . . . . [8047-38]

Network exploitation using WAMI tracks, Raymond D. Rimey, Dan Keefe, Jim N. Record, Lockheed Martin Corp. (USA); Levi Kennedy, Christopher E. Cramer, Signal Innovations Group, Inc. (USA) . . . . . [8062-20]

Lunch/Exhibition Break . . . . . 12:10 to 1:40 pm

SESSION 5 . . . . . Thurs. 1:40 to 4:50 pm

Communications and Networks

Session Chairs: **Vasu D. Chakravarthy,** Air Force Research Lab.;
Gayle D. Grant, Consultant

A performance study of common anomaly detection algorithm performance on wireless sensor network data streams, Joseph Natarian, Leonard Lightfoot, Ellen Laubie, Air Force Research Lab. (USA) . . . . . [8062-21]

Strategy for wireless integration into U.S. Army tactical networks, Frederick R. Carlson, U.S. Army Battle Command Battle Lab.-Gordon (USA) . . . . . [8062-22]

Potential game models for efficient resource allocation in wireless networks, Yenumula B. Reddy, Grambling State Univ. (USA) . . . . . [8062-23]

Fast detection of network intrusion, Xinjia Chen, Ernest L. Walker, Southern Univ. and A&M College (USA) . . . . . [8062-24]

Analyzing the requirements for a robust security criteria and management of multilevel security in the clouds, Bassam S. Farroha, U.S. Dept. of Defense (USA) and The Johns Hopkins Univ. (USA); Deborah L. Farroha, U.S. Dept. of Defense (USA) . . . . . [8062-25]

A novel approach to implementing a comprehensive digital policy management as an enabler for dynamic secure information sharing, Bassam S. Farroha, Northrop Grumman Electronic Systems (USA); Deborah L. Farroha, U.S. Dept. of Defense (USA) . . . . . [8062-26]

Agile enterprise development framework: utilizing services principles for building pervasive security in the enterprise, Deborah L. Farroha, U.S. Dept. of Defense (USA); Bassam S. Farroha, Northrop Grumman Electronic Systems (USA) . . . . . [8062-27]

Single-ended IP roaming solution for dynamic network reconstruction, Joshua S. White, Adam W. Pilbeam, Joe McCoy, Everis, Inc. (USA) . . . . [8062-28]

This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Mobile Multimedia/Image Processing, Security, and Applications 2011

Conference Chairs: **Sos S. Agaian,** The Univ. of Texas at San Antonio; **Sabah A. Jassim,** Univ. of Buckingham (United Kingdom); **Eliza Yingzi Du,** Indiana Univ.-Purdue Univ. Indianapolis

Program Committee: **Farid Ahmed,** The Johns Hopkins Univ.; **David Akopian,** The Univ. of Texas at San Antonio; **Salim Alsharif,** Univ. of South Alabama; **Cesar Bandera,** BanDeMar Networks; **Chang Wen Chen,** Univ. at Buffalo; **Reiner Creutzburg,** Fachhochschule Brandenburg (Germany); **Stephen P. DelMarco,** BAE Systems; **Martin Dietze,** Consultant (Germany); **Frederic Dufaux,** Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Touradj Ebrahimi,** Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Erlan H. Feria,** College of Staten Island; **Phalguni Gupta,** Indian Institute of Technology Kanpur (India); **Yo-Ping Huang,** National Taipei Univ. of Technology (Taiwan); **Jacques Koreman,** Norwegian Univ. of Science and Technology (Norway); **Maryline Maknavicius,** TELECOM & Management SudParis (France); **Alessandro Neri,** Univ. degli Studi di Roma Tre (Italy); **Salil Prabhakar,** DigitalPersona, Inc.; **Cheryl L. Resch,** The Johns Hopkins Univ.; **Sonia Garcia-Salicetti,** Telecom ParisTech (France); **Harin Sellahewa,** Univ. of Buckingham (United Kingdom); **Xiyu Shi,** Univ. of Surrey (United Kingdom); **Yuri Shukuryan,** National Academy of Sciences of Armenia (Armenia)

Monday 25 April

SESSION 1 . . . . . Mon. 8:00 to 10:00 am

Information/Image Security I

Session Chairs: **Sabah A. Jassim,** Univ. of Buckingham (United Kingdom); **Reiner Creutzburg,** Fachhochschule Brandenburg (Germany)

Video scrambling for privacy protection in video surveillance: recent results and validation framework *(Invited Paper)*, Frederic Dufaux, Telecom ParisTech (France) . . . . . [8063-01]

Ensuring security of H.264 videos by using watermarking *(Invited Paper)*, Marc Chaumont, Lab. d'Informatique de Robotique et de Microelectronique de Montpellier (France). . . . . [8063-02]

Novel technology for enhanced security and trust in communication networks, Alexander Milovanov, Leonid Bukshpun, Ranjit Pradhan, Tomasz Jannson, Physical Optics Corp. (USA) . . . . . [8063-03]

System for nondisruptive high-capacity indexed data embedding and recovery using multimedia signal covers, James C. Collins, The Univ. of Texas at San Antonio (USA). . . . . [8063-04]

Establishing trust in decentralized smart sensor networks, Hauke Vagts, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung Germany). . . . . [8063-05]

SESSION 2 . . . . . Mon. 10:30 am to 12:20 pm

Multimedia Signal Processing Algorithms and Systems

Session Chairs: **Sos S. Agaian,** The Univ. of Texas at San Antonio; **Salim Alsharif,** Univ. of South Alabama

Maximizing gain to time-cost of human-machine interactive decision-making under asymmetrical time constraints *(Invited Paper)*, Hideyasu Sasaki, Ritsumeikan Univ. (Japan) and Keio Univ. (Japan) . . . . . [8063-47]

An adaptive LMS technique for wavelet polynomial threshold denoising, David Akopian, Sushanth G. Sathyanarayana, Sos S. Agaian, The Univ. of Texas at San Antonio (USA). . . . . [8063-06]

Accuracy, security, and processing time comparisons of biometric fingerprint recognition system using digital and optical enhancements, Salim Alsharif, Aed M. El-Saba, Univ. of South Alabama (USA) . . . . . [8063-07]

Arabic handwritten baseline estimation, slope correction, and document segmentation into sub-words, Makki Maliki, Sabah A. Jassim, Harin Sellahewa, Naseer Al-Jawad, Univ. of Buckingham (United Kingdom). . . . . [8063-08]

Remote object authentication against counterfeiting using elliptic curves, Jean Lancrenon, Roland D. Gillard, Univ. Joseph Fourier (France); Thierry Fournel, Univ. Jean Monnet Saint-Etienne (France) . . . . . [8063-09]

Lunch Break . . . . . 12:20 to 1:50 pm

SESSION 3 . . . . . Mon. 1:50 to 3:20 pm

Mobile Applications

Session Chairs: **Sos S. Agaian,** The Univ. of Texas at San Antonio; **Dalton S. Rosario,** U.S. Army Research Lab.

Smart compression using high-dimensional imagery *(Invited Paper)*, Dalton S. Rosario, U.S. Army Research Lab. (USA) . . . . . [8063-10]

Multitemplate image matching using alpha-rooted biquaternion phase correlation with application to logo recognition, Stephen P. DelMarco, BAE Systems (USA). . . . . [8063-11]

Parallel design patterns for a low-power, software defined compressed video encoder, Michael W. Bruns, Martin A. Hunt, Coherent Logix, Inc. (USA) . . . . . [8063-12]

A fast, efficiency-preserving system for simultaneous compression and encryption, Richard Metzler, Sos S. Agaian, The Univ. of Texas at San Antonio (USA) . . . . . [8063-13]

SESSION 4 . . . . . Mon. 3:50 to 5:50 pm

Biometrics I

Session Chairs: **Eliza Yingzi Du,** Indiana Univ.-Purdue Univ. Indianapolis; **Jacob Scharcanski,** Univ. Federal do Rio Grande do Sul (Brazil)

Real-time and location-secured multifactor biometrics for mCommerce authentication, Torben Kuseler, Hisham Al-Assam, Ihsan A. Lami, Sabah A. Jassim, Univ. of Buckingham (United Kingdom). . . . . [8063-14]

Block error correction codes for face recognition, Wafaa R. Hussein, Harin Sellahewa, Sabah A. Jassim, Univ. of Buckingham (United Kingdom). . . [8063-15]

Estimation of the head pose based on monocular images, Yessenia Yari, Jacob Scharcanski, Univ. Federal do Rio Grande do Sul (Brazil) . . . . . [8063-16]

A design of smart robot for human identification, Zhi Zhou, Eliza Y. Du, Indiana Univ.-Purdue Univ. Indianapolis (USA); Edward J. Delp III, Purdue Univ. (USA) . . . . . [8063-17]

A new approach for willingness test in biometric systems, Kai Yang, Eliza Y. Du, Indiana Univ.-Purdue Univ. Indianapolis (USA) . . . . . [8063-18]

Unsupervised tattoo segmentation combining bottom-up and top-down cues, Josef D. Allen, Harris Corp. (USA). . . . . [8063-19]

Tuesday 26 April

Symposium-Wide Plenary Session

Tuesday • 8:30 to 9:30 am

Dr. Regina E. Dugan

Director, Defense Advanced Research Projects Agency (DARPA)

See page 11 for details • Open to All Attendees

SESSION 5 . . . . . Tues. 10:00 am to 12:30 pm

Image/Information Security II

Session Chairs: **Sos S. Agaian,** The Univ. of Texas at San Antonio; **Erlan H. Feria,** College of Staten Island

iPhone forensics: an overview *(Invited Paper)*, Thomas Höne, Reiner Creutzburg, Fachhochschule Brandenburg (Germany). . . . . [8063-20]

Automated detection of semagram-laden images using adpative neural networks, Paul Cerkez, DCS Corp. (USA) . . . . . [8063-21]

Rapid prototyping of an automated video surveillance system: a hardware-software co-design approach, Hau T. Ngo, Ryan N. Rakvic, Randy P. Broussard, Robert W. Ives, U.S. Naval Academy (USA). . . . . [8063-22]

System approach to steganalysis, Josef D. Allen, Harris Corp. (USA) . [8063-23]

Forensic investigation of mobile phones, Silas Luttenberger, Reiner Creutzburg, Fachhochschule Brandenburg (Germany). . . . . [8063-24]

Video object trajectory perturbation-based data hiding, Abdullah Cay, Old Dominion Univ. (USA) . . . . . [8063-25]

On the novel space-time duality language of the latency information theory revolution, part I: the time-dislocation of the information-space uncertainty outputs of sources, Erlan H. Feria, College of Staten Island (USA) . . . . [8063-26]

Lunch/Exhibition Break . . . . . 12:30 to 1:50 pm

SESSION 6 . . . . . Tues. 1:50 to 3:10 pm

Biometrics II

Session Chairs: **Sabah A. Jassim,** Univ. of Buckingham (United Kingdom); **Stephen P. DelMarco,** BAE Systems

Palmprint identification using FRIT, Dakshina R. Kisku, Asansol Engineering College (India); Phalguni Gupta, Indian Institute of Technology Kanpur (India); Jamuna K. Sing, Jadavpur Univ. (India); Ajita Rattani, Univ. degli Studi di Cagliari (Italy) . . . . . [8063-27]

A secure wavelet-based isometric projection for face recognition, Hisham Al-Assam, Harin Sellahewa, Sabah Jassim, Univ. of Buckingham (United Kingdom). . . . . [8063-28]

A three-factor challenge/response approach for remote biometric authentication, Hisham Al-Assam, Sabah Jassim, Univ. of Buckingham (United Kingdom). . . . . [8063-29]

Palmprint verification using Lagrangian decomposition and invariant interest points, Dakshina R. Kisku, Asansol Engineering College (India); Phalguni Gupta, Indian Institute of Technology Kanpur (India); Jamuna K. Sing, Jadavpur Univ. (India); Ajita Rattani, Univ. degli Studi di Cagliari (Italy). . . . . [8063-30]

POSTERS-TUESDAY . . . . . Tues. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

SIFT-based feature level fusion of face, palmprint and fingerprint biometrics using log polar transform, Dakshina R. Kisku, Asansol Engineering College (India); Phalguni Gupta, Indian Institute of Technology Kanpur (India); Jamuna K. Sing, Jadavpur Univ. (India); Ajita Rattani, Univ. degli Studi di Cagliari (Italy) . . . . . [8063-31]

PreNotiS: a case study of a mobile disaster informatics framework, David Akopian, Michael Chan, Abhinav Kumar, The Univ. of Texas at San Antonio (USA) . . . . . [8063-32]

An interpolation filter based on wavelet polynomial threshold operators, David Akopian, Michael Chan, Sos S. Agaian, The Univ. of Texas at San Antonio (USA) . . . . . [8063-33]

An image similarity measure using enhanced human visual system characteristics, Shahan C. Nercessian, Karen A. Panetta, Tufts Univ. (USA); Sos S. Agaian, The Univ. of Texas at San Antonio (USA) . . . . . [8063-34]

Remote laboratory architecture for radio-communications, Arsen Melkonyan, Murillo Pontual, Grant Huang, Andreas Gampe, David Akopian, The Univ. of Texas at San Antonio (USA) . . . . . [8063-35]

Image sequence enhancement based on alpha trimmed mean and histogram equalization, Josue R. Figueroa, Sos S. Agaian, The Univ. of Texas at San Antonio (USA) . . . . . [8063-36]

Empirical mode decomposition-based contrast enhancement for color images, Somayeh Bakhtiari, Sos S. Agaian, Mo Jamshidi, The Univ. of Texas at San Antonio (USA). . . . . [8063-37]

Novel local enhancement algorithm with 3D weighted median filters for image sequences, Sos S. Agaian, Emanuel Silva, Josue R. Figueroa, The Univ. of Texas at San Antonio (USA) . . . . . [8063-38]

A polynomial threshold wavelet denoising approach for 3D biomedical applications, David Akopian, Michael Chan, Sushanth G. Sathyanarayana, Sos S. Agaian, The Univ. of Texas at San Antonio (USA). . . . . [8063-39]

Comparative study of color image enhancement techniques, Junjun Xia, Karen A. Panetta, Tufts Univ. (USA); Sos S. Agaian, The Univ. of Texas at San Antonio (USA) . . . . . [8063-40]

Using fuzzy data mining to diagnose patients' degrees of melancholia, Yo-Ping Huang, Wen-Lin Kuo, National Taipei Univ. of Technology (Taiwan) . . . . . [8063-41]

Detection of modified matrix encoding using compressed sensing, Josef D. Allen, Harris Corp. (USA). . . . . [8063-42]

On the novel space-time duality language of the latency information theory revolution, part II: the space-dislocation of the latency-time certainty inputs of movers, Erlan H. Feria, College of Staten Island (USA) . . . . . [8063-43]

On the novel space-time duality language of the latency information theory revolution, part III: the time-dislocation of the information-space uncertainty outputs of retainers, Erlan H. Feria, College of Staten Island (USA). . . . [8063-44]

On the novel space-time duality language of the latency information theory revolution, part IV: the space-dislocation of the latency-time certainty inputs of processors, Erlan H. Feria, College of Staten Island (USA). . . . . [8063-45]

A new approach for automatic human deceit detection, Jacob Norby, Eliza Y. Du, Indiana Univ.-Purdue Univ. Indianapolis (USA) . . . . . [8063-46]

Possibilities of forensic investigation of CD, DVD and Blu-ray disc, Frank Irmler, Reiner Creutzburg, Fachhochschule Brandenburg (Germany) . . . [8063-48]

Speed up face recognition with the use of limited physiological characteristics and SURF, Dakshina R. Kisku, Asansol Engineering College (India); Phalguni Gupta, Indian Institute of Technology Kanpur (India); Jamuna K. Sing, Jadavpur Univ. (India); Ajita Rattani, Univ. degli Studi di Cagliari (Italy) . . . . . [8063-49]

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This program is current as of 24 January 2011, for latest updates: spie.org/dssprogram

Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications 2011

Conference Chair: **Jerome J. Braun,** MIT Lincoln Lab.

Program Committee: **Sheela V. Belur,** The Van Dyke Technology Group, Inc.; **D. Paul Benjamin,** Pace Univ.; **Belur V. Dasarathy,** Information Fusion Technologies; **Michael Heizmann,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Charles F. Hester,** U.S. Army Research, Development and Engineering Command; **Mieczyslaw M. Kokar,** Northeastern Univ.; **Damian M. Lyons,** Fordham Univ.; **Mirela Popa,** General Dynamics Armament and Technical Products; **Firooz A. Sadjadi,** Lockheed Martin Maritime Systems & Sensors; **Pierre Valin,** Defence Research and Development Canada (Canada); **Pramod Kumar Varshney,** Syracuse Univ.; **Shanchieh Jay Yang,** Rochester Institute of Technology

Wednesday 27 April

SESSION 1 . . . . . Wed. 8:40 to 10:00 am

Information Fusion Approaches and Algorithms I

Session Chairs: **Jerome J. Braun,** MIT Lincoln Lab.; **Damian M. Lyons,** Fordham Univ.

Image fusion for remote sensing using fast, large-scale neuroscience models, Steven P. Brumby, Los Alamos National Lab. (USA) . . . . . [8064-01]

The continuum fusion theory of signal detection, with an application to multimodal fusion, Alan P. Schaum, U.S. Naval Research Lab. (USA). . [8064-02]

Probabilistic inference for battle damage assessment using physics-based models, Youngwon Shin, Applied Research Associates, Inc. (USA) . . . . [8064-03]

Wavelet-based fusion of overhead imagery and digital surface models, Alan M. Thomas, J. Michael Burkhart, Georgia Tech Research Institute (USA) [8064-04]

CROSS-CONFERENCE HOT TOPIC PANEL
Wed. 10:30 am to 12:30 pm

Data to Decisions: "Sensors are No Longer King"

Moderator: **John. M. Pellegrino,** Director, Army Research Lab., Computational and Information Sciences Directorate (CISD)

This cross-conference hot topic provides a unique forum for senior leaders from different organizational perspectives to discuss the shifting paradigm of what is needed to achieve the required situational understanding to make the best actionable battlefield decisions. We need to get away from the "autistic" view of sensing and learn to integrate other non-traditional information sources including HUMINT, cultural understanding, social networks, policies and behavior modeling.

Identifying the Technology Needs from a Holistic Perspective

Lunch/Exhibition Break . . . . . 12:30 to 2:00 pm

SESSION 2 . . . . . Wed. 2:00 to 3:00 pm

Information Fusion Approaches and Algorithms II

Session Chairs: **Pierre Valin,** Defence Research and Development Canada (Canada); **Charles F. Hester,** U.S. Army Research, Development and Engineering Command

Feature-aided Monte Carlo probabilistic data association filter for ballistic missile tracking, Onur Ozdemir, ANDRO Computational Solutions, LLC (USA); Ruixin Niu, L.C. Smith College of Engineering & Computer Science of Syracuse Univ. (USA); Pramod K. Varshney, Syracuse Univ. (USA); Andrew L. Drozd, Richard Loe, ANDRO Computational Solutions, LLC (USA) . . . . . [8064-05]

Architectures, algorithms, and applications using Bayesian networks, Todd Kingsbury, General Dynamics Advanced Information Systems (USA) . . . [8064-06]

Fusion of hyperspectral and ladar data for autonomous target detection, Andrey V. Kanaev, Thomas J. Walls, U.S. Naval Research Lab. (USA) . . [8064-07]

SESSION 3 . . . . . Wed. 3:30 to 4:50 pm

Information Fusion in Cognitive Robotics

Session Chairs: **Damian M. Lyons,** Fordham Univ.; **D. Paul Benjamin,** Pace Univ.

A relaxed fusion of information from real and synthetic images to predict complex behavior, Damian M. Lyons, Fordham Univ. (USA); D. Paul Benjamin, Pace Univ. (USA) . . . . . [8064-08]

Inner rehearsal modeling for cognitive robotics, Jerome J. Braun, Karianne Bergen, Timothy J. Dasey, MIT Lincoln Lab. (USA) . . . . . [8064-09]

The perception problem in robotics, Troy D. Kelley, U.S. Army Research Lab. (USA) . . . . . [8064-10]

A motion writing based on perceptograms and its use in motor skill transfer, Adrian Stoica, Jet Propulsion Lab. (USA) . . . . . [8064-11]

Panel Discussion. . . . . Wed. 4:50 to 5:50 pm

Panel Moderator: **Jerome J. Braun,** MIT Lincoln Lab.

Thursday 28 April

SESSION 4 . . . . . Thurs. 9:00 to 10:20 am

Information Fusion Approaches and Algorithms III

Session Chairs: **D. Paul Benjamin,** Pace Univ.; **Jerome J. Braun,** MIT Lincoln Lab.

A hidden Markov model for multimodal biometrics score fusion, Yufeng Zheng, Alcorn State Univ. (USA) . . . . . [8064-12]

INFORM Lab: a testbed for high-level information fusion and resource management, Pierre Valin, Adel Guitouni, Eloi Bossé, Defence Research and Development Canada (Canada); Hans W. Wehn, Jens Happe, MacDonald, Dettwiler and Associates Ltd. (Canada) . . . . . [8064-13]

Multisensor remote sensing information fusion for urban area classification and change detection, Gintautas Palubinskas, Aliaksei Makarau, Peter Reinartz, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [8064-14]

Metrics for the selection of frequency bands from hyperspectral data for image fusion and sensor development, Jack E. Fulton, Jr., Naval Surface Warfare Ctr. Crane Div. (USA) . . . . . [8064-15]

SESSION 5 . . . . . Thurs. 10:50 to 11:50 am

Information Fusion Approaches and Algorithms IV

Session Chairs: **Michael Heizmann,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Mirela Popa,** General Dynamics Armament and Technical Products

Fusion of chemical, biological, and meteorological observations for agent source term estimation and hazard refinement, Paul E. Bieringer, National Ctr. for Atmospheric Research (USA). . . . . [8064-16]

Implementation and testing of a sensor-netting algorithm for early warning and high confidence C/B threat detection, Thomas C. Gruber, Jr., Larry B. Grim, Ryan A. Fauth, Brian M. Tercha, MESH, Inc. (USA) . . . . . [8064-17]

Fusion of disparate spectra for chemical identification, Christian P. Minor, Nova Research, Inc. (USA); Kevin Johnson, Heather Brooke, U.S. Naval Research Lab. (USA) . . . . . [8064-18]

Lunch/Exhibition Break . . . . . 11:50 am to 1:20 pm

SESSION 6 . . . . . Thurs. 1:20 to 3:00 pm

Image Fusion

Session Chairs: **Mirela Popa,** General Dynamics Armament and Technical Products; **Pierre Valin,** Defence Research and Development Canada (Canada)

Learned fusion operators based on matrix completion, Charles F. Hester, Kelly K. Dobson, U.S. Army Aviation and Missile Command (USA) . . . . . [8064-19]

Mask pyramid methodology for enhanced localization in image fusion and enhancement, David C. Zhang, Gooitzen S. van der Wal, Sek Chai, David Berends, Azhar A. Sufi, Greg Buchanan, Michael Piacentino, Peter J. Burt, Sarnoff Corp. (USA) . . . . . [8064-20]

GStreamer as a framework for image processing applications in image fusion, Stephen D. Burks, Joshua M. Doe, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [8064-21]

Ultrasonic flaw imaging exploiting multipath information, Xizhong Shen, Shanghai Institute of Technology (China) and Villanova Univ. (USA); Yimin D. Zhang, Ramazan Demirli, Moeness G. Amin, Villanova Univ. (USA). . . . . [8064-22]

A classification-based image fusion scheme using wavelet transform, Xiaoyan Luo, Jun Zhang, BeiHang Univ. (China); Qionghai Dai, Tsinghua Univ. (China) . . . . . [8064-23]

SESSION 7 . . . . . Thurs. 3:30 to 4:30 pm

Information Fusion Applications and Systems

Session Chairs: **Charles F. Hester,** U.S. Army Research, Development and Engineering Command; **Michael Heizmann,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

Songs of cyberspace: an update on sonifications of network traffic to support situational awareness, Mark Ballora, Nicklaus A. Giacobe, David L. Hall, The Pennsylvania State Univ. (USA) . . . . . [8064-24]

Secure data aggregation in WSN-based border surveillance systems, Suat Ozdemir, Gazi Univ. (Turkey). . . . . [8064-25]

Multisource information fusion for logistics, Robert Woodley, Plamen V. Petrov, Warren Noll, 21st Century Systems, Inc. (USA) . . . . . [8064-26]

POSTERS-THURSDAY . . . . . Thurs. 6:00 to 7:30 pm

All symposium attendees are invited to attend the poster sessions. Come view the high-quality papers that are presented in this alternative format, and interact with the poster author who will be available for discussion. Enjoy light refreshments while networking with colleagues in your field. Attendees are required to wear their conference registration badges to the poster sessions.

Fusion of spaceborne AIS and SAR with iterative expansion assignment for maritime surveillance, Alex Wang, Snezana Mitrovic-Minic, MacDonald, Dettwiler and Associates Ltd. (Canada) . . . . . [8064-27]

Augmenting information fusion using search engines as sensors, Eric McMillan, The Pennsylvania State Univ. (USA) . . . . . [8064-28]

Course of Related Interest

SC994 **Multisensor Data Fusion for Object Detection, Classification and Identification** (Klein) Tuesday, 8:30 am to 5:30 pm

See full course listing and descriptions on pp. 144-192.

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IR Sensors and Systems

Monday 25 April	Tuesday 26 April	Wednesday 27 April	Thursday 28 April	Friday 29 April
SC713 **Engineering Approach to Imaging System Design** *(Holst)* 8:30 am to 5:30 pm, $530 / $620, p. 152	SC950 **Infrared Imaging Radiometry** *(Richards)* 8:30 am to 5:30 pm, $480 / $570, p. 156	SC1035 **Military Laser Safety** *(Marshall)* 8:30 am to 5:30 pm, $480 / $570, p. 157 NEW	SC755 **Infrared Optics and Zoom Lenses** *(Mann)* 8:30 am to 12:30 pm, $320 / $370, p. 152 NEW	SC154 **Electro-Optical Imaging System Performance** *(Holst)* 8:30 am to 5:30 pm, $560 / $650, p. 149
SC278 **Infrared Detectors** *(Dereniak)* 8:30 am to 12:30 pm, $385 / $435, p. 151	SC892 **Infrared Search and Track Systems** *(Schwering)* 8:30 am to 5:30 pm, $480 / $570, p. 154	SC947 **Cost-Conscious Tolerancing of Optical and IR Systems** *(Youngworth, Contreras)* 8:30 to 5:30 pm, $480 / $570, p. 155	SC067 **Testing and Evaluation of E-O Imaging Systems** *(Holst)* 8:30 am to 5:30 pm, $560 / $650, p. 149	SC789 **Introduction to Optical and Infrared Sensor Systems** *(Shaw)* 8:30 am to 5:30 pm, $480 / $570, p. 153
SC835 **Infrared Systems - Technology & Design** *(Daniels)* 8:30 am to 5:30 pm, $1035 / $1255, p. 153			SC659 **Understanding Reflective Optical Design** *(Contreras)* 8:30 am to 5:30 pm, $480 / $570, p. 151	
SC178 **Introduction to Radiometry and Photometry** *(Grant)* 8:30 am to 12:30 pm, $390 / $440, p. 150	SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** *(Vollmerhausen)* 8:30 am to 5:30 pm, $520 / $610, p. 150			
SC900 **Uncooled Thermal Imaging Detectors and Systems** *(Hanson)* 8:30 am to 5:30 pm, $520 / $610, p. 154	SC838 **Laser Range Gated Imaging Techniques** *(Duncan)* 1:30 to 5:30 pm, $275 / $325, p. 154			
SC152 **Infrared Focal Plane Arrays** *(Dereniak, Hubbs)* 1:30 to 5:30 pm, $275 / $325, p. 149	SC214 **Infrared Window and Dome Materials** *(Harris)* 8:30 am to 5:30 pm, $545 / $635, p. 151			
SC1000 **Introduction to Infrared and Ultraviolet Imaging Technology** *(Richards)* 1:30 to 5:30 pm, $310 / $360, p. 156				
SC944 **The Radiometry Case Files** *(Grant)* 1:30 to 5:30 pm, $350 / $400, p. 155				

Defense, Homeland Security, and Law Enforcement

SC719 **Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies** *(Gardner)* 8:30 am to 12:30 pm, $275 / $325, p. 157		SC1035 **Military Laser Safety** *(Marshall)* 8:30 am to 5:30 pm, $480 / $570, p. 160 NEW	SC952 **Applications of Detection Theory** *(Carrano)* 8:30 am to 5:30 pm, $480 / $570, p. 158	SC1034 **Lab-on-a-Chip Technology - Towards Portable Detection Systems** *(Gärtner)* 8:30 am to 12:30 pm, $275 / $325, p. 159 NEW
SC954 **Scanning Microscopy in Forensic Science** *(Platek, Trimpe, McVicar, Postek)* 8:30 am to 5:30 pm, $480 / $570, p. 158 NEW			SC995 **Target Detection Algorithms for Hyperspectral Imagery** *(Nasrabadi)* 8:30 am to 5:30 pm, $480 / $570, p. 159	

Daily Course Schedule

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Imaging and Sensing

SC713 **Engineering Approach to Imaging System Design** *(Holst)* 8:30 am to 5:30 pm, $530 / $620, p. 162	SC950 **Infrared Imaging Radiometry** *(Richards)* 8:30 am to 5:30 pm, $480 / $570, p. 165	SC157 **MTF in Optical and Electro-Optical Systems** *(Ducharme)* 8:30 am to 5:30 pm, $520 / $610, p. 161	SC952 **Applications of Detection Theory** *(Carrano)* 8:30 am to 5:30 pm, $480 / $570, p. 165	SC154 **Electro-Optical Imaging System Performance** *(Holst)* 8:30 am to 5:30 pm, $560 / $650, p. 161
SC178 **Introduction to Radiometry and Photometry** *(Grant)* 8:30 am to 12:30 pm, $390 / $440, p. 166	SC838 **Laser Range Gated Imaging Techniques** *(Duncan)* 1:30 to 5:30 pm, $275 / $325, p. 163	SC194 **Multispectral and Hyperspectral Image Sensors** *(Lomheim)* 8:30 am to 12:30 pm, $275 / $325, p. 162	NEW SC1033 **Optical Phased Array Technologies and Systems** *(Probst, McManamon)* 8:30 am to 5:30 pm, $480 / $570, p. 167	SC789 **Introduction to Optical and Infrared Sensor Systems** *(Shaw)* 8:30 am to 5:30 pm, $480 / $570, p. 163
SC1000 **Introduction to Infrared and Ultraviolet Imaging Technology** *(Richards)* 1:30 to 5:30 pm, $310 / $360, p. 156	SC946 **Super Resolution in Imaging Systems** *(Bagheri, Javidi)* 8:30 to 5:30 pm, $480 / $570, p. 164	SC947 **Cost-Conscious Tolerancing of Optical and IR Systems** *(Youngworth, Contreras)* 8:30 to 5:30 pm, $480 / $570, p. 165	SC995 **Target Detection Algorithms for Hyperspectral Imagery** *(Nasrabadi)* 8:30 am to 5:30 pm, $480 / $570, p. 166	
NEW SC1031 **Radar Micro-Doppler Signatures - Principles and Applications** *(Chen, Tahmoush)* 1:30 to 5:30 pm, $275 / $325, p. 167			SC067 **Testing and Evaluation of E-O Imaging Systems** *(Holst)* 8:30 am to 5:30 pm, $560 / $650, p. 160	
SC944 **The Radiometry Case Files** *(Grant)* 1:30 to 5:30 pm, $350 / $400, p. 164				

Laser Sensors and Systems

SC167 **Introduction to Laser Radar** *(Kamerman)* 8:30 am to 12:30 pm, $275 / $325, p. 168	SC1032 **Direct Detection Laser Radar Systems for Imaging Applications** *(Richmond, Cain)* 8:30 am to 5:30 pm, $525 / $615, p. 171	NEW SC1035 **Military Laser Safety** *(Marshall)* 8:30 am to 5:30 pm, $480 / $570, p. 172	SC188 **Laser Beam Propagation for Applications in Laser Communications, Laser Radar, and Active Imaging** *(Phillips, Andrews)* 8:30 am to 5:30 pm, $610 / $700, p. 169	
SC168 **Advanced Coherent Laser Radars Design and Applications** *(Kamerman)* 1:30 to 5:30 pm, $275 / $325, p. 168	SC160 **Precision Stabilized Pointing and Tracking Systems** *(Hilkert)* 8:30 am to 5:30 pm, $480 / $570, p. 168	NEW SC1036 **Diode Pumped Alkali Lasers** *(Perram)* 1:30 to 5:30 pm, $275 / $325, p. 173	NEW SC1033 **Optical Phased Array Technologies and Systems** *(Probst, McManamon)* 8:30 am to 5:30 pm, $480 / $570, p. 172	
NEW SC1031 **Radar Micro-Doppler Signatures - Principles and Applications** *(Chen, Tahmoush)* 1:30 to 5:30 pm, $275 / $325, p. 171	SC838 **Laser Range Gated Imaging Techniques** *(Duncan)* 1:30 to 5:30 pm, $275 / $325, p. 169	SC997 **High Power Laser Beam Quality** *(Ross)* 1:30 to 5:30 pm, $275 / $325, p. 170	SC995 **Target Detection Algorithms for Hyperspectral Imagery** *(Nasrabadi)* 8:30 am to 5:30 pm, $480 / $570, p. 170	
		SC947 **Cost-Conscious Tolerancing of Optical and IR Systems** *(Youngworth, Contreras)* 8:30 to 5:30 pm, $480 / $570, p. 169		

Sensor Data and Information Exploitation

NEW SC1031 **Radar Micro-Doppler Signatures - Principles and Applications** *(Chen, Tahmoush)* 1:30 to 5:30 pm, $275 / $325, p. 175	SC994 **Multisensor Data Fusion for Object Detection, Classification and Identification** *(Klein)* 8:30 am to 5:30 pm, $550 / $640, p. 174	NEW SC1035 **Military Laser Safety** *(Marshall)* 8:30 am to 5:30 pm, $480 / $570, p. 176	SC158 **Fundamentals of Automatic Target Recognition** *(Sadjadi)* 8:30 am to 5:30 pm, $480 / $570, p. 173	
	SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** *(Vollmerhausen)* 8:30 am to 5:30 pm, $520 / $610, p. 174	SC194 **Multispectral and Hyperspectral Image Sensors** *(Lomheim)* 8:30 am to 12:30 pm, $275 / $325, p. 174	SC995 **Target Detection Algorithms for Hyperspectral Imagery** *(Nasrabadi)* 8:30 am to 5:30 pm, $480 / $570, p. 175	

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Signal, Image, and Neural Net Processing

SC066 **Fundamentals of Electronic Image Processing** *(Weeks)* 8:30 am to 5:30 pm, $550 / $640, p. 176	SC994 **Multisensor Data Fusion for Object Detection, Classification and Identification** *(Klein)* 8:30 am to 5:30 pm, $550 / $640, p. 178		SC952 **Applications of Detection Theory** *(Carrano)* 8:30 am to 5:30 pm, $480 / $570, p. 177	
	SC946 **Super Resolution in Imaging Systems** *(Bagheri, Javidi)* 8:30 to 5:30 pm, $480 / $570, p. 177		SC995 **Target Detection Algorithms for Hyperspectral Imagery** *(Nasrabadi)* 8:30 am to 5:30 pm, $480 / $570, p. 178	

Sensing for Industry, Environment, and Health

SC719 **Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies** *(Gardner)* 8:30 am to 12:30 pm, $275 / $325, p. 179			SC952 **Applications of Detection Theory** *(Carrano)* 8:30 am to 5:30 pm, $480 / $570, p. 179	SC1034 **Lab-on-a-Chip Technology - Towards Portable Detection Systems** *(Gärtner)* 8:30 am to 12:30 pm, $275 / $325, p. 180 NEW
			SC995 **Target Detection Algorithms for Hyperspectral Imagery** *(Nasrabadi)* 8:30 am to 5:30 pm, $480 / $570, p. 180	

Information Systems and Networks: Processing, Fusion, and Knowledge Generation

	SC994 **Multisensor Data Fusion for Object Detection, Classification and Identification** *(Klein)* 8:30 am to 5:30 pm, $550 / $640, p. 181		SC952 **Applications of Detection Theory** *(Carrano)* 8:30 am to 5:30 pm, $480 / $570, p. 181	

Innovative Defense and Security Applications for Displays

		SC159 **Head-Mounted Displays: Design and Applications** *(Melzer, Browne)* 8:30 am to 5:30 pm, $515 / $605, p. 182		

Unmanned, Robotic, and Layered Systems

		SC996 **Introduction to GPS Receivers** *(Zhu)* 8:30 am to 12:30 pm, $275 / $325, p.183	SC952 **Applications of Detection Theory** *(Carrano)* 8:30 am to 5:30 pm, $480 / $570, p. 183	
		SC549 **Incorporating GPS Technology into Commercial and Military Applications** *(Zhu)* 1:30 to 5:30 pm, $275 / $325, p. 182		

Daily Course Schedule

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Emerging Technologies

				SC1034 **Lab-on-a-Chip Technology - Towards Portable Detection Systems** *(Gärtner)* 8:30 am to 12:30 pm, $275 / $325, p. 184 NEW

Scanning Microscopy and Forensics

SC954 **Scanning Microscopy in Forensic Science** *(Platek, Trimpe, McVicar, Postek)* 8:30 am to 5:30 pm, $480 / $570, p. 184 NEW				

Optical and Optomechanical Engineering

SC156 **Basic Optics for Engineers** *(Ducharme)* 8:30 am to 5:30 pm, $520 / $610, p. 186	SC950 **Infrared Imaging Radiometry** *(Richards)* 8:30 am to 5:30 pm, $480 / $570, p. 189	SC014 **Introduction to Optomechanical Design** *(Vukobratovich)* 8:30 am to 5:30 pm, $890 / $1110, p. 185		
SC010 **Introduction to Optical Alignment Techniques** *(Ruda)* 8:30 am to 5:30 pm, $890 / $1110, p. 185		SC220 **Optical Alignment Mechanisms** *(Guyer)* 8:30 am to 12:30 pm, $275 / $325, p. 186	SC755 **Infrared Optics and Zoom Lenses** *(Mann)* 8:30 am to 12:30 pm, $320 / $370, p. 188 NEW	
SC178 **Introduction to Radiometry and Photometry** *(Grant)* 8:30 am to 12:30 pm, $390 / $440, p. 186	WS609 **Basic Optics for Non-Optics Personnel** *(Harding)* 1:30 to 4:00 pm, $100 / $150, p. 190	SC781 **Optomechanical Analysis** *(Hatheway)* 8:30 am to 5:30 pm, $480 / $570, p. 188	SC254 **Integrated Opto-Mechanical Analysis** *(Genberg, Doyle)* 8:30 am to 5:30 pm, $530 / $620, p. 187	
SC1000 **Introduction to Infrared and Ultraviolet Imaging Technology** *(Richards)* 1:30 to 5:30 pm, $310 / $360, p. 190		SC947 **Cost-Conscious Tolerancing of Optical and IR Systems** *(Youngworth, Contreras)* 8:30 to 5:30 pm, $480 / $570, p. 189	SC659 **Understanding Reflective Optical Design** *(Contreras)* 8:30 am to 5:30 pm, $480 / $570, p. 187	
SC944 **The Radiometry Case Files** *(Grant)* 1:30 to 5:30 pm, $350 / $400, p. 188				

Business & Professional Development

	WS951 **Leading Successful Product Innovation** *(Carrano)* 8:30 am to 12:30 pm, $275 / $325, p. 192	WS933 **Complying with the ITAR: A Case Study** *(Scarlott)* 8:30 am to 12:30 pm, $275 / $325, p. 191	WS1037 **Advanced Topics in U.S. International Trade Regulations** *(Scarlott)* 8:30 am to 12:30 pm, $275 / $325, p. 191 NEW	
	WS609 **Basic Optics for Non-Optics Personnel** *(Harding)* 1:30 to 4:00 pm, $100 / $150, p. 192			

Sign up today
Course fees increase after 8 April 2011

IR Sensors and Systems

Testing and Evaluation of E-O Imaging Systems

SC067

Course level: Advanced
CEU .65 Member $560 / Non-member $650 USD
Thursday 8:30 am to 5:30 pm

This course describes all the quantitative and qualitative metrics that are used to characterize imaging system performance. While this course highlights thermal imaging systems, the concepts are generic and can be applied to all imaging systems (CCDs, intensified CCDs, CMOS, and near IR cameras). Data analysis techniques are independent of the sensor selected (i.e., wavelength independent). The difference lies in the input variable name (watts, lumens, or delta-T) and the output variable name (volts, lumens, or observer response). Slightly different test methodologies are used for visible and thermal imaging systems. Performance parameters discussed include resolution, responsivity, aperiodic transfer function, slit response function, random noise, uniformity, fixed pattern noise, modulation transfer function (MTF), contrast transfer function (CTF), minimum resolvable temperature (MRT), and the minimum resolvable contrast (MRC). The eye's spatial and temporal integration allows perception of images whose signal-to-noise ratio (SNR) is less than unity. Since all imaging system spatially sample the scene, sampling artifacts occur in all imagery and therefore affects all measurements. Sampling can significantly affect MRT and MTF tests. Low SNR and sampling effects are interactively demonstrated. This course describes the most common testing techniques. Equally important is identifying those parameters that adversely affect results.

LEARNING OUTCOMES

This course will enable you to:
- write concise test procedures with unambiguous system specifications
- identify all appropriate test parameters
- describe the radiometric relationship between delta-T and spectral radiance
- differentiate between observer variability and system response during MRC and MRT testing
- describe the difference between the CTF and the MTF
- learn about the latest MTF measurement techniques
- discern the difference between poor system performance, peculiarities of the system under test, and measurement errors
- assess how sampling affects test results
- appreciate the benefits and short comings of fully automated testing
- identify parameters that can lead to poor results.
- learn about evolving standardized testing concepts

INTENDED AUDIENCE

The course is for managers, specification writers, and test engineers involved with all phases of imaging system characterization ranging from satisfying customer requirements to ensuring that specifications are unambiguous and testable.

INSTRUCTOR

Gerald Holst is an independent consultant for imaging system analysis and testing. He was a technical liaison to NATO, research scientist for DoD, and a member of the Lockheed-Martin senior technical staff. Dr. Holst has chaired the SPIE conference Infrared Imaging Systems: Design, Analysis, Modeling and Testing since 1989. He is author of over 30 journal articles and 6 books (published by SPIE and/or JCD Publishing). Dr. Holst is a member of OSA and is a SPIE Fellow.

COURSE PRICE INCLUDES the text *Testing and Evaluation of Infrared Imaging Systems, Third Edition* (SPIE Press and JCD Publishing, 2008) by Gerald C. Holst.

Infrared Focal Plane Arrays

SC152

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Monday 1:30 to 5:30 pm

The course presents a fundamental understanding of two-dimensional arrays applied to detecting the infrared spectrum. The physics and electronics associated with 2-D infrared detection are stressed with special emphasis on the hybrid architecture unique to two-dimensional infrared arrays.

LEARNING OUTCOMES

This course will enable you to:
- develop the building blocks of 2-D arrays
- explain charge transfer concepts of various architectures
- describe various input electronics circuits
- discuss testing techniques used in the IR for 2-D arrays
- provide an overview of current technologies
- demonstrate aliasing effects
- review room temperature arrays
- discuss dual band arrays

INTENDED AUDIENCE

This material is intended for engineers, scientists and project managers who need to learn more about two-dimensional IR arrays from a user's point of view. It gives the student insight into the optical detection process, as well as what is available to application engineers, advantages, characteristics and performance.

INSTRUCTORS

Eustace Dereniak is a Professor of Optical Sciences and Electrical and Computer Engineering at the University of Arizona, Tucson, AZ. His research interests are in the areas of detectors for optical radiation, imaging spectrometers and imaging polarimeters instrument development. Dereniak is a co-author of several textbooks and has authored book chapters. His publications also include over 100 authored or co-authored refereed articles. He spent many years in industrial research with Raytheon, Rockwell International, and Ball Brothers Research Corporation. He has taught extensively and is a Fellow of the SPIE and OSA, and a member of the Board of Directors of SPIE.

John Hubbs is an engineer with Ball Aerospace and Technologies.

Electro-Optical Imaging System Performance

SC154

Course level: Intermediate
CEU .65 Member $560 / Non-member $650 USD
Friday 8:30 am to 5:30 pm

While this course highlights thermal imaging systems, the concepts are generic and can be applied to all imaging systems (CCDs, intensified CCDs, CMOS, and near IR cameras). System analysis could be performed in the spatial domain. However, it is far easier to work in the frequency domain using MTFs. Subsystem MTFs are combined for overall system analysis. This is often called image chain modeling. Although the math is sometimes complex, the equations are graphed for easy understanding. With the Sept 2002 models (e.g., NVTherm), the minimum resolvable temperature (MRT) and minimum resolvable contrast (MRC) are coupled with the target signature and atmospheric transmittance to provide range performance predictions (target acquisition modeling). Three ranges are predicted: detection, recognition, and identification (often shorten to DRI). DRI ranges depend upon the subsystem MTFs, noise (primarily random and fixed pattern noise), the display, and the eye's response. The two-dimensional (fictitious) spatial frequency approach, three-dimensional noise model, and target discrimination metrics (Johnson's N50) are applied to performance predictions. The 2007 models (e.g., NVThermIP) employ contrast rather than MRT (MRC) for

target acquisition and use V50 as a discrimination metric. Limitations and applications of NVTherm and NVThermIP are discussed with a brief demonstration of the models. Selection and optimization of a specific sensor depends upon a myriad of radiometric, spectral, and spatial parameters (e.g., target signature, atmospheric conditions, optics f-number, field-of-view, and detector responsivity). MTFs and their effect on imagery are interactively demonstrated. Spatial sampling is present in all cameras. Super-resolution reconstruction and microscan minimize sampling artifacts. Several optimization examples are discussed (case study examples).

LEARNING OUTCOMES

This course will enable you to:
- use the correct MTFs for image chain analysis
- describe the radiometric relationship between delta-T and spectral radiance
- compare the differences among scanning, staring, and microscan staring array performance
- recognize the limitations of back-of-the-envelope approximations such as resolution and sensitivity
- identify the subsystem (e.g., motion, optics, detector, electronics, and display) that limits performance
- appreciate limitations of range performance predictions (target acquisition predictions)
- determine if mid-wave (MWIR) or long-wave (LWIR) infrared is appropriate for your application
- appreciate the value of graphs rather than a table of numbers
- be conversant with the myriad of technological terms
- become a smart buyer, analyst, and/or user of imaging systems

INTENDED AUDIENCE

This course is intended for engineers, managers, and buyers who want to understand the wealth of information available from imaging system end-to-end analysis. It is helpful if the students are familiar with linear system theory (MTF analysis).

INSTRUCTOR

Gerald Holst is an independent consultant for imaging system analysis and testing. He was a technical liaison to NATO, research scientist for DoD, and a member of the Lockheed-Martin senior technical staff. Dr. Holst has chaired the SPIE conference Infrared Imaging Systems: Design, Analysis, Modeling and Testing since 1989. He is author of over 30 journal articles and 6 books (published by SPIE and/or JCD Publishing). Dr. Holst is a member of OSA and is a SPIE Fellow.

COURSE PRICE INCLUDES the text *Electro-Optical Imaging System Performance, Fifth Edition* (SPIE Press and JCD Publishing, 2008) by Gerald C. Holst.

Introduction to Radiometry and Photometry

SC178

Course level: Introductory
CEU .35 Member $390 / Non-member $440 USD
Monday 8:30 am to 12:30 pm

In this half-day course the basic quantities of radiometry, their units, and their relationships to electro-magnetic field quantities are presented. Photometry, its units, and conversion factors to older units are also addressed. The course covers the fundamentals of blackbody radiation generation and transfer. The basic equations needed to set up and solve problems are discussed.

The course introduces radiometric and photometric sources, detectors of optical radiation, instrumentation, and calibration. The supplementary textbook, *Introduction to Radiometry and Photometry* by Ross McCluney, is provided with the course and offers more detail in detector optical/ electrical characterization, color theory, and optical properties of specific materials.

This course is an ideal lead-in to SC944 The Radiometry Case Files, which provides many applied examples of the concepts introduced here.

LEARNING OUTCOMES

This course will enable you to:
- learn the methodology used for quantifying and describing electromagnetic radiation from the extreme UV through the visible portions of the spectrum and into the far IR
- become conversant with the concepts, terminology, and units of both radiometry and photometry
- master key radiometric laws and approximations
- master the basics of photometry, the system of terminology and units used whenever the eye is the detector
- describe the characterization of optical properties of surfaces, materials, and objects
- gain insight into the design and calibration of radiometers and photometers

INTENDED AUDIENCE

This course is for engineers and scientists who deal with electromagnetic radiation who need to quantify this radiation using international standard units and terminology. The course is for teachers, students, and researchers interested in using proper methods, terminology, symbols, and units in their courses and their research work. It is also for practitioners solving problems in radiation transfer, and in measuring radiant and luminous flux in optical systems and in nature.

INSTRUCTOR

Barbara Grant is the co-author, with Jim Palmer, of *The Art of Radiometry*. For more than twenty years she has applied her engineering skills to solve problems in industries as diverse as aerospace and indoor tanning. A consultant in electro-optics, she received the M.S. degree in Optical Sciences from the University of Arizona and two NASA awards for her work on the GOES weather satellite imager and sounder. Her previous work for SPIE includes developing and chairing a special session on FLIR image analysis.

COURSE PRICE INCLUDES the text *Introduction to Radiometry and Photometry* (Artech House, 1994) by Ross McCluney.

Predicting Target Acquisition Performance of Electro-Optical Imagers

SC181

Course level: Advanced
CEU .65 Member $520 / Non-member $610 USD
Tuesday 8:30 am to 5:30 pm

This course describes how to predict and evaluate electro-optical (EO) imager performance. Metrics that quantify imager resolution are described. The detection, recognition, and identification tasks are discussed, and the meaning of acquisition probabilities is explained. The basic theory of operation of thermal imagers, image intensifiers, and video cameras is presented. This course describes how to quantify the resolution and noise characteristics of an EO imager. The theory and analysis of sampled imagers is emphasized. Image quality metrics are described, and the relationship between image quality and target acquisition performance is explained. The course provides a complete overview of how to analyze and evaluate the performance of EO imagers.

LEARNING OUTCOMES

This course will enable you to:
- describe what a target acquisition model does
- describe the operation of thermal sensors, video cameras and other EO imagers
- analyze the impact of sampling on targeting performance
- evaluate the targeting performance of an EO imager

INTENDED AUDIENCE

This course is intended for the design engineer or system analyst who is interested in quantifying the performance of EO imagers. Some background in linear systems analysis is helpful but not mandatory.

INSTRUCTOR

Richard Vollmerhausen recently retired from the Army's Night Vision and Electronic Sensors Directorate. He is currently consulting. Mr. Vollmerhausen is the developer of the current generation of target acquisition models used by the Army.

COURSE PRICE INCLUDES the text *Analysis of Sampled Imaging Systems* (SPIE Press, 2010) by Richard H. Vollmerhausen, Ronald G. Driggers, and Don Reago.

Infrared Window and Dome Materials

SC214

CEU .65 Member $545 / Non-member $635 USD
Tuesday 8:30 am to 5:30 pm

This course presents an overview of the optical, thermal and mechanical characteristics of infrared-transmitting window and dome materials. Other topics include thermal shock response, rain and particle erosion, protective coatings, antireflection coatings, electromagnetic shielding, proof testing, and fabrication of optical ceramics. The course concludes with a brief discussion of sapphire and diamond as infrared materials.

LEARNING OUTCOMES

This course will enable you to:
- identify the optical, thermal and mechanical characteristics of a window material that are critical to its selection for a particular application
- predict optical, thermal and mechanical performance of window materials under a range of conditions, based on tabulated data
- compare the strengths and weaknesses of different materials and different coatings for a given application
- describe the principal methods by which optical ceramics are manufactured

INTENDED AUDIENCE

The course is directed at engineers, scientists, managers and marketing personnel who need an introduction to properties, performance, and manufacture of windows and domes. A basic degree in engineering or science is the expected background, but care will be taken to provide introductory background information for each topic.

INSTRUCTOR

Daniel C. Harris is a Senior Scientist at the Naval Air Warfare Center, China Lake, California, where he directs programs in optical materials.

COURSE PRICE INCLUDES the text Materials for Infrared Windows and Domes (SPIE Press, 1999) by Daniel Harris. ***Attendees should bring a calculator to this course.***

Infrared Detectors

SC278

Course level: Introductory
CEU .35 Member $385 / Non-member $435 USD
Monday 8:30 am to 12:30 pm

This course will provide a broad and useful background on optical detectors, both photon and thermal, with a special emphasis placed on the infrared detectors. Discussion of optical detection will be stressed. The fundamentals of responsivity (RI), noise equivalent power (NEPI) and specific detectivity (D*) will be discussed. These figures of merit will be extended to photon noise limited performance and Johnson noise limitations (RA product). Discussion of optical detector fundamentals will be stressed. To aid the attendee in selecting the proper detector choice, the detailed behavior of the more important IR detector materials will be described in detail. Newer technologies such as quantum well infrared photodetectors and blocked impurity bands as well as IR detectors will be covered briefly.

LEARNING OUTCOMES

This course will enable you to:
- understand optical radiation detection processes
- explain noise mechanisms related to optical detectors
- derive figures of merit for optical detectors
- compare BLIP condition to RA product performance
- evaluate and discuss HgCdTe detectors' unique features
- understand why room temperature thermal detectors are so important
- derive the wavelength dependence of detectors

INTENDED AUDIENCE

This class is directed at people who need to learn more about optical detectors from a user point of view. It will give the student insight into the optical detection process as well as what is available to application engineers, advantages, shortcomings, and pitfalls.

INSTRUCTOR

Eustace Dereniak is a Professor of Optical Sciences and Electrical and Computer Engineering at the Univ. of Arizona, Tucson, Arizona. His research interests are in the areas of detectors for optical radiation, imaging spectrometers and imaging polarimeters instrument development. Dereniak is a co-author of several textbooks and has authored book chapters. His publications also include over 100 authored or co-authored refereed articles. He spent many years in industrial research with Raytheon, Rockwell International, and Ball Brothers Research Corporation. He has taught extensively and is a Fellow of the SPIE and OSA, and a member of the Board of Directors of SPIE.

COURSE PRICE INCLUDES the text *Infrared Detectors and Systems* (Wiley, 1996) by E. L. Dereniak and G. D. Boreman.

Understanding Reflective Optical Design

SC659

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

This course provides attendees with a working knowledge of reflective optical system design. The morning session concentrates on analytical differences from refractive systems, including basic 1st order layout considerations and optimization techniques. It provides an overview of the conceptual development of various reflective designs, and provides an understanding of the basic capabilities, advantages and disadvantages of many common reflective forms. The afternoon session offers insights into departing from symmetry, understanding aberration forms with off axis apertures, a discussion of segmented mirror systems, and a brief overview of assembly and test considerations and manufacturing techniques.

LEARNING OUTCOMES

This course will enable you to:
- develop and analyze the appropriate set of 1st order parameters for reflective systems
- identify the advantages and constraints of various common reflective forms
- list analysis parameters unique to reflective system design
- trace the logical progression of reflective system from the single to multiple mirrors
- establish reasonable starting point layouts for 3 mirror design forms
- identify situations that may call for departing from symmetry in the design and understand the advantages and limitations of this technique
- recognize aberration forms in off-axis apertures and how to mitigate them
- classify the basic advantages and constraints of designs with segmented mirrors
- identify key strategies for integration I&T of reflective architectures
- describe fundamental manufacturing techniques and considerations, including diamond turning methods and mirror material properties

INTENDED AUDIENCE

This material is intended for anyone who needs to design or specify reflective optical systems, or who works with optical designers on a regular basis. A basic understanding of 1st order optics is helpful; a brief overview will be provided. No optical design experience is required, but a basic knowledge of optical aberrations will be assumed for the optical design specific discussions. The more in depth, design oriented portions of the course will include summary information valuable to engineers in non-optical disciplines. Those who have either little optical design experience or just minimal reflective design experience will find this course especially valuable.

INSTRUCTOR

James Contreras is a principal optical engineer at Exotic Electro-Optics, a subsidiary of II-VI Incorporated in Murrieta, CA. He has extensive experience in the design, analysis and fabrication of reflective optical systems for a variety of applications ranging from military platforms to the James Webb Space Telescope. His current projects include conceptual optical design of multiple wavelength band sensors for military and commercial applications, design for manufacturability of existing products, and investigation of replicated mirror technologies.

Engineering Approach to Imaging System Design

SC713

Course level: Intermediate
CEU .65 Member $530 / Non-member $620 USD
Monday 8:30 am to 5:30 pm

This course discusses the three popular approaches to electro-optical imaging system design: spatial resolution, sensitivity (signal-to-noise ratio), and modulation transfer function (MTF) analysis. While often evaluated individually, all three must be considered to optimize system design. Usually, the dominant MTFs in machine vision devices are image motion (including random vibration of the sensor), optics (including aberrations), and the detector. For man-in-the-loop operation, the display and the eye are of concern and, in many situations, these limit the overall system performance.

Equally important, but often neglected is sampling; an inherent feature of all electronic imaging systems. Sampling, which creates blocky images are particularly bothersome with periodic targets such as test targets and bar codes. An engineering approach is taken. This course will provide numerous practical design examples (case studies) to illustrate the interplay between subsystem MTFs, resolution, sensitivity, and sampling.

LEARNING OUTCOMES

This course will enable you to:
- use approximations; often called 'rules-of-thumb,' or 'back-of-the-envelope' analysis
- identify the subsystem components that affect resolution and sensitivity
- determine if your system is resolution or sensitivity limited
- equivalently determine if your system is detector-limited or optics-limited
- determine which subsystem limits system performance and why
- understand sampling artifacts (Nyquist frequency limit, aliasing, Moiré patterns, and variations in object edge location and width)
- use MTFs, resolution, sensitivity, and sampling concepts for system optimization
- understand the trade-off between MTF and aliasing

INTENDED AUDIENCE

The course is for managers, system designers, test engineers, machine vision specialists, and camera users who want the best performance from their systems. It is helpful if the students are familiar with linear system theory (MTF analysis).

INSTRUCTOR

Gerald Holst is an independent consultant for imaging system analysis and testing. He was a technical liaison to NATO, research scientist for DoD, and a member of the Lockheed-Martin senior technical staff. Dr. Holst has chaired the SPIE conference *Infrared Imaging Systems: Design, Analysis, Modeling and Testing* since 1989. He is author of over 30 journal articles and 6 books (published by SPIE and/or JCD Publishing). Dr. Holst is a member of OSA and IEEE and is a SPIE Fellow.

COURSE PRICE INCLUDES the text *Holst's Practical Guide to Electro-Optical Systems* (JCD Publishing, 2003) by Gerald C. Holst.

Infrared Optics and Zoom Lenses

SC755

Course level: Intermediate
CEU .35 Member $320 / Non-member $370 USD
Thursday 8:30 am to 12:30 pm

This course describes the fundamental properties of the infrared region of the spectrum and explains the techniques involved in the design and analysis of representative infrared zoom lenses. The use of computer optimization is discussed with examples to illustrate the step-by-step development of any optical system and zoom lenses in particular. It gives attendees an insight into zoom lens characteristics in general and the design and analysis process involved in developing an infrared zoom lens system. Civil and military applications are discussed which match the optics with infrared detectors and sensors. Recent trends include the advent of focal plane arrays and the shift to the near infrared spectral region. 32 refractive zoom lens systems and 9 representative reflective zoom systems are presented, along with many new diagrams.

LEARNING OUTCOMES

After completing this course, attendees will be able to:
- describe the fundamental properties of zoom lenses as to whether they are mechanically or optically compensated and with regard to positive or negative moving groups
- describe the relevant issues that are unique to the infrared region of the spectrum, including sources, detectors, CCD arrays, optical materials, athermalization, narcissus, and coatings
- gain an insight into the optical design techniques utilized in the design of infrared zoom lenses, including achieving high magnification ratios, achromatization, aberration control, the use of aspherics and diffractive optical elements, compactness techniques, computer optimization, global search, scaling, and tolerances
- classify infrared zoom lenses according to their application: scanning telescopes, target simulators, surveillance systems, target recognition, battlefield detection, imaging systems, solar observatories, laser beam expanders, and cell phone cameras
- establish requirements for your particular application
- decide whether a given zoom lens optical system meets your requirements and matches the capabilities of the detector

INTENDED AUDIENCE

This course is for engineers and scientists interested in learning more about the infrared region of the spectrum and about infrared zoom lenses and their applications.

INSTRUCTOR

Allen Mann has over forty years' experience in the design and analysis of optical systems, including visual and infrared zoom lenses. Mr. Mann has written several papers on the subject of infrared zoom lenses and is the editor for the SPIE Milestone Volume on Zoom Lenses. He was chairman of SPIE Zoom Lens Conference I and co-chair of Zoom Lens Conference II. He is retired from Hughes Aircraft Company and is now an independent consultant. Mr. Mann has been elected to be a Fellow of SPIE.

COURSE PRICE INCLUDES the text *Infrared Optics and Zoom Lenses, Second Edition* (SPIE, 2009) by Allen Mann.

Introduction to Optical and Infrared Sensor Systems

SC789

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Friday 8:30 am to 5:30 pm

This course provides a broad introduction to optical (near UV-visible) and infrared sensor systems, with an emphasis on systems used in defense and security. Topics include both passive imagers and active laser radars (lidar/ladar). We begin with a discussion of radiometry and radiometric calculations to determine how much optical power is captured by a sensor system. We survey atmospheric propagation and phenomenology (absorption, emission, scattering, and turbulence) and explore how these issues affect sensor systems. Finally, we perform signal calculations that consider the source, the atmosphere, and the optical system and detector, to arrive at a signal-to-noise ratio for typical passive and active sensor systems. These principles of optical radiometry, atmospheric propagation, and optical detection are combined in examples of real sensors studied at the block-diagram level. Sensor system examples include passive infrared imagers, polarization imagers, and hyperspectral imaging spectrometers, and active laser radars (lidars or ladars) for sensing distributed or hard targets. The course organization is approximately one third on the radiometric analysis of sensor systems, one third on atmospheric phenomenology and detector parameters, and one third on example calculations and examination of sensor systems at the block-diagram level.

LEARNING OUTCOMES

This course will enable you to:
- understand and use radiometry for describing and calculating the flow of optical energy in an optical or infrared sensor system
- determine the radiometric throughput of sensor systems
- describe atmospheric phenomenology relevant to propagation of optical and infrared radiation
- explain how the atmosphere affects the performance of sensor systems
- use detector parameters with radiometric calculations to predict the signal received by passive and active sensors
- calculate signal-to-noise ratio for typical sensor systems
- understand real-world sensor systems at the block-diagram level
- explain the difference between and important concepts of passive reflection-based and emission-based imaging
- understand the basic operating principles of passive imagers and active laser radar (lidar/ladar) systems for distributed and solid target sensing

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who find themselves working on (or curious about) optical (uv-vis) and infrared sensor systems without formal training in this area. Undergraduate training in engineering or science is assumed.

INSTRUCTOR

Joseph Shaw has been developing optical remote sensing systems and using them in environmental and military sensing for two decades, first at NOAA and currently as professor of electrical engineering and physics at Montana State University. Recognition for his work in this field includes NOAA research awards, a Presidential Early Career Award for Scientists and Engineers, and the World Meteorological Organization's Vaisala Prize. He earned a Ph.D. in Optical Sciences at the University of Arizona. Dr. Shaw is a Fellow of both the OSA and SPIE.

Infrared Systems - Technology & Design

SC835

Course level: Advanced
CEU 1.30 $1035 / Non-member $1255 USD
Monday 8:30 am to 5:30 pm

This course covers the range of topics necessary to understand the theoretical principles of modern infrared-technology. It combines numerous engineering disciplines necessary for the development of infrared systems. Practical engineering calculations are highlighted, with examples of trade studies illustrating the interrelationships among the various hardware characteristics.

This course is comprised of four sections:

Section 1 introduces the geometrical optics concepts including image formation, stops and pupils, thick lenses and lens combinations, image quality, and the properties of infrared materials.

Section 2 covers the essentials of radiometry necessary for the quantitative understanding of infrared signatures and flux transfer. These concepts are then developed and applied to flux-transfer calculations for blackbody, graybody, and selective radiator sources. Remote temperature calibrations and measurements are then used as an illustration of these radiometric principles.

Section 3 is devoted to fundamental background issues for optical detection-processes. It compares the characteristics of cooled and uncooled detectors with an emphasis on spectral and blackbody responsivity, detectivity (D*), as well as the noise mechanisms related to optical detection. The detector parameters and capabilities of single detectors and third generation focal plane arrays (FPAs) are analyzed.

With this acquired background, Section 4 considers the systems-design aspects of infrared imagers. The impact of scan format on signal-to-noise ratio is described, and the engineering tradeoffs inherent in the development of infrared search and track (IRST) systems are explained. Figures of merit such as MTF, NETD, and MRTD of staring arrays are examined for the performance metrics of thermal sensitivity and spatial resolution of thermal imaging systems (TIS). Contrast threshold functions based on Johnson and visible cycles (often denoted as N- and V-cycles) are specified. The interrelationships among the design parameters are identified through trade-study examples.

LEARNING OUTCOMES

This course will enable you to:
- learn the principles and fundamentals of infrared optical design
- choose the proper infrared materials suite for your applications
- quickly execute flux-transfer calculations
- calibrate infrared sources and target signatures
- recognize the importance of background in thermal signatures
- have an appreciation for the capacity of infrared systems and learn the interaction of its critical components (optics, detectors, and electronics) in the production of a final infrared image
- assess the influence of noise mechanisms related to optical detection
- comprehend the fundamental response mechanisms and differences between cooled and uncooled single detectors as well as focal plane arrays (FPAs)
- comprehend the central theory behind third generation infrared imagers
- define and use common descriptors for detector and system performance (R, D*, NEP, NEI, MTF, NETD, and MRTD)
- estimate system performance given subsystem and component specifications
- apply design tradeoffs in both infrared search and track systems (IRST) and thermal-imaging systems (TIS)
- carry out the preliminary design of infrared systems for different thermal applications

INTENDED AUDIENCE

This course is directed to the practicing engineers and/or scientists who require both theoretical and effective practical technical information to design, build, and/or test infrared systems in a wide variety of thermal applications. A background at the bachelor's level in engineering is high-

ly recommended. The participant should also have ample understanding of Fourier analysis and random processes.

INSTRUCTOR

Arnold Daniels is a senior lead engineer with extensive experience in the conceptual definition of advance infrared, optical, and electro-optical systems. His background consists of technical contributions to applications for infrared search & track, thermal imaging, and ISR systems. Other technical expertise include infrared radiometry (testing and measurements), infrared test systems (i.e., MTF, NETD, and MRTD), thermographic nondestructive testing (TNDT), optical design, precision optical alignment, stray light analysis, adaptive optics, Fourier analysis, image processing, and data acquisition systems. He earned an M.S. in Electrical Engineering from the University of Tel-Aviv and a doctorate in Electro-Optics from the School of Optics (CREOL) at the University of Central Florida. In 1995 he received the Rudolf Kingslake medal and prize for the most noteworthy original paper to appear in SPIE's Journal of Optical Engineering. He is presently developing direct energy laser weapon systems for defense applications.

COURSE PRICE INCLUDES the *Field Guide to Infrared Systems, Detectors, and FPAs, 2nd Edition* by Arnold Daniels (SPIE, 2010) and *Infrared Detectors and Systems* (Wiley, 1996) by Eustace L. Dereniak and Glenn D. Boreman.

Laser Range Gated Imaging Techniques

SC838

Course level: Intermediate
CEU .35 Member $275 / Non-member $325 USD
Tuesday 1:30 to 5:30 pm

This course provides attendees with a detailed background in the benefits and applications of laser gated imaging, also known as Burst Illumination Ladar (BIL). This technique covers the use of laser illumination in conjunction with focal plane arrays to improve the ability to detect and identify objects across a wide range of scenarios. The course concentrates on the components involved in such a system, the phenomena that are unique to laser illumination, and the performance one can expect from laser illuminated sensing. Practical examples to demonstrate the benefits and limitations of these systems will be covered. At the end of this course, you will be knowledgeable in the types of sources and sensors that can be used and the image processing that can be applied to optimize the system performance.

LEARNING OUTCOMES

This course will enable you to:
- compare the advantages and limitations of laser gated imaging systems
- describe various components within a laser gated imaging system
- compare the relative merits of gated detector technologies
- identify the parameters that influence system performance in resolution, SNR and laser characteristics
- analyze range performance predictions for different laser gated imaging systems
- judge atmospheric effects and their mitigation in laser illuminated imaging

INTENDED AUDIENCE

Engineers, scientists and managers who want to improve their understanding of the use of laser illumination for improved imaging techniques and the benefits of gated sensors. No background in laser gated imaging is assumed, although some familiarity with basic concepts of imaging systems will be advantageous.

INSTRUCTOR

Stuart Duncan is Chief Technical Officer with SELEX Sensors and Airborne Systems in the United Kingdom and has been involved in Electro Optic System Design and Integration for over 24 years. He is a Masters graduate from Imperial College, London.

Infrared Search and Track Systems

SC892

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Tuesday 8:30 am to 5:30 pm

This short course provides an overview of the role that Infrared Search and Track systems (IRST) can provide in the protection of military and non-military platforms. All system aspects will be discussed, including the definition of the threat and associated scenarios, requirements, target signatures, background- and atmospheric effects, sources of false alarm, sensor design, signal processing algorithms, range performance, test and evaluation, situational awareness, sensor fusion. The applications include the defense of compounds, vehicles, helicopters, planes and ships as they are used in peace keeping and peace-enforcing operations. The threat includes small arms weapons, rocket propelled grenades, missiles, unmanned aerial vehicles, small surface targets, operating in complex, such as littoral, environments. The course provides quantitative analysis of target, background and atmospheric effects on IRSTs, and comparisons of different kinds of test measurement data.

LEARNING OUTCOMES

This course will enable you to:
- describe the relationship between the various system design aspects of IRST systems and the performance requirements
- know how to design a modern IRST sensor for a given set of requirements for a specific application
- make trade-offs between and optimize the choice of the various sensor parameters for minimum false alarm rate and maximum signal to clutter ratio
- have knowledge of how to test and evaluate IRST sensors and system concepts with realistic threats in a realistic environment

INTENDED AUDIENCE

Scientists, engineers, technicians, users and managers involved in the defense of military platforms. Undergraduate level of knowledge on physics, optics, electronics and signal processing is recommended.

INSTRUCTOR

Piet Schwering is senior scientist in the electro-optics department of TNO Defense, Security and Safety (Netherlands). He has 25 years of experience in infrared sensors for various applications and has been active in the development and testing of IRST systems for more than 20 years, and is well experienced in associated field trials on land and at sea. He has participated and chaired NATO Task Groups and participated in EDA joint projects. In the last decade he has presented numerous papers on IRST related topics with emphasis on system concepts, backgrounds, and signal processing. At present he is leading the TNO program for the development of electro-optics techniques for the next generation IRST.

Uncooled Thermal Imaging Detectors and Systems

SC900

Course level: Intermediate
CEU .65 Member $520 / Non-member $610 USD
Monday 8:30 am to 5:30 pm

The success of uncooled infrared imaging in commercial and military markets has greatly increased the number of participants in the field, and, consequently, the variety of products available and in development. The intent of this course is to provide attendees a broad view of the field as well as an in-depth look at important technologies. The course describes the fundamentals of uncooled IR imaging arrays, emphasizing resistive bolometric and ferroelectric/pyroelectric detectors, but also including a number of innovative technologies such as thermally activated cantilevers, thin films with temperature-dependent optical transmission properties, and thermal-capacitive detectors. Students will learn the fundamentals of uncooled IR sensors, how the various technologies operate, the merits and deficiencies of the different technologies, quantitative

metrics for evaluating and comparing performance, and how key factors influence those metrics. The course also explores the limits of performance of uncooled IR imaging, as well as trends to be expected in future products.

LEARNING OUTCOMES

This course will enable you to:
- describe the operation of uncooled IR detectors and basic readout circuits
- evaluate performance in terms of responsivity, noise, noise equivalent temperature difference, minimum resolvable temperature, and response time
- gauge the fundamental limits to their performance, including temperature-fluctuation noise and background fluctuation noise
- compare theory with measured performance of the uncooled arrays
- evaluate practical issues and limitations of current technology
- ascertain the state of development of new IR technologies by asking the right questions
- differentiate well-developed concepts from ill-conceived notional concepts
- identify the uncooled IR technology best suited to your needs
- assess the performance potential of novel IR imaging technologies
- evaluate quantitatively the performance of a wide variety of uncooled IR detectors
- summarize construction details from the technical literature.

INTENDED AUDIENCE

This material is intended for engineers, scientists, and managers who need a background knowledge of uncooled IR technologies, for those who need to be able to evaluate those technologies for usefulness in particular applications, and for those working in the field who wish to deepen their knowledge and understanding. Anyone concerned with current and future directions in thermal imaging or involved in the development of IR detector technology or advanced uncooled IR system concepts will find this course valuable. The course has a significant mathematical content designed to illustrate the origin of the principles involved, but knowledge of the mathematics is not required to understand the concepts and results.

INSTRUCTOR

Charles Hanson has a Ph.D. in theoretical solid-state physics and is the CTO for Infrared Products at L-3 Communications Electro-Optical Systems. He has held government and industrial positions in infrared imaging for more than 40 years. He is a past chairman of Military Sensing Symposia (MSS) Passive Sensors and is presently a member of the SPIE Infrared Technology and Applications program committee.

COURSE PRICE INCLUDES the text *Uncooled Thermal Imaging Arrays, Systems, and Applications* (SPIE Press, 2001) by Paul Kruse.

The Radiometry Case Files

SC944

Course level: Introductory
CEU .35 Member $350 / Non-member $400 USD
Monday 1:30 to 5:30 pm

This course takes basic radiometric principles and applies them to calculate the amount of radiation reaching a system's entrance aperture or focal plane for a variety of source-system combinations. It provides a wide array of examples from which solutions to related problems may be drawn. It encompasses the UV, visible, and infrared regions of the electromagnetic spectrum, and includes several cases taken directly from the instructor's industrial experience.

Typical applications to be addressed include solar and overcast sky irradiance, IR system calibration, tanning lamp output, lighting illumination, sensor signals from specular and diffuse reflectors, star detection on orbit, solar simulators and integrating spheres.

LEARNING OUTCOMES

This course will enable you to:
- identify approaches to problem-solving based on source and geometry considerations
- calculate the amount of light received from single and multiple sources
- determine the effects of source material properties on calculations
- apply atmospheric and system spectral response characteristics to solution formulation
- operate a radiation slide rule
- qualify the limitations of your solution

INTENDED AUDIENCE

This class is designed for the practicing engineer or technologist who is expected to solve radiometric problems but is unsure what factors to identify in formulating a solution, or where to locate examples of similar problems. Though taught at an introductory level, the course assumes a basic familiarity with radiometric terminology.

INSTRUCTOR

Barbara Grant is the co-author, with Jim Palmer, of *The Art of Radiometry*. For more than twenty years she has applied her engineering skills to solve problems in industries as diverse as aerospace and indoor tanning. A consultant in electro-optics, she received the M.S. degree in Optical Sciences from the University of Arizona and two NASA awards for her work on the GOES weather satellite imager and sounder. Her previous work for SPIE includes developing and chairing a special session on FLIR image analysis.

COURSE PRICE INCLUDES the text *The Art of Radiometry* (SPIE Press, 2009) by James M. Palmer and Barbara G. Grant.

Cost-Conscious Tolerancing of Optical and IR Systems

SC947

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Wednesday 8:30 to 5:30 pm

The purpose of this course is to present concepts, tools, and methods that will help attendees determine optimal tolerances for opto-mechanical systems in optical applications. Detailed topics in the course apply to all volumes of systems being developed - from single systems to millions of units. The importance of tolerancing throughout the design process is discussed in detail, including determining robustness of the specification and design for manufacture and operation. The course also provides a background to effective tolerancing with discussions on variability and relevant applied statistics. A treatment of third-order aberrations is included, with emphasis on understanding their origins and how to influence cost and production yield by considering their impacts. Tolerance analysis and assignment with strong methodology and examples are discussed, including the development of a design trade for a simple IR system. References and examples are included to help researchers, designers, engineers, and technicians practically apply the concepts to plan, design, engineer, and build high-quality cost-competitive optical systems.

LEARNING OUTCOMES

This course will enable you to:
- identify key system requirements for tolerancing
- develop insight into cost and sensitivity factors early in the design process
- define variability and comprehend its impact on nominal systems
- utilize fundamental applied statistics in tolerancing
- construct tolerance analysis budgets
- perform detailed tolerance analysis
- summarize different design of experiment and statistical process control strategies

INTENDED AUDIENCE

This material is intended for managers, engineers, and technical staff involved in product design from concept through manufacturing.

INSTRUCTORS

Richard Youngworth Ph.D. is the Director of Optical Engineering at Light Capture, Inc., an optical and optomechanical design firm providing consulting, innovation incubation, and product development services. His industrial experience spans diverse topics including optical metrology, design, manufacturing, and analysis. In particular, Dr. Youngworth has spent significant time working on optical systems in the challenging transition from ideal design to successful volume manufacturing. He is widely considered an expert, due to his research, lectures, publications, and industrial work on the design, producibility, and tolerance analysis of optical components and systems. He has a B.S. in electrical engineering from the University of Colorado at Boulder and earned his Ph.D. in optics at the University of Rochester by researching tolerance analysis of optical systems.

James Contreras is a Principal Optical Engineer at Exotic Electro-Optics in Murrieta, CA, where he serves as the project lead for all optomechanical assembly projects. He has extensive experience in the design, analysis and fabrication of reflective and refractive optical systems for a variety of applications ranging from tactical military platforms to the James Webb Space Telescope. His primary expertise is in reflective and IR optical design, specializing in design for manufacturability. He is actively involved in teaching for SPIE and mentoring junior engineers. He was trained in Physics at Rensselaer Polytechnic Institute (B.S.) and the Georgia Institute of Technology (M.S.); the majority of his career has been in the defense and aerospace industry at companies such as Hughes Aircraft Company and Ball Aerospace Corp.

Infrared Imaging Radiometry

SC950

Course level: Advanced
CEU .65 Member $480 / Non-member $570 USD
Tuesday 8:30 am to 5:30 pm

This course will enable the user to understand how an infrared camera system can be calibrated to measure radiance and/or temperature and how the digital data is converted into radiometric data. The user will learn how to perform their own external, “by hand” calibrations on a science-grade infrared camera system using area or cavity blackbodies and an Excel spreadsheet provided by the instructor. The influences of lenses, ND and bandpass filters, windows, emissivity, reflections and atmospheric absorption on the system calibration will be covered. The instructor will use software to illustrate these concepts and will show how to measure emissivity using an infrared camera and how to predict system performance outside the calibration range.

LEARNING OUTCOMES

This course will enable you to:
- classify the measurement units of radiometry and thermography
- describe infrared camera transfer functions - electrical signal output versus radiance signal input
- determine which cameras, lenses and both cold and warm filters to select for your application
- assess effects of ND filters and bandpass filters on calibrations, and calculate which ND warm filter you need for a given temperature range of target
- perform radiometric calibration of camera systems using cavity and area blackbodies
- convert raw data to radiometric data, and convert radiometric data to temperatures
- measure target emissivity and calibrate emissivity into the system
- gauge and account for reflections and atmospheric effects on measurements

INTENDED AUDIENCE

This material is intended for engineers, scientists, graduate students and range technicians that are working with science-grade infrared cameras in the lab, on military test ranges, or similar situations.

INSTRUCTOR

Austin Richards is a senior research scientist at FLIR Commercial Vision Systems in Santa Barbara, and has specialized in scientific applications of infrared imaging technology for over 9 years. He holds a Ph.D. in astrophysics from UC Berkeley and is the author of the SPIE monograph *Alien Vision: Exploring the Electromagnetic Spectrum with Imaging Technology*.

Introduction to Infrared and Ultraviolet Imaging Technology

SC1000

Course level: Introductory
CEU .35 Member $310 / Non-member $360 USD
Monday 1:30 to 5:30 pm

The words infrared and ultraviolet are coming into much more widespread use, as ideas about the technology penetrates the public’s awareness and becomes part of popular culture through TV and film. In industry and academia, applications for infrared and ultraviolet cameras are multiplying rapidly, because both of the continued reduction in system cost as the technology penetrates the commercial marketplace, and the forward march of technology. At the same time, there is a fairly limited body of information about applications for these cameras. This is because camera manufacturers tend focus on the products themselves, not applications, and because most textbooks on IR and UV technology are outdated and tend to emphasize the basics of radiometry and detection by single detectors, not imaging applications.

This course gives a non-technical overview of commercial infrared and ultraviolet camera systems, the “taxonomy” of infrared and ultraviolet wavebands, and the wide variety of applications for these wavebands. The course relies heavily on interesting imagery captured by the presenter over the last ten years and uses a SPIE monograph written by the author as a supplementary textbook.

LEARNING OUTCOMES

This course will enable you to:
- identify the different wavebands of the infrared and ultraviolet spectrum and describe their differences
- gain familiarity with the different types of cameras, sensors and optics used for imaging in the infrared and ultraviolet wavebands
- describe some of the key imaging applications for different wavebands of the infrared and ultraviolet

INTENDED AUDIENCE

The course is suitable both for technology professionals and non-technical persons that are new to infrared and ultraviolet imaging and want a very basic, qualitative overview of the fields with minimal mathematics. Little to no mathematic background is required.

INSTRUCTOR

Austin Richards is a senior research scientist at FLIR Systems in Santa Barbara, CA. He holds a PhD in Astrophysics from UC Berkeley, and has worked in the commercial infrared industry for over 10 years. He is also the CTO of Oculus Photonics, a small company devoted to near-ultraviolet imaging systems manufacturing, sales and support. Richards is the author of the SPIE monograph *Alien Vision: Exploring the Electromagnetic Spectrum with Imaging Technology* and an adjunct professor at the Brooks Institute of Photography in Santa Barbara.

COURSE PRICE INCLUDES the text *Alien Vision: Exploring the Electromagnetic Spectrum with Imaging Technology* (SPIE Press, 2001) by Austin A. Richards.

Military Laser Safety

SC1035

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Wednesday 8:30 am to 5:30 pm

This course explains the basic hazards associated with the use of lasers commonly encountered by military and law enforcement personnel, with particular emphasis on operation in an outdoor environment. Both laser classification and certification of laser products will be covered. The Department of Defense has an exemption from the Food and Drug Administration that allows manufacturers to produce military specific laser devices not available to the general public. The rules for using the Department of Defense exemption or obtaining a variance to purchase these special purpose products are explained.

LEARNING OUTCOMES

This course will enable you to:

- describe how a laser could cause personal injury to either the eye or skin
- describe how laser exposure limits were developed
- describe visual interference levels
- describe nominal ocular hazard distance and nominal skin hazard distance
- list differences in laser classification according to the:
  - Food and Drug Administration (FDA),
  - International Electrotechnical Commission (IEC), and
  - American National Standards Institute (ANSI)
- describe eye protection specifications for glasses and filters, such as optical density and visual transmission
- classify military applications of lasers, such as range finding, designating targets, dazzling
- manufacture and sell a federally compliant laser product
- learn the origin of the military exemption - 76 EL-01 DOD
- know whether your product meets the criteria for a military specific product
- know what features are required for a military specific product
- purchase a military specific laser product from a manufacturer
- dispose of a military specific laser product that has been manufactured under 76 EL-01 DOD
- evaluate the variance process for making a product not fully in compliance with federal product performance standards
- request evaluation of a system designed for joint military service use

INTENDED AUDIENCE

Engineers, scientists, technicians and managers involved in the development of laser-based defense related products who need to understand the regulatory process for certifying these devices. Military and civilian personnel, involved in operations, range safety, and procurement, who want to understand the safety issues involved with the field use of lasers.

INSTRUCTOR

Wesley Marshall has been involved with military laser safety for almost 40 years and has been involved with the development of laser safety standards and military products. He has evaluated hundreds of military specific laser systems and has published dozens of articles in peer reviewed technical journals. He has taught laser safety courses for the US Army, Occupational Safety and Health Administration, North Atlantic Treaty Organization, Laser Institute of America, and Rockwell Laser Industries. For over three years, he served as manager for the Army Institute of Health Laser/Optical Radiation Program (formerly known as CHPPM).

Defense, Homeland Security, and Law Enforcement

Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies

SC719

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Monday 8:30 am to 12:30 pm

This course introduces chemical and biological detection and identification techniques which are commonly utilized for military and civil applications. Remote and sampled detection, discrimination, and identification techniques are introduced with design parameters and performance models. A sampling of specific technology applications for chemical point, chemical standoff, biological point, and biological standoff sensing will be described. These technologies include Mass Spectrometry, Ion Mobility Spectrometry, Raman Spectroscopy, Fourier Transform Infrared Spectroscopy, Differential Absorption Lidar, Laser-Induced Fluorescence, Laser-Induced Breakdown Spectroscopy and others. The course will include a brief overview of chemical and biological agents and features which may be interrogated by detection systems.

LEARNING OUTCOMES

This course will enable you to:

- list and analyze chemical/biological detection and discrimination techniques
- describe the trade space for point and standoff detection
- estimate spatial, spectral, and temporal variations in chemical/biological media
- formulate fundamental design and performance equations for chemical/biological sensors
- compare mass and mobility techniques for point detection
- compare active and passive techniques for standoff detection

INTENDED AUDIENCE

This course is intended for those interested in the design and development of chemical and biological sensors for applications ranging from military to industrial sensing. It is an overview course with a survey of a broad class of sensing techniques. Mathematical models for the various sensors will be presented and discussed; however, this course does not require an in-depth understanding of the mathematical principles to appreciate the technological benefits of the various approaches. Some background in electro-optical and infrared systems is helpful, but not required.

INSTRUCTOR

Patrick Gardner is a program manager for the Charles Stark Draper Laboratory. He received a B.S. from the University of Florida and a M.S. and Ph.D. in Electrical Engineering from the Air Force Institute of Technology. He is a retired Lt. Colonel, U.S. Air Force, with 25 years of active-duty service. He was assigned to the U.S. Special Operations Command as a technical liaison officer for both the U.S. Air Force and the U.S. Dept. of Energy. Following active duty he served as Chief Scientist for General Dynamics ATP, Chemical & Biological Detection and Countermeasures. He is an adjunct professor for the electrical engineering department at Western Carolina University and regularly teaches professional short courses in chemical and biological detection for Georgia Tech University and others.

The information contained in this written material was developed from a compilation of sources available in the open literature. The information delivered in written and oral form does not represent the official position or interests of, or endorsement by any Federal or state departments or affiliated agencies. Specific vendor products are used as representative examples only and are not intended as critiques or endorsements of specific products and technologies.

Applications of Detection Theory

SC952

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

The fundamental goal of this course is to enable you to assess and explain the performance of sensors, detectors, diagnostics, or any other type of system that is attempting to give, with some level of confidence, a determination of the presence or absence of a "target." In this case the term "target" may be a wide variety of types (e.g. a biological pathogen or chemical agent; or a physical target of some sort; or even just some electronic signal). We will rigorously cover the theory and mathematics underlying the construction of the "Receiver Operating Characteristic" (ROC) curve, including dichotomous test histograms, false positives, false negatives, sensitivity, specificity, and total accuracy. In addition, we will discuss in depth the theory behind "Decision Tree Analysis" culminating with an in class exercise. Decision tree analysis allows one to "fuse together" multivariate signals (or results) in such a manner as to produce a more accurate outcome than would have been attained with any one signal alone. This course includes two major in class exercises: the first will involve constructing a ROC curve from real data with the associated analysis; the second will involve constructing a complete decision tree including the new (improved) ROC curve. The first exercise will be ~30min in length, and the second will be ~60min.

LEARNING OUTCOMES

This course will enable you to:
- define false positives, false negatives and dichotomous test
- define sensitivity, specificity, limit-of-detection, and response time
- comprehend and analyze a dose-response curve
- construct and analyze a Receiver Operating Characteristic (ROC) curve from raw data
- define Positive Predictive Value (PPV) and Negative Predictive Value (NPV)
- analyze statistical data and predict results
- describe the process and theory underlying decision tree analysis
- construct and analyze a decision tree using real data
- construct a "Spider Chart" from system-level attributes
- interpret sensor performance trade-offs using a ROC curve

INTENDED AUDIENCE

This course designed for scientists, engineers, and researchers that are involved in sensor design and development, particular from the standpoint of complex data analysis. Application areas for which Detection Theory is most relevant includes biological detection, medical diagnostics, radar, multi-spectral imaging, explosives detection and chemical agent detection. A working knowledge of basic freshman-level statistics is useful for this course.

INSTRUCTOR

John Carrano is President of Carrano Consulting. Previously, he was the Vice President, Research & Development, Corporate Executive Officer, and Chairman of the Scientific Advisory Board for Luminex Corporation, where he led the successful development of several major new products from early conception to market release and FDA clearance. Before joining Luminex, Dr. Carrano was as a Program Manager at DARPA, where he created and led several major programs related to bio/chem sensing, hyperspectral imaging and laser systems. He retired from the military as a Lieutenant Colonel in June 2005 after over 24 years' service; his decorations include the "Defense Superior Service Medal" from the Secretary of Defense. Dr. Carrano is a West Point graduate with a doctorate in Electrical Engineering from the University of Texas at Austin. He has co-authored over 50 scholarly publications and has 3 patents pending. He is the former DSS Symposium Chairman (2006-2007), and is an SPIE Fellow.

COURSE PRICE INCLUDES a free PDF copy of the report, "Chemical and Biological Sensor Standards Study" (Principal author, Dr. John C. Carrano.)

Scanning Microscopy in Forensic Science

SC954

NEW

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Monday 8:30 am to 5:30 pm

This one day short course will be devoted to the use of scanning microscopies including scanning electron microscopy (SEM), scanning optical profilometry, and energy dispersive x-ray (EDS) and x-ray fluorescence (XRF) spectrometry to forensic sample analyses including counter terrorism, explosives, pyrotechnics, counterfeit drugs and food and product tampering. The course is presented in four sections. Section one will provide the students with an understanding of the value and pitfalls of relying on instrument software in the examination of varying samples types and analysis conditions. Emphasis will be place on issues of instrument quality assurance including calibration, operation and understanding your instrument's data and compliance with certification organizations including ISO and ASCLD/LAB. Section two will be devoted to a presentation of sample handling and preparation as well as "unknown white powder" case analyses and other cases involving counterfeit drugs, food and product tampering. Section three will cover the issues of gunshot residue (GSR) analysis and more "unknown white powder" analyses related to pyrotechnic devices and flares as well as a presentation on improvised acid/foil bombs. Section four will include additional approaches to the analyses of "unknown white powder" cases so common today, the capabilities of a forensic laboratory in supporting emergency responders, and a number of illustrative case histories. Additional topics may cover a Scientific Working Group on Gun Shot Residue (SWGGSR) update report and perspective on instant shooter GSR kits. This course will be jointly presented by four instructors, all recognized experts in their respective area of scanning microscopy and applications to forensic science.

LEARNING OUTCOMES

This course will enable you to:
- use a variety of techniques (many being very simple) to collect, isolate, and process suspect trace evidence particles and fibers for SEM/EDS analysis
- take back to your laboratory a number of effective tips and analytical approaches to small particle handling and analyses including the "unknown white powder"
- evaluate critical factors related to SEM/EDS calibration and how they relate to the accuracy of your measurements and subsequent analyses
- learn the state-of-the-art procedures in the analysis of GSR data by SEM/EDS
- learn the current guidelines in interpretation of GSR data
- relate and compare your personal analytical case work or quality control analyses to illustrated forensic cases and analytical approaches

INTENDED AUDIENCE

This course is directed at the laboratory analyst using scanning electron microscopy and energy dispersive x-ray spectrometry analyses as well as other types of scanning probe instrumentation in the analysis of trace evidence including unknown surfaces, individual particles, "unknown white powder" and gunshot residue. Individuals employed in other related fields including forensic laboratory accreditation, quality management, environmental sample and microchemical analyses will find this course beneficial. All analysts using SEM/EDS, regardless of their discipline, will find this course interesting and readily see how SEM/EDS analyses of forensic samples applies to many types of laboratory and environmental investigations.

INSTRUCTORS

S. Frank Platek is a Research Biologist in the Trace Examination Section of the U.S. FDA's Forensic Chemistry Center. Prior to his 20 years with the FDA, he served 15 years as a research biologist with the National Institute for Occupation Safety and Health (NIOSH) specializing in SEM/TEM/EDS analysis of fine particles and fibers. Since 1993, he has been a member of the editorial review board of the Journal SCANNING and chairperson for the Scanning Microscopy in Forensic Science Session

and course for the International SCANNING meeting. He has served as a national touring speaker for the Microbeam Analysis Society and the Microscopy Society of America. He lectures in Forensic Science Applications of SEM at the Lehigh University Microscopy School and has taught SEM/EDS analysis at Northern Kentucky University for over 30 years. He is a member of the American Academy of Forensic Science, Mid-Western Association of Forensic Science, Microscopy Society of America, and Microscopy Society of the Ohio River Valley.

Michael Trimpe has worked at the Hamilton County Coroner's Lab for 31 years. He is a Past President of the Midwestern Association of Forensic Scientists and received the Distinguished Scientist Award. He conducted the FBI GSR Symposium in 2005. He is the founder and chairman of the International Scientific Working Group for Gunshot Residue. He is a Fellow member of the American Academy of Forensic Sciences, and is the recipient of the Mary E. Cowen Award in the Criminalistics Section in 2010. His other scientific memberships include the European Network of Forensic Scientists, TWGFEX, and the International Association of Arson Investigators. Mr. Trimpe has taught the analysis of gunshot residue all over the country and has frequently been asked to speak at GSR Seminars all over the world.

Michael McVicar is an Assistant Section Head in the Chemistry Section of the Centre of Forensic Sciences (CFS) in Toronto, Canada. He has worked as a forensic chemist at the CFS for 24 years, reporting in trace evidence casework involving glass, paint, polymers, fire debris, building materials, metals, and gunshot residue. He has applied scanning electron microscopy to trace evidence examination for over 20 years. He is a member of the Scientific Working Group for Gunshot Residue, is the Chemistry Section Chair of the Canadian Society of Forensic Science, a Member of the Technical Advisory Committee to ASCLD/LAB, an invited speaker at the 2008 ENFSI Firearms/GSR meeting, an invited speaker at the 2006 Ontario Bar Association panel discussion on Gunshot Residue, and an invited speaker at the 2005 Osgoode Hall Law School Panel on "Best Practices for Collecting, Compiling and Communicating Expert Evidence." He was a presenter on the Forensic Applications of SEM at the 2006, 2007, and 2008 Scanning Conferences.

Michael Postek is the Chief of the Mechanical Metrology Division within the new National Institute of Standards and Technology (NIST) Physical Measurement Laboratory. Dr. Postek was the Assistant to the NIST Director for Nanotechnology and is both a nationally and internationally recognized expert in nanometrology and scanning electron microscope (SEM) critical dimension (CD) metrology.

Target Detection Algorithms for Hyperspectral Imagery

SC995

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

This course provides a broad introduction to the basic concept of automatic target and object detection and its applications in Hyperspectral Imagery (HSI). The primary goal of this course is to introduce the well known target detection algorithms in hyperspectral imagery. Examples of the classical target detection techniques such as spectral matched filter, subspace matched filter, adaptive matched filter, orthogonal subspace, support vector machine (SVM) and machine learning are reviewed. Construction of invariance subspaces for target and background as well as the use of regularization techniques are presented. Standard atmospheric correction and compensation techniques are reviewed. Anomaly detection techniques for HSI and dual band FLIR imagery are also discussed. Applications of HSI for detection of mines, targets, humans, chemical plumes and anomalies are reviewed.

LEARNING OUTCOMES

This course will enable you to:
- describe the fundamental concepts of target detection algorithms as applied to HSI
- learn the procedure to use the generalized maximum likelihood ratio test to design spectral detectors
- describe the fundamental differences between different detection algorithms based on their model representations
- develop statistical models as well as subspace models for HSI data
- explain the difference between anomaly detection and classification
- distinguish between linear and nonlinear approaches (SVM and Kernel learning techniques)
- develop anomaly detection techniques for different environmental scenarios
- describe linear models and unmixing techniques for abundance measures
- plot ROC curves to evaluate the performance of the algorithms

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to learn more about target detection in hyperspectral, multispectral or dual-band FLIR imagery. Undergraduate training in engineering or science is assumed.

INSTRUCTOR

Nasser Nasrabadi is a senior research scientist (ST) at US Army Research Laboratory (ARL). He is also an adjunct professor in the Electrical and Computer Engineering Department at the Johns Hopkins University. He is actively engaged in research in image processing, neural networks, automatic target recognition, and video compression and its transmission over high speed networks. He has published over 200 papers in journals and conference proceedings. He has been an associate editor for the IEEE Transactions on Image Processing,IEEE Transactions on Circuits and Systems for Video Technology and IEEE Transactions for Neural Networks. He is a Fellow of IEEE and SPIE.

Lab-on-a-Chip Technology - Towards Portable Detection Systems

SC1034

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Friday 8:30 am to 12:30 pm

The miniaturization of analytical systems ultimately targets sample-in/result-out systems for the complete analysis of biological samples. Besides the enhanced performance of those systems - namely combining sample preparation, biological reaction, and the detection itself in one device - miniaturization enables the construction of portable systems for on-site analysis of suspicious samples. This course will provide a broad overview of the underlying technologies enabling the realization of a miniaturized integrated biological lab. It starts with the history over two decades of microfluidics and goes on to describe the fabrication technologies for miniaturized devices.

The main focus is the application of microfluidic components in biotechnology (e.g. separation techniques, PCR, Lab-on-a-Chip etc.) and chemistry (e.g. micro reactors, micro mixers etc.), leading finally to the challenges in their use for mobile detection of biological pathogens. Guidelines for the efficient development of microfluidic devices for mobile detection of biological agents will be presented, based on the microfluidic tool box concept. Finally, some hands-on tests with microfluidic devices will give the attendee an opportunity to get in touch with this novel technology.

LEARNING OUTCOMES

This course will enable you to:
- describe the basic physical and chemical principles of microfluidics
- identify the most interesting microfluidic components and their challenging applications in chemistry and life sciences
- review current products and development issues
- efficiently design microfluidic devices based on the microfluidic toolbox concept
- have microfluidic components fabricated for your own application

INTENDED AUDIENCE

This course will be of value for engineers and researchers from industry and academia, business developers, general managers with a need to learn about novel technologies, potential investors in microtechnology / microfluidics and anyone who is interested in the realization, application or commercialization of microfluidic components.

INSTRUCTOR

Claudia Gärtner PhD studied chemistry and biology at the University of Duesseldorf, Germany. She obtained her PhD in biochemistry and became involved with microtechnologies at the Institute of Microtechnology Mainz (IMM). In 1999 she took over the position of the director of the newly founded Application Center for Microtechnology Jena, Germany (amt). She was involved in the founding of the biotechnology start-up "x-zyme" (2001) and the microfluidic company "microfluidic ChipShop" (2002). In 2002 she was nominated for the German Founders Prize and decorated with the Thuringian award for the best business concept for microfluidic ChipShop. In March 2006 Dr. Gaertner was named CEO for microfluidic ChipShop. She is involved in a wide variety of research projects in the field of lab-on-a-chip systems. Furthermore, she is leading several collaborative R&D aiming in the development of portable systems for the detection of B-agents.

Military Laser Safety

SC1035

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Wednesday 8:30 am to 5:30 pm

This course explains the basic hazards associated with the use of lasers commonly encountered by military and law enforcement personnel, with particular emphasis on operation in an outdoor environment. Both laser classification and certification of laser products will be covered. The Department of Defense has an exemption from the Food and Drug Administration that allows manufacturers to produce military specific laser devices not available to the general public. The rules for using the Department of Defense exemption or obtaining a variance to purchase these special purpose products are explained.

LEARNING OUTCOMES

This course will enable you to:
- describe how a laser could cause personal injury to either the eye or skin
- describe how laser exposure limits were developed
- describe visual interference levels
- describe nominal ocular hazard distance and nominal skin hazard distance
- list differences in laser classification according to the:
  - Food and Drug Administration (FDA),
  - International Electrotechnical Commission (IEC), and
  - American National Standards Institute (ANSI)
- describe eye protection specifications for glasses and filters, such as optical density and visual transmission
- classify military applications of lasers, such as range finding, designating targets, dazzling
- manufacture and sell a federally compliant laser product
- learn the origin of the military exemption - 76 EL-01 DOD
- know whether your product meets the criteria for a military specific product
- know what features are required for a military specific product
- purchase a military specific laser product from a manufacturer
- dispose of a military specific laser product that has been manufactured under 76 EL-01 DOD
- evaluate the variance process for making a product not fully in compliance with federal product performance standards
- request evaluation of a system designed for joint military service use

INTENDED AUDIENCE

Engineers, scientists, technicians and managers involved in the development of laser-based defense related products who need to understand the regulatory process for certifying these devices. Military and civilian personnel, involved in operations, range safety, and procurement, who want to understand the safety issues involved with the field use of lasers.

INSTRUCTOR

Wesley Marshall has been involved with military laser safety for almost 40 years and has been involved with the development of laser safety standards and military products. He has evaluated hundreds of military specific laser systems and has published dozens of articles in peer reviewed technical journals. He has taught laser safety courses for the US Army, Occupational Safety and Health Administration, North Atlantic Treaty Organization, Laser Institute of America, and Rockwell Laser Industries. For over three years, he served as manager for the Army Institute of Health Laser/Optical Radiation Program (formerly known as CHPPM).

Imaging and Sensing

Testing and Evaluation of E-O Imaging Systems

SC067

Course level: Advanced
CEU .65 Member $560 / Non-member $650 USD
Thursday 8:30 am to 5:30 pm

This course describes all the quantitative and qualitative metrics that are used to characterize imaging system performance. While this course highlights thermal imaging systems, the concepts are generic and can be applied to all imaging systems (CCDs, intensified CCDs, CMOS, and near IR cameras). Data analysis techniques are independent of the sensor selected (i.e., wavelength independent). The difference lies in the input variable name (watts, lumens, or delta-T) and the output variable name (volts, lumens, or observer response). Slightly different test methodologies are used for visible and thermal imaging systems. Performance parameters discussed include resolution, responsivity, aperiodic transfer function, slit response function, random noise, uniformity, fixed pattern noise, modulation transfer function (MTF), contrast transfer function (CTF), minimum resolvable temperature (MRT), and the minimum resolvable contrast (MRC). The eye's spatial and temporal integration allows perception of images whose signal-to-noise ratio (SNR) is less than unity. Since all imaging system spatially sample the scene, sampling artifacts occur in all imagery and therefore affects all measurements. Sampling can significantly affect MRT and MTF tests. Low SNR and sampling effects are interactively demonstrated. This course describes the most common testing techniques. Equally important is identifying those parameters that adversely affect results.

LEARNING OUTCOMES

This course will enable you to:
- write concise test procedures with unambiguous system specifications
- identify all appropriate test parameters
- describe the radiometric relationship between delta-T and spectral radiance
- differentiate between observer variability and system response during MRC and MRT testing
- describe the difference between the CTF and the MTF
- learn about the latest MTF measurement techniques
- discern the difference between poor system performance, peculiarities of the system under test, and measurement errors
- assess how sampling affects test results
- appreciate the benefits and short comings of fully automated testing
- identify parameters that can lead to poor results.
- learn about evolving standardized testing concepts

INTENDED AUDIENCE

The course is for managers, specification writers, and test engineers involved with all phases of imaging system characterization ranging from

satisfying customer requirements to ensuring that specifications are unambiguous and testable.

INSTRUCTOR

Gerald Holst is an independent consultant for imaging system analysis and testing. He was a technical liaison to NATO, research scientist for DoD, and a member of the Lockheed-Martin senior technical staff. Dr. Holst has chaired the SPIE conference Infrared Imaging Systems: Design, Analysis, Modeling and Testing since 1989. He is author of over 30 journal articles and 6 books (published by SPIE and/or JCD Publishing). Dr. Holst is a member of OSA and is a SPIE Fellow.

COURSE PRICE INCLUDES the text *Testing and Evaluation of Infrared Imaging Systems, Third Edition* (SPIE Press and JCD Publishing, 2008) by Gerald C. Holst.

Electro-Optical Imaging System Performance

SC154

Course level: Intermediate
CEU .65 Member $560 / Non-member $650 USD
Friday 8:30 am to 5:30 pm

While this course highlights thermal imaging systems, the concepts are generic and can be applied to all imaging systems (CCDs, intensified CCDs, CMOS, and near IR cameras). System analysis could be performed in the spatial domain. However, it is far easier to work in the frequency domain using MTFs. Subsystem MTFs are combined for overall system analysis. This is often called image chain modeling. Although the math is sometimes complex, the equations are graphed for easy understanding. With the Sept 2002 models (e.g., NVTherm), the minimum resolvable temperature (MRT) and minimum resolvable contrast (MRC) are coupled with the target signature and atmospheric transmittance to provide range performance predictions (target acquisition modeling). Three ranges are predicted: detection, recognition, and identification (often shorten to DRI). DRI ranges depend upon the subsystem MTFs, noise (primarily random and fixed pattern noise), the display, and the eye's response. The two-dimensional (fictitious) spatial frequency approach, three-dimensional noise model, and target discrimination metrics (Johnson's N50) are applied to performance predictions. The 2007 models (e.g., NVThermIP) employ contrast rather than MRT (MRC) for target acquisition and use V50 as a discrimination metric. Limitations and applications of NVTherm and NVThermIP are discussed with a brief demonstration of the models. Selection and optimization of a specific sensor depends upon a myriad of radiometric, spectral, and spatial parameters (e.g., target signature, atmospheric conditions, optics f-number, field-of-view, and detector responsivity). MTFs and their effect on imagery are interactively demonstrated. Spatial sampling is present in all cameras. Super-resolution reconstruction and microscan minimize sampling artifacts. Several optimization examples are discussed (case study examples).

LEARNING OUTCOMES

This course will enable you to:
- use the correct MTFs for image chain analysis
- describe the radiometric relationship between delta-T and spectral radiance
- compare the differences among scanning, staring, and microscan staring array performance
- recognize the limitations of back-of-the-envelope approximations such as resolution and sensitivity
- identify the subsystem (e.g., motion, optics, detector, electronics, and display) that limits performance
- appreciate limitations of range performance predictions (target acquisition predictions)
- determine if mid-wave (MWIR) or long-wave (LWIR) infrared is appropriate for your application
- appreciate the value of graphs rather than a table of numbers
- be conversant with the myriad of technological terms
- become a smart buyer, analyst, and/or user of imaging systems

INTENDED AUDIENCE

This course is intended for engineers, managers, and buyers who want to understand the wealth of information available from imaging system end-to-end analysis. It is helpful if the students are familiar with linear system theory (MTF analysis).

INSTRUCTOR

Gerald Holst is an independent consultant for imaging system analysis and testing. He was a technical liaison to NATO, research scientist for DoD, and a member of the Lockheed-Martin senior technical staff. Dr. Holst has chaired the SPIE conference Infrared Imaging Systems: Design, Analysis, Modeling and Testing since 1989. He is author of over 30 journal articles and 6 books (published by SPIE and/or JCD Publishing). Dr. Holst is a member of OSA and is a SPIE Fellow.

COURSE PRICE INCLUDES the text *Electro-Optical Imaging System Performance, Fifth Edition* (SPIE Press and JCD Publishing, 2008) by Gerald C. Holst.

MTF in Optical and Electro-Optical Systems

SC157

Course level: Introductory
CEU .65 Member $520 / Non-member $610 USD
Wednesday 8:30 am to 5:30 pm

Modulation transfer function (MTF)is used to specify the image quality achieved by an imaging system. It is useful in analysis of situations where several independent subsystems are combined. This course provides a background in the application of MTF techniques to performance specification, estimation and characterization of optical and electro-optical systems.

LEARNING OUTCOMES

This course will enable you to:
- list the basic assumptions of linear systems theory, including the concept of spatial frequency
- identify relationship between impulse response, resolution, MTF, OTF, PTF, and CTF
- estimate the MTF for both diffraction-limited and aberration-limited systems
- explain the relationship between MTF, line response, and edge response functions
- identify MTF contributions from finite detector size, crosstalk, charge transfer inefficiency, and electronics
- summarize the effects of noise

INTENDED AUDIENCE

Engineers, scientists, and managers who need to understand and apply the basic concepts of MTF to specifying, estimating, or characterizing performance. Some prior background in Fourier concepts is helpful.

INSTRUCTOR

Alfred Ducharme is a professor of optics and electrical engineering in the College of Engineering and Computer Science at the University of Central Florida. He received a B.S. in Electrical Engineering from the University of Massachusetts/Lowell, and both a M.S. and Ph.D. in Electrical Engineering from the University of Central Florida/School of Optics (CREOL). Dr. Ducharme is the Program Coordinator for the 4-year undergraduate program in Photonics (BSEET-Photonics) offered by the Engineering Technology Department.

COURSE PRICE INCLUDES the text *Modulation Transfer Function in Optical and Electro-Optical Systems* (SPIE Press, 2001) by Glenn D. Boreman.

Introduction to Radiometry and Photometry

SC178

Course level: Introductory
CEU .35 Member $390 / Non-member $440 USD
Monday 8:30 am to 12:30 pm

In this half-day course the basic quantities of radiometry, their units, and their relationships to electro-magnetic field quantities are presented. Photometry, its units, and conversion factors to older units are also addressed. The course covers the fundamentals of blackbody radiation generation and transfer. The basic equations needed to set up and solve problems are discussed.

The course introduces radiometric and photometric sources, detectors of optical radiation, instrumentation, and calibration. The supplementary textbook, *Introduction to Radiometry and Photometry* by Ross McCluney, is provided with the course and offers more detail in detector optical/ electrical characterization, color theory, and optical properties of specific materials.

This course is an ideal lead-in to SC944 The Radiometry Case Files, which provides many applied examples of the concepts introduced here.

LEARNING OUTCOMES

This course will enable you to:

- learn the methodology used for quantifying and describing electromagnetic radiation from the extreme UV through the visible portions of the spectrum and into the far IR
- become conversant with the concepts, terminology, and units of both radiometry and photometry
- master key radiometric laws and approximations
- master the basics of photometry, the system of terminology and units used whenever the eye is the detector
- describe the characterization of optical properties of surfaces, materials, and objects
- gain insight into the design and calibration of radiometers and photometers

INTENDED AUDIENCE

This course is for engineers and scientists who deal with electromagnetic radiation who need to quantify this radiation using international standard units and terminology. The course is for teachers, students, and researchers interested in using proper methods, terminology, symbols, and units in their courses and their research work. It is also for practitioners solving problems in radiation transfer, and in measuring radiant and luminous flux in optical systems and in nature.

INSTRUCTOR

Barbara Grant is the co-author, with Jim Palmer, of *The Art of Radiometry*. For more than twenty years she has applied her engineering skills to solve problems in industries as diverse as aerospace and indoor tanning. A consultant in electro-optics, she received the M.S. degree in Optical Sciences from the University of Arizona and two NASA awards for her work on the GOES weather satellite imager and sounder. Her previous work for SPIE includes developing and chairing a special session on FLIR image analysis.

COURSE PRICE INCLUDES the text *Introduction to Radiometry and Photometry* (Artech House, 1994) by Ross McCluney.

Multispectral and Hyperspectral Image Sensors

SC194

Course level: Advanced
CEU .35 Member $275 / Non-member $325 USD
Wednesday 8:30 am to 12:30 pm

This course will describe the imaging capabilities and applications of the principal types of multispectral (MS) and hyperspectral (HS) sensors. The focus will be on sensors that work in the visible, near-infrared and shortwave-infrared spectral regimes, but the course will touch on long-wave-infrared applications. A summary of the salient features of classical color imaging (human observation) will also be provided in an appendix.

LEARNING OUTCOMES

This course will enable you to:

- understand many of the applications and advantages of multispectral (MS) and hyperspectral (HS) imaging
- describe and categorize the properties of the principal MS / HS design types (multi-band scanner, starers with filter wheels, dispersive, wedge, and Fourier transform imagers with 2D arrays, etc.)
- list and define the relevant radiometric radiometric quantities, concepts and phenomenology
- understand the process of translating system requirements into sensor hardware constraints and specifications
- analyze signal-to-noise ratio, modulation-transfer-function, and spatial / spectral sampling for MS and HS sensors
- define, understand and apply the relevant noise-equivalent figures-of-merit (Noise-equivalent reflectance difference, Noise-equivalent temperature difference, Noise-equivalent spectral radiance, Noise-equivalent irradiance, etc.)
- describe the elements of the image chain from photons-in to bits-out (photon detection, video signal manipulation, analog processing, and digitization)
- list and review key imager subsystem technology elements (optical, focal plane, video electronics, and thermal)
- formulate a detailed end-to-end design example of a satellite imaging scanning HS sensor
- provide an appendix that summarizes color imaging principles and sensor associated elements for human observation applications (e.g. color television, still cameras, etc.)

INTENDED AUDIENCE

Engineers, scientists, and technical managers who are interested in understanding and applying multispectral and hyperspectral sensors in advanced military, civil, scientific and commercial applications.

INSTRUCTOR

Terrence Lomheim holds the position of Distinguished Engineer at The Aerospace Corp. He has 32 years of hardware and analysis experience in visible and infrared electro-optical systems, focal plane technology, and applied optics, and has authored and co-authored 53 publications in these technical areas. He is a Fellow of the SPIE.

COURSE PRICE INCLUDES the text *CMOS/CCD Sensors and Camera Systems, 2nd edition* (SPIE Press, 2011) by Terrence Lomheim and Gerald Holst.

Engineering Approach to Imaging System Design

SC713

Course level: Intermediate
CEU .65 Member $530 / Non-member $620 USD
Monday 8:30 am to 5:30 pm

This course discusses the three popular approaches to electro-optical imaging system design: spatial resolution, sensitivity (signal-to-noise ra-

tio), and modulation transfer function (MTF) analysis. While often evaluated individually, all three must be considered to optimize system design. Usually, the dominant MTFs in machine vision devices are image motion (including random vibration of the sensor), optics (including aberrations), and the detector. For man-in-the-loop operation, the display and the eye are of concern and, in many situations, these limit the overall system performance.

Equally important, but often neglected is sampling; an inherent feature of all electronic imaging systems. Sampling, which creates blocky images are particularly bothersome with periodic targets such as test targets and bar codes. An engineering approach is taken. This course will provide numerous practical design examples (case studies) to illustrate the interplay between subsystem MTFs, resolution, sensitivity, and sampling.

LEARNING OUTCOMES

This course will enable you to:
- use approximations; often called 'rules-of-thumb,' or 'back-of-the-envelope' analysis
- identify the subsystem components that affect resolution and sensitivity
- determine if your system is resolution or sensitivity limited
- equivalently determine if your system is detector-limited or optics-limited
- determine which subsystem limits system performance and why
- understand sampling artifacts (Nyquist frequency limit, aliasing, Moiré patterns, and variations in object edge location and width)
- use MTFs, resolution, sensitivity, and sampling concepts for system optimization
- understand the trade-off between MTF and aliasing

INTENDED AUDIENCE

The course is for managers, system designers, test engineers, machine vision specialists, and camera users who want the best performance from their systems. It is helpful if the students are familiar with linear system theory (MTF analysis).

INSTRUCTOR

Gerald Holst is an independent consultant for imaging system analysis and testing. He was a technical liaison to NATO, research scientist for DoD, and a member of the Lockheed-Martin senior technical staff. Dr. Holst has chaired the SPIE conference *Infrared Imaging Systems: Design, Analysis, Modeling and Testing* since 1989. He is author of over 30 journal articles and 6 books (published by SPIE and/or JCD Publishing). Dr. Holst is a member of OSA and IEEE and is a SPIE Fellow.

COURSE PRICE INCLUDES the text *Holst's Practical Guide to Electro-Optical Systems* (JCD Publishing, 2003) by Gerald C. Holst.

Introduction to Optical and Infrared Sensor Systems

SC789

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Friday 8:30 am to 5:30 pm

This course provides a broad introduction to optical (near UV-visible) and infrared sensor systems, with an emphasis on systems used in defense and security. Topics include both passive imagers and active laser radars (lidar/ladar). We begin with a discussion of radiometry and radiometric calculations to determine how much optical power is captured by a sensor system. We survey atmospheric propagation and phenomenology (absorption, emission, scattering, and turbulence) and explore how these issues affect sensor systems. Finally, we perform signal calculations that consider the source, the atmosphere, and the optical system and detector, to arrive at a signal-to-noise ratio for typical passive and active sensor systems. These principles of optical radiometry, atmospheric propagation, and optical detection are combined in examples of real sensors studied at the block-diagram level. Sensor system examples include passive infrared imagers, polarization imagers, and hyperspectral imaging spectrometers, and active laser radars (lidars or ladars) for sensing distributed or hard targets. The course organization is approximately one third on the radiometric analysis of sensor systems, one third on atmospheric phenomenology and detector parameters, and one third on example calculations and examination of sensor systems at the block-diagram level.

LEARNING OUTCOMES

This course will enable you to:
- understand and use radiometry for describing and calculating the flow of optical energy in an optical or infrared sensor system
- determine the radiometric throughput of sensor systems
- describe atmospheric phenomenology relevant to propagation of optical and infrared radiation
- explain how the atmosphere affects the performance of sensor systems
- use detector parameters with radiometric calculations to predict the signal received by passive and active sensors
- calculate signal-to-noise ratio for typical sensor systems
- understand real-world sensor systems at the block-diagram level
- explain the difference between and important concepts of passive reflection-based and emission-based imaging
- understand the basic operating principles of passive imagers and active laser radar (lidar/ladar) systems for distributed and solid target sensing

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who find themselves working on (or curious about) optical (uv-vis) and infrared sensor systems without formal training in this area. Undergraduate training in engineering or science is assumed.

INSTRUCTOR

Joseph Shaw has been developing optical remote sensing systems and using them in environmental and military sensing for two decades, first at NOAA and currently as professor of electrical engineering and physics at Montana State University. Recognition for his work in this field includes NOAA research awards, a Presidential Early Career Award for Scientists and Engineers, and the World Meteorological Organization's Vaisala Prize. He earned a Ph.D. in Optical Sciences at the University of Arizona. Dr. Shaw is a Fellow of both the OSA and SPIE.

Laser Range Gated Imaging Techniques

SC838

Course level: Intermediate
CEU .35 Member $275 / Non-member $325 USD
Tuesday 1:30 to 5:30 pm

This course provides attendees with a detailed background in the benefits and applications of laser gated imaging, also known as Burst Illumination Ladar (BIL). This technique covers the use of laser illumination in conjunction with focal plane arrays to improve the ability to detect and identify objects across a wide range of scenarios. The course concentrates on the components involved in such a system, the phenomena that are unique to laser illumination, and the performance one can expect from laser illuminated sensing. Practical examples to demonstrate the benefits and limitations of these systems will be covered. At the end of this course, you will be knowledgeable in the types of sources and sensors that can be used and the image processing that can be applied to optimize the system performance.

LEARNING OUTCOMES

This course will enable you to:
- compare the advantages and limitations of laser gated imaging systems
- describe various components within a laser gated imaging system
- compare the relative merits of gated detector technologies
- identify the parameters that influence system performance in resolution, SNR and laser characteristics
- analyze range performance predictions for different laser gated imaging systems

- judge atmospheric effects and their mitigation in laser illuminated imaging

INTENDED AUDIENCE

Engineers, scientists and managers who want to improve their understanding of the use of laser illumination for improved imaging techniques and the benefits of gated sensors. No background in laser gated imaging is assumed, although some familiarity with basic concepts of imaging systems will be advantageous.

INSTRUCTOR

Stuart Duncan is Chief Technical Officer with SELEX Sensors and Airborne Systems in the United Kingdom and has been involved in Electro Optic System Design and Integration for over 24 years. He is a Masters graduate from Imperial College, London.

The Radiometry Case Files

SC944

Course level: Introductory
CEU .35 Member $350 / Non-member $400 USD
Monday 1:30 to 5:30 pm

This course takes basic radiometric principles and applies them to calculate the amount of radiation reaching a system's entrance aperture or focal plane for a variety of source-system combinations. It provides a wide array of examples from which solutions to related problems may be drawn. It encompasses the UV, visible, and infrared regions of the electromagnetic spectrum, and includes several cases taken directly from the instructor's industrial experience.

Typical applications to be addressed include solar and overcast sky irradiance, IR system calibration, tanning lamp output, lighting illumination, sensor signals from specular and diffuse reflectors, star detection on orbit, solar simulators and integrating spheres.

LEARNING OUTCOMES

This course will enable you to:
- identify approaches to problem-solving based on source and geometry considerations
- calculate the amount of light received from single and multiple sources
- determine the effects of source material properties on calculations
- apply atmospheric and system spectral response characteristics to solution formulation
- operate a radiation slide rule
- qualify the limitations of your solution

INTENDED AUDIENCE

This class is designed for the practicing engineer or technologist who is expected to solve radiometric problems but is unsure what factors to identify in formulating a solution, or where to locate examples of similar problems. Though taught at an introductory level, the course assumes a basic familiarity with radiometric terminology.

INSTRUCTOR

Barbara Grant is the co-author, with Jim Palmer, of *The Art of Radiometry*. For more than twenty years she has applied her engineering skills to solve problems in industries as diverse as aerospace and indoor tanning. A consultant in electro-optics, she received the M.S. degree in Optical Sciences from the University of Arizona and two NASA awards for her work on the GOES weather satellite imager and sounder. Her previous work for SPIE includes developing and chairing a special session on FLIR image analysis.

COURSE PRICE INCLUDES the text *The Art of Radiometry* (SPIE Press, 2009) by James M. Palmer and Barbara G. Grant.

Super Resolution in Imaging Systems

SC946

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Tuesday 8:30 to 5:30 pm

This course provides an introduction to the signal processing methods used to increase image resolution. Specifically, it provides attendees with the practical knowledge to estimate the benefits of using super resolution in an imaging system as well as the guidance to select the right super resolution method for a given application.

The course is divided into three parts. In the first part, we describe the fundamental limits to resolution in an imaging system and establish the necessity of using signal processing as a mean to achieve super resolution. In the second part we focus on different super resolution techniques. Specifically, we cover defocus based techniques, zoom based techniques, photometry based techniques and edge enhancement based techniques.

In the third part of the course we provide some real life examples from various imaging fields to establish how the super resolution techniques work. The attendee will therefore benefit from a concise and realistic overview of current signal processing methods for super resolution, and thus be able to make the right decision when it comes to accessing the potential use of super resolution for a specific product development.

LEARNING OUTCOMES

This course will enable you to:
- explain the concept of point-spread function (PSF), modulation transfer function (MTF) and other key imaging functions along with the principles of image processing
- choose the right resolution enhancement method for your application from the range of available technologies in signal processing
- choose the right technology for the right performance/computation cost ratio
- compare the benefits and limitations of each resolution enhancement technology and describe the fundamentals of each method
- describe where signal processing for super resolution is applied today and where it may be applied tomorrow

INTENDED AUDIENCE

This course is intended for scientists, engineers, researchers, physicists, product development managers, directors of engineering, development engineers, or anyone who is interested in increasing resolution of imaging systems. The course helps the students to understand why, when and how to use signal processing to increase resolution in existing imaging systems and/or product lines and new product development programs, in order to decrease production costs, increase optical performance, or simply find new solutions to existing technological problems.

INSTRUCTORS

Saeed Bagheri (PhD) is with the IBM Thomas J. Watson Research Center in Yorktown Heights, NY. He received his B.S. from Sharif University of Technology in 2004. Later that year he joined Massachusetts Institute of Technology for his graduate studies where he graduated with two M.S. and a Ph.D. in 2007 majoring in Optics and Optimization. He has been with IBM since then. He has several refereed published articles as well as conference papers.

Bahram Javidi (PhD) is Board of Trustees Distinguished Professor at the University of Connecticut. He received his B.S. in Electrical Engineering from George Washington University in 1980 and his M.S. and Ph.D. in Electrical Engineering from the Pennsylvania State University in 1982 and 1986, respectively. Prof. Javidi is fellows of seven professional societies, including IEEE, OSA and SPIE. He has authored more than 620 book, chapter, refereed published articles, and conference papers. He was awarded the Alexander von Humboldt Prize for senior US scientists. He has received the SPIE Gabor Award and SPIE Technology Achievement award.

Cost-Conscious Tolerancing of Optical and IR Systems

SC947

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Wednesday 8:30 to 5:30 pm

The purpose of this course is to present concepts, tools, and methods that will help attendees determine optimal tolerances for opto-mechanical systems in optical applications. Detailed topics in the course apply to all volumes of systems being developed - from single systems to millions of units. The importance of tolerancing throughout the design process is discussed in detail, including determining robustness of the specification and design for manufacture and operation. The course also provides a background to effective tolerancing with discussions on variability and relevant applied statistics. A treatment of third-order aberrations is included, with emphasis on understanding their origins and how to influence cost and production yield by considering their impacts. Tolerance analysis and assignment with strong methodology and examples are discussed, including the development of a design trade for a simple IR system. References and examples are included to help researchers, designers, engineers, and technicians practically apply the concepts to plan, design, engineer, and build high-quality cost-competitive optical systems.

LEARNING OUTCOMES

This course will enable you to:
- identify key system requirements for tolerancing
- develop insight into cost and sensitivity factors early in the design process
- define variability and comprehend its impact on nominal systems
- utilize fundamental applied statistics in tolerancing
- construct tolerance analysis budgets
- perform detailed tolerance analysis
- summarize different design of experiment and statistical process control strategies

INTENDED AUDIENCE

This material is intended for managers, engineers, and technical staff involved in product design from concept through manufacturing.

INSTRUCTORS

Richard Youngworth Ph.D. is the Director of Optical Engineering at Light Capture, Inc., an optical and optomechanical design firm providing consulting, innovation incubation, and product development services. His industrial experience spans diverse topics including optical metrology, design, manufacturing, and analysis. In particular, Dr. Youngworth has spent significant time working on optical systems in the challenging transition from ideal design to successful volume manufacturing. He is widely considered an expert, due to his research, lectures, publications, and industrial work on the design, producibility, and tolerance analysis of optical components and systems. He has a B.S. in electrical engineering from the University of Colorado at Boulder and earned his Ph.D. in optics at the University of Rochester by researching tolerance analysis of optical systems.

James Contreras is a Principal Optical Engineer at Exotic Electro-Optics in Murrieta, CA, where he serves as the project lead for all opto-mechanical assembly projects. He has extensive experience in the design, analysis and fabrication of reflective and refractive optical systems for a variety of applications ranging from tactical military platforms to the James Webb Space Telescope. His primary expertise is in reflective and IR optical design, specializing in design for manufacturability. He is actively involved in teaching for SPIE and mentoring junior engineers. He was trained in Physics at Rensselaer Polytechnic Institute (B.S.) and the Georgia Institute of Technology (M.S.); the majority of his career has been in the defense and aerospace industry at companies such as Hughes Aircraft Company and Ball Aerospace Corp.

Infrared Imaging Radiometry

SC950

Course level: Advanced
CEU .65 Member $480 / Non-member $570 USD
Tuesday 8:30 am to 5:30 pm

This course will enable the user to understand how an infrared camera system can be calibrated to measure radiance and/or temperature and how the digital data is converted into radiometric data. The user will learn how to perform their own external, “by hand” calibrations on a science-grade infrared camera system using area or cavity blackbodies and an Excel spreadsheet provided by the instructor. The influences of lenses, ND and bandpass filters, windows, emissivity, reflections and atmospheric absorption on the system calibration will be covered. The instructor will use software to illustrate these concepts and will show how to measure emissivity using an infrared camera and how to predict system performance outside the calibration range.

LEARNING OUTCOMES

This course will enable you to:
- classify the measurement units of radiometry and thermography
- describe infrared camera transfer functions - electrical signal output versus radiance signal input
- determine which cameras, lenses and both cold and warm filters to select for your application
- assess effects of ND filters and bandpass filters on calibrations, and calculate which ND warm filter you need for a given temperature range of target
- perform radiometric calibration of camera systems using cavity and area blackbodies
- convert raw data to radiometric data, and convert radiometric data to temperatures
- measure target emissivity and calibrate emissivity into the system
- gauge and account for reflections and atmospheric effects on measurements

INTENDED AUDIENCE

This material is intended for engineers, scientists, graduate students and range technicians that are working with science-grade infrared cameras in the lab, on military test ranges, or similar situations.

INSTRUCTOR

Austin Richards is a senior research scientist at FLIR Commercial Vision Systems in Santa Barbara, and has specialized in scientific applications of infrared imaging technology for over 9 years. He holds a Ph.D. in astrophysics from UC Berkeley and is the author of the SPIE monograph *Alien Vision: Exploring the Electromagnetic Spectrum with Imaging Technology*.

Applications of Detection Theory

SC952

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

The fundamental goal of this course is to enable you to assess and explain the performance of sensors, detectors, diagnostics, or any other type of system that is attempting to give, with some level of confidence, a determination of the presence or absence of a “target.” In this case the term “target” may be a wide variety of types (e.g. a biological pathogen or chemical agent; or a physical target of some sort; or even just some electronic signal). We will rigorously cover the theory and mathematics underlying the construction of the “Receiver Operating Characteristic” (ROC) curve, including dichotomous test histograms, false positives, false negatives, sensitivity, specificity, and total accuracy. In addition, we will discuss in depth the theory behind “Decision Tree Analysis” culminating with an in class exercise. Decision tree analysis allows one to “fuse together” multivariate signals (or results) in such a manner as to produce a more accurate outcome than would have been attained with any one signal alone. This course includes two major in class exercises:

the first will involve constructing a ROC curve from real data with the associated analysis; the second will involve constructing a complete decision tree including the new (improved) ROC curve. The first exercise will be ~30min in length, and the second will be ~60min.

LEARNING OUTCOMES

This course will enable you to:
- define false positives, false negatives and dichotomous test
- define sensitivity, specificity, limit-of-detection, and response time
- comprehend and analyze a dose-response curve
- construct and analyze a Receiver Operating Characteristic (ROC) curve from raw data
- define Positive Predictive Value (PPV) and Negative Predictive Value (NPV)
- analyze statistical data and predict results
- describe the process and theory underlying decision tree analysis
- construct and analyze a decision tree using real data
- construct a "Spider Chart" from system-level attributes
- interpret sensor performance trade-offs using a ROC curve

INTENDED AUDIENCE

This course designed for scientists, engineers, and researchers that are involved in sensor design and development, particular from the standpoint of complex data analysis. Application areas for which Detection Theory is most relevant includes biological detection, medical diagnostics, radar, multi-spectral imaging, explosives detection and chemical agent detection. A working knowledge of basic freshman-level statistics is useful for this course.

INSTRUCTOR

John Carrano is President of Carrano Consulting. Previously, he was the Vice President, Research & Development, Corporate Executive Officer, and Chairman of the Scientific Advisory Board for Luminex Corporation, where he led the successful development of several major new products from early conception to market release and FDA clearance. Before joining Luminex, Dr. Carrano was as a Program Manager at DARPA, where he created and led several major programs related to bio/chem sensing, hyperspectral imaging and laser systems. He retired from the military as a Lieutenant Colonel in June 2005 after over 24 years' service; his decorations include the "Defense Superior Service Medal" from the Secretary of Defense. Dr. Carrano is a West Point graduate with a doctorate in Electrical Engineering from the University of Texas at Austin. He has co-authored over 50 scholarly publications and has 3 patents pending. He is the former DSS Symposium Chairman (2006-2007), and is an SPIE Fellow.

COURSE PRICE INCLUDES a free PDF copy of the report, "Chemical and Biological Sensor Standards Study" (Principal author, Dr. John C. Carrano.)

Target Detection Algorithms for Hyperspectral Imagery

SC995

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

This course provides a broad introduction to the basic concept of automatic target and object detection and its applications in Hyperspectral Imagery (HSI). The primary goal of this course is to introduce the well known target detection algorithms in hyperspectral imagery. Examples of the classical target detection techniques such as spectral matched filter, subspace matched filter, adaptive matched filter, orthogonal subspace, support vector machine (SVM) and machine learning are reviewed. Construction of invariance subspaces for target and background as well as the use of regularization techniques are presented. Standard atmospheric correction and compensation techniques are reviewed. Anomaly detection techniques for HSI and dual band FLIR imagery are also discussed. Applications of HSI for detection of mines, targets, humans, chemical plumes and anomalies are reviewed.

LEARNING OUTCOMES

This course will enable you to:
- describe the fundamental concepts of target detection algorithms as applied to HSI
- learn the procedure to use the generalized maximum likelihood ratio test to design spectral detectors
- describe the fundamental differences between different detection algorithms based on their model representations
- develop statistical models as well as subspace models for HSI data
- explain the difference between anomaly detection and classification
- distinguish between linear and nonlinear approaches (SVM and Kernel learning techniques)
- develop anomaly detection techniques for different environmental scenarios
- describe linear models and unmixing techniques for abundance measures
- plot ROC curves to evaluate the performance of the algorithms

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to learn more about target detection in hyperspectral, multispectral or dual-band FLIR imagery. Undergraduate training in engineering or science is assumed.

INSTRUCTOR

Nasser Nasrabadi is a senior research scientist (ST) at US Army Research Laboratory (ARL). He is also an adjunct professor in the Electrical and Computer Engineering Department at the Johns Hopkins University. He is actively engaged in research in image processing, neural networks, automatic target recognition, and video compression and its transmission over high speed networks. He has published over 200 papers in journals and conference proceedings. He has been an associate editor for the IEEE Transactions on Image Processing,IEEE Transactions on Circuits and Systems for Video Technology and IEEE Transactions for Neural Networks. He is a Fellow of IEEE and SPIE.

Introduction to Infrared and Ultraviolet Imaging Technology

SC1000

Course level: Introductory
CEU .35 Member $310 / Non-member $360 USD
Monday 1:30 to 5:30 pm

The words infrared and ultraviolet are coming into much more widespread use, as ideas about the technology penetrates the public's awareness and becomes part of popular culture through TV and film. In industry and academia, applications for infrared and ultraviolet cameras are multiplying rapidly, because both of the continued reduction in system cost as the technology penetrates the commercial marketplace, and the forward march of technology. At the same time, there is a fairly limited body of information about applications for these cameras. This is because camera manufacturers tend focus on the products themselves, not applications, and because most textbooks on IR and UV technology are outdated and tend to emphasize the basics of radiometry and detection by single detectors, not imaging applications.

This course gives a non-technical overview of commercial infrared and ultraviolet camera systems, the "taxonomy" of infrared and ultraviolet wavebands, and the wide variety of applications for these wavebands. The course relies heavily on interesting imagery captured by the presenter over the last ten years and uses a SPIE monograph written by the author as a supplementary textbook.

LEARNING OUTCOMES

This course will enable you to:
- identify the different wavebands of the infrared and ultraviolet spectrum and describe their differences
- gain familiarity with the different types of cameras, sensors and optics used for imaging in the infrared and ultraviolet wavebands
- describe some of the key imaging applications for different wavebands of the infrared and ultraviolet

INTENDED AUDIENCE

The course is suitable both for technology professionals and non-technical persons that are new to infrared and ultraviolet imaging and want a very basic, qualitative overview of the fields with minimal mathematics. Little to no mathematic background is required.

INSTRUCTOR

Austin Richards is a senior research scientist at FLIR Systems in Santa Barbara, CA. He holds a PhD in Astrophysics from UC Berkeley, and has worked in the commercial infrared industry for over 10 years. He is also the CTO of Oculus Photonics, a small company devoted to near-ultraviolet imaging systems manufacturing, sales and support. Richards is the author of the SPIE monograph *Alien Vision: Exploring the Electromagnetic Spectrum with Imaging Technology* and an adjunct professor at the Brooks Institute of Photography in Santa Barbara.

COURSE PRICE INCLUDES the text *Alien Vision: Exploring the Electromagnetic Spectrum with Imaging Technology* (SPIE Press, 2001) by Austin A. Richards.

Radar Micro-Doppler Signatures - Principles and Applications

SC1031

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Monday 1:30 to 5:30 pm

This course explains basic principles and applications of the micro-Doppler signatures of radar targets. A micro-Doppler signature is a distinctive characteristic of the intricate frequency modulations generated from each component part of a target and is represented in the joint time and Doppler frequency domain. Micro-Doppler signatures provide unique target features that are complementary to those made available by existing methods.

The primary goals of the course are to describe the radar micro-Doppler effect, the mathematical and dynamic models of targets with various motions and the analysis of micro-Doppler signatures. The course will present current applications of radar micro-Doppler signature analysis to target detection, characterization, and classification. Radar data returned from rigid body motion and non-rigid body motion will be used in the presentation examples as well as simulations. Examples are shown from state-of-the-art radars in both anechoic chambers and realistic environments.

LEARNING OUTCOMES

This course will enable you to:

- describe the motion and Doppler effect resulting from rigid and non-rigid body motion
- determine the Micro-Doppler effect observed by a radar
- describe the radar EM scattering from a body with motion
- perform micro-Doppler processing, estimation, and analysis
- describe Mono-static, bi-static and multi-static micro-Doppler signatures
- evaluate the micro-Doppler of simple rigid body motions like a windmill or the rotating rotor blades of a helicopter
- interpret the micro-Doppler signature of human walking and various other various human motions
- compare and classify the micro-Doppler signatures of humans, vehicles, and animals
- model the multi-static micro-Doppler signature
- perform micro-Doppler signature classification
- explain the role of angle of motion and lookdown angle on micro-Doppler

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to understand the micro-Doppler effect in radar, the analysis of micro-Doppler signature of targets, and the applications of micro-Doppler signature for target recognition, identification, and classification. University professors, graduate students, and industry professionals are likely to benefit from this tutorial. Undergraduate training in engineering or science is assumed.

INSTRUCTORS

Victor Chen is internationally recognized for his work on micro-Doppler signatures and time-frequency analysis. He has published more than 130 papers and articles in books, chapters in books, journals and proceedings including the text “Time-Frequency Transforms for Radar Imaging and Signal Analysis” and the recent new text “Micro-Doppler Effect in Radar - Principles and Applications”. Dr. Chen is a Fellow of the IEEE.

David Tahmoush of the US Army Research Laboratory is contributing work on micro-Doppler signatures and classification analysis as well as example radar data. Dr. Tahmoush has published more than 30 papers and articles, and organizes the Workshop on Dismount Detection and Classification.

Optical Phased Array Technologies and Systems

SC1033

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

This course is an introduction to Optical Phased Arrays and their applications in active electro-optical systems, including high energy laser systems, long range laser imaging and laser communications. The course will develop an understanding of high resolution imaging using multiple sub-apertures, high resolution laser beam projection using multiple sub-apertures, optical phased array beam steering, phased array beam propagation, adaptive optics as applied to phased arrays, and modeling of phased array systems.

Phased array component technologies to be covered will include fiber laser sources, high and low bandwidth imaging cameras, beam transport in fibers, non-mechanical beam steering elements, and other system elements. Some systems issues discussed will include system efficiencies, optical isolation for transmitters and imagers, acquisition, tracking and pointing (ATP), phased array fire control, and system weight and volume estimation.

LEARNING OUTCOMES

This course will enable you to:

- design methods for phasing multiple optical sub-apertures to create a high resolution far field laser beam
- design wide angle, high efficiency, non-mechanical beam steering subsystems
- utilize methods for phasing multiple optical sub-apertures to create high resolution images
- describe optical phased array propagation for weapons, sensing, and communications
- design phased array adaptive optics
- utilize phased array HEL performance modeling, including isolation, steering, laser sources, ATP, and fire control
- design phased array subsystems including laser sources, high and low bandwidth imaging cameras, beam transport and phasing elements, and thermal and power management subsystems
- evaluate phased array systems and applications, including generic and mission specific system architectures

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to learn more about how to design or use optical phased array based EO systems. Undergraduate training in engineering or science is assumed.

INSTRUCTORS

Kevin Probst is president and founder of The CORE Group, an independent defense consulting firm. He has spent over seven years in phased array research, modeling, analysis, and concept development. Previous experience includes the Airborne Laser Lab (ALL), Charles Stark Draper Labs, the AFRL Beam Control Division, the LEAPS Division, and the Strategic Defense Initiative Office (SDIO) where he served as the head of the ATP/FC division. Mr. Probst also served as Chief Scientist on the Zenith Star Space Based Laser program. For AFRL and DARPA he has worked

on Phased Array beam control under programs such as Steered Agile Beam (STAB), Phased Array of Phased Arrays (PAPA), the JTO HIPOP/HIPAT projects, the AFRL/RY Phased Array Aperture Study, and the DARPA Adaptive Photonic Phase Locked Elements (APPLE) program. He also served on the initial Beam Control Technology Area Working Group (TAWG) for JTO, and at the DDR&E Directed Energy Group. Kevin is a retired Air Force officer.

Paul McManamon is an independent consultant and works half time as the Technical Director of the Ladar and Optical Communications institute, LOCI, at the University of Dayton. Until May of 2008 he was chief scientist for the Sensors Directorate, Air Force Research Laboratory, Air Force Material Command, Wright-Patterson Air Force Base, Ohio. Dr. McManamon is a Fellow of SPIE, IEEE, OSA, the Air Force Research Laboratory, and the Military Sensing Symposia, MSS. He was the 2006 President of SPIE. Dr. McManamon received the WRG Baker award from the IEEE in 1998 for the best paper in any refereed IEEE journal or publication. He was Vice Chairman of a recently concluded National Academy of Sciences study called “Seeing Photons”.

Laser Sensors and Systems

Precision Stabilized Pointing and Tracking Systems

SC160

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Tuesday 8:30 am to 5:30 pm

This course provides a practical description of the design, analysis, integration, and evaluation processes associated with development of precision stabilization, pointing and tracking systems. Major topics include stabilized platform technology, electro-mechanical system configuration and analysis, and typical pointing and tracking system architectures.

LEARNING OUTCOMES

This course will enable you to:
- acquire the terminology of stabilization, pointing, and tracking systems and understand the common system architectures and operation
- define typical electro-mechanical configurations and key subsystems and components used in precision stabilization and laser pointing systems
- describe the primary systems engineering tradeoffs and decisions that are required to configure and design stabilization, pointing and tracking systems
- distinguish the performance capabilities of specific design configurations

INTENDED AUDIENCE

This material is designed for engineers and managers responsible for design, analysis, development, or test of electro-optical stabilization, pointing and tracking systems or components. A minimum BS degree in an engineering discipline and familiarity with basic control systems is recommended.

INSTRUCTOR

James Hilkert is president of Alpha-Theta Technologies, an engineering consulting firm specializing in precision pointing, tracking and stabilization applications for clients such as Raytheon, General Dynamics, Northrop Grumman, DRS, Atlantic Positioning and the U.S. Navy. Prior to founding Alpha-Theta Technologies in 1994, he spent 20 years at Texas Instruments Defense Systems (now Raytheon) where he designed inertial tracking and pointing systems for a variety of military applications and later managed the Control Systems Technology Center. He received the Dr. Engineering degree from Southern Methodist University and MSME and BSME degrees from Mississippi State University, is a member of ASME, AIAA and SPIE, and lectures on control systems at The University of Texas at Dallas.

Introduction to Laser Radar

SC167

Course level: Intermediate
CEU .35 Member $275 / Non-member $325 USD
Monday 8:30 am to 12:30 pm

This course explains the principles of operation and the basis of laser radar systems. An analytical approach to the evaluation of system performance is presented. This approach is derived from physical optics and from classical antenna theory. Practical applications for laser radar and alternative system architectures are described. Major system components are identified.

LEARNING OUTCOMES

This course will enable you to:
- identify the major elements of laser radar systems
- list important applications of laser radar
- predict the performance of real or conceptual systems
- estimate the effect of environmental factors on system performance
- formulate system level designs for common applications
- explain the critical issues affecting various classes of laser radars
- compare the laser radar approaches for selected applications

INTENDED AUDIENCE

This material is intended for engineers, managers, scientists, and students to become familiar with laser radar or to evaluate the performance of laser radar systems.

INSTRUCTOR

Gary Kamerman is the Chief Scientist of FastMetrix, Inc. and a Fellow of SPIE. He is the author of Laser Radar in the Infrared and Electro-Optical Handbook and the editor of the SPIE Milestone Series Laser Radar. He has designed, built and field tested laser radars for over 30 years and serves as a technical advisor to the Department of Defense, NASA and major international corporations.

Advanced Coherent Laser Radars Design and Applications

SC168

Course level: Advanced
CEU .35 Member $275 / Non-member $325 USD
Monday 1:30 to 5:30 pm

This course identifies the procedures and the requirements for a comprehensive coherent laser radar design. Using a detailed examination of the design process for military, industrial and medical applications, the course covers system level requirements as applied to diversified applications, development, and allocation for the major subsystems. Candidate system designs, optimization, making compromises and component options are presented. Heterodyne and homodyne detection systems, transmitter modulation techniques and compatible formats are emphasized. System architectures, subsystem approaches and component options are compared. Machine vision, 3-D imaging systems, unmanned vehicle sensors, atmospheric sensing, chemical detection, visualization of structures of industrial and biomedical objects and evaluation of their optical parameters are used to illustrate the design techniques.

LEARNING OUTCOMES

This course will enable you to:
- identify practical applications of laser radars
- analyze and predict real-world laser radar performance
- design cost effective laser radar systems
- optimize system effectiveness and efficiency
- evaluate and compare design alternatives
- plan and conduct systematic and sensible testing and calibration
- identify new prospective uses and areas of interest for laser radars

INTENDED AUDIENCE

This material is intended for engineers, scientists and students to further understand the practical applications and limitations of laser radar. Previous experience with radar and optical systems is recommended. *Introduction to Laser Radar* (SC167) or an equivalent course is a required prerequisite.

INSTRUCTOR

Gary Kamerman is the Chief Scientist of FastMetrix, Inc. and a Fellow of SPIE. He is the author of Laser Radar in the Infrared and Electro-Optical Handbook and the editor of the SPIE Milestone Series Laser Radar. He has designed, built and field tested laser radars for over 30 years and serves as a technical advisor to the Department of Defense, NASA and major international corporations.

Laser Beam Propagation for Applications in Laser Communications, Laser Radar, and Active Imaging

SC188

Course level: Intermediate
CEU .65 Member $610 / Non-member $700 USD
Thursday 8:30 am to 5:30 pm

This course describes beam wave propagation through optical turbulence. Satellite communication systems, laser radar, remote sensing, and adaptive optics are some of the applications affected by optical turbulence. Tractable analytic equations are provided for calculating Gaussian-beam wave statistical quantities affecting system performance. The mutual coherence function (MCF), mean intensity, degree of coherence, and intensity fluctuations (scintillation) are presented. Videos of actual experiments show how to gather data. Examples are presented using MATHEMATICA software programs. Copies of these programs are available in the text.

LEARNING OUTCOMES

This course will enable you to:
- calculate power budget for laser-based radar and communications systems
- calculate system reliability for laser radar and communication systems
- calculate backscatter effects from targets in monostatic and bistatic laser radar systems
- use MATHEMATICA programs to calculate statistical parameters for laser-based systems

INTENDED AUDIENCE

This course is intended for scientists, supervising and design engineers who are interested in understanding the propagation phenomena, which impose limitations on system performance, and in learning new approaches to improving system design.

INSTRUCTORS

Ronald Phillips is Director of the Florida Space Institute, Professor of Electrical and Computer Engineering, and an associate member of the School of Optics/CREOL at the University of Central Florida. He has worked in optical wave propagation for more than 25 years.

Larry Andrews is Professor of Mathematics and an associate member of School of Optics/CREOL at the University of Central Florida. He has worked in optical wave propagation for more than 20 years.

COURSE PRICE INCLUDES the texts, *Laser Beam Propagation through Random Media* (SPIE Press, 2005) by Ronald Phillips and Larry Andrews and the *Field Guide to Atmospheric Optics* (SPIE Press, 2004) by Larry C. Andrews.

Laser Range Gated Imaging Techniques

SC838

Course level: Intermediate
CEU .35 Member $275 / Non-member $325 USD
Tuesday 1:30 to 5:30 pm

This course provides attendees with a detailed background in the benefits and applications of laser gated imaging, also known as Burst Illumination Ladar (BIL). This technique covers the use of laser illumination in conjunction with focal plane arrays to improve the ability to detect and identify objects across a wide range of scenarios. The course concentrates on the components involved in such a system, the phenomena that are unique to laser illumination, and the performance one can expect from laser illuminated sensing. Practical examples to demonstrate the benefits and limitations of these systems will be covered. At the end of this course, you will be knowledgeable in the types of sources and sensors that can be used and the image processing that can be applied to optimize the system performance.

LEARNING OUTCOMES

This course will enable you to:
- compare the advantages and limitations of laser gated imaging systems
- describe various components within a laser gated imaging system
- compare the relative merits of gated detector technologies
- identify the parameters that influence system performance in resolution, SNR and laser characteristics
- analyze range performance predictions for different laser gated imaging systems
- judge atmospheric effects and their mitigation in laser illuminated imaging

INTENDED AUDIENCE

Engineers, scientists and managers who want to improve their understanding of the use of laser illumination for improved imaging techniques and the benefits of gated sensors. No background in laser gated imaging is assumed, although some familiarity with basic concepts of imaging systems will be advantageous.

INSTRUCTOR

Stuart Duncan is Chief Technical Officer with SELEX Sensors and Airborne Systems in the United Kingdom and has been involved in Electro Optic System Design and Integration for over 24 years. He is a Masters graduate from Imperial College, London.

Cost-Conscious Tolerancing of Optical and IR Systems

SC947

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Wednesday 8:30 to 5:30 pm

The purpose of this course is to present concepts, tools, and methods that will help attendees determine optimal tolerances for opto-mechanical systems in optical applications. Detailed topics in the course apply to all volumes of systems being developed - from single systems to millions of units. The importance of tolerancing throughout the design process is discussed in detail, including determining robustness of the specification and design for manufacture and operation. The course also provides a background to effective tolerancing with discussions on variability and relevant applied statistics. A treatment of third-order aberrations is included, with emphasis on understanding their origins and how to influence cost and production yield by considering their impacts. Tolerance analysis and assignment with strong methodology and examples are discussed, including the development of a design trade for a simple IR system. References and examples are included to help researchers, designers, engineers, and technicians practically apply the concepts to plan, design, engineer, and build high-quality cost-competitive optical systems.

LEARNING OUTCOMES

This course will enable you to:
- identify key system requirements for tolerancing
- develop insight into cost and sensitivity factors early in the design process
- define variability and comprehend its impact on nominal systems
- utilize fundamental applied statistics in tolerancing
- construct tolerance analysis budgets
- perform detailed tolerance analysis
- summarize different design of experiment and statistical process control strategies

INTENDED AUDIENCE

This material is intended for managers, engineers, and technical staff involved in product design from concept through manufacturing.

INSTRUCTORS

Richard Youngworth Ph.D. is the Director of Optical Engineering at Light Capture, Inc., an optical and optomechanical design firm providing consulting, innovation incubation, and product development services. His industrial experience spans diverse topics including optical metrology, design, manufacturing, and analysis. In particular, Dr. Youngworth has spent significant time working on optical systems in the challenging transition from ideal design to successful volume manufacturing. He is widely considered an expert, due to his research, lectures, publications, and industrial work on the design, producibility, and tolerance analysis of optical components and systems. He has a B.S. in electrical engineering from the University of Colorado at Boulder and earned his Ph.D. in optics at the University of Rochester by researching tolerance analysis of optical systems.

James Contreras is a Principal Optical Engineer at Exotic Electro-Optics in Murrieta, CA, where he serves as the project lead for all optomechanical assembly projects. He has extensive experience in the design, analysis and fabrication of reflective and refractive optical systems for a variety of applications ranging from tactical military platforms to the James Webb Space Telescope. His primary expertise is in reflective and IR optical design, specializing in design for manufacturability. He is actively involved in teaching for SPIE and mentoring junior engineers. He was trained in Physics at Rensselaer Polytechnic Institute (B.S.) and the Georgia Institute of Technology (M.S.); the majority of his career has been in the defense and aerospace industry at companies such as Hughes Aircraft Company and Ball Aerospace Corp.

Target Detection Algorithms for Hyperspectral Imagery

SC995

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

This course provides a broad introduction to the basic concept of automatic target and object detection and its applications in Hyperspectral Imagery (HSI). The primary goal of this course is to introduce the well known target detection algorithms in hyperspectral imagery. Examples of the classical target detection techniques such as spectral matched filter, subspace matched filter, adaptive matched filter, orthogonal subspace, support vector machine (SVM) and machine learning are reviewed. Construction of invariance subspaces for target and background as well as the use of regularization techniques are presented. Standard atmospheric correction and compensation techniques are reviewed. Anomaly detection techniques for HSI and dual band FLIR imagery are also discussed. Applications of HSI for detection of mines, targets, humans, chemical plumes and anomalies are reviewed.

LEARNING OUTCOMES

This course will enable you to:
- describe the fundamental concepts of target detection algorithms as applied to HSI
- learn the procedure to use the generalized maximum likelihood ratio test to design spectral detectors
- describe the fundamental differences between different detection algorithms based on their model representations
- develop statistical models as well as subspace models for HSI data
- explain the difference between anomaly detection and classification
- distinguish between linear and nonlinear approaches (SVM and Kernel learning techniques)
- develop anomaly detection techniques for different environmental scenarios
- describe linear models and unmixing techniques for abundance measures
- plot ROC curves to evaluate the performance of the algorithms

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to learn more about target detection in hyperspectral, multispectral or dual-band FLIR imagery. Undergraduate training in engineering or science is assumed.

INSTRUCTOR

Nasser Nasrabadi is a senior research scientist (ST) at US Army Research Laboratory (ARL). He is also an adjunct professor in the Electrical and Computer Engineering Department at the Johns Hopkins University. He is actively engaged in research in image processing, neural networks, automatic target recognition, and video compression and its transmission over high speed networks. He has published over 200 papers in journals and conference proceedings. He has been an associate editor for the IEEE Transactions on Image Processing,IEEE Transactions on Circuits and Systems for Video Technology and IEEE Transactions for Neural Networks. He is a Fellow of IEEE and SPIE.

High Power Laser Beam Quality

SC997

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Wednesday 1:30 to 5:30 pm

This course covers definitions and applications of common measures of beam quality, including Brightness, Power-in-the-bucket, M^2, 'times diffraction limited', Strehl ratio, beam parameter product etc. Special emphasis will be given to choosing an appropriate beam quality metric, tracing the metric to the application of the laser system, and to various conceptual pitfalls which arise in this field. This course is especially applicable to novel lasers that may not have Gaussian modes, especially high energy lasers or unstable resonators. Material presented will come from general scientific literature as well as original work done by Dr. Sean Ross and Dr. William Latham, both from the Air Force Research Laboratory Directed Energy Directorate.

LEARNING OUTCOMES

This course will enable you to:
- convert between common measures of beam quality
- design an appropriate beam quality measure for your own laser application
- evaluate the suitability of commercial, black box beam quality analyzers for your application
- comprehend and take correct ISO 11146 M^2 measurements

INTENDED AUDIENCE

This course should benefit anyone with an interest in laser beam quality, including program managers, scientists and engineers who are not experts in the field.

INSTRUCTOR

T. Sean Ross has been with the Air Force Research Laboratory, Directed Energy Directorate, High Power Solid State Laser Branch since he received his PhD from the Center for Research and Education in Optics and Lasers (CREOL) in 1998. Research interests include nonlinear frequency conversion, high power solid state lasers, thermal management and laser beam quality. Beginning in 2000, frustration with commercial beam quality devices led to the work eventually presented in the Journal of Directed Energy, Vol. 2 No. 1 Summer 2006 "Appropriate Measures and Consistent Standard for High Energy Laser Beam Quality". This paper and its conference version (presented at the 2005 DEPS Symposium) have received awards from the Directed Energy Professional Society and the Directed Energy Directorate.

Radar Micro-Doppler Signatures - Principles and Applications

SC1031

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Monday 1:30 to 5:30 pm

This course explains basic principles and applications of the micro-Doppler signatures of radar targets. A micro-Doppler signature is a distinctive characteristic of the intricate frequency modulations generated from each component part of a target and is represented in the joint time and Doppler frequency domain. Micro-Doppler signatures provide unique target features that are complementary to those made available by existing methods.

The primary goals of the course are to describe the radar micro-Doppler effect, the mathematical and dynamic models of targets with various motions and the analysis of micro-Doppler signatures. The course will present current applications of radar micro-Doppler signature analysis to target detection, characterization, and classification. Radar data returned from rigid body motion and non-rigid body motion will be used in the presentation examples as well as simulations. Examples are shown from state-of-the-art radars in both anechoic chambers and realistic environments.

LEARNING OUTCOMES

This course will enable you to:

- describe the motion and Doppler effect resulting from rigid and non-rigid body motion
- determine the Micro-Doppler effect observed by a radar
- describe the radar EM scattering from a body with motion
- perform micro-Doppler processing, estimation, and analysis
- describe Mono-static, bi-static and multi-static micro-Doppler signatures
- evaluate the micro-Doppler of simple rigid body motions like a windmill or the rotating rotor blades of a helicopter
- interpret the micro-Doppler signature of human walking and various other various human motions
- compare and classify the micro-Doppler signatures of humans, vehicles, and animals
- model the multi-static micro-Doppler signature
- perform micro-Doppler signature classification
- explain the role of angle of motion and lookdown angle on micro-Doppler

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to understand the micro-Doppler effect in radar, the analysis of micro-Doppler signature of targets, and the applications of micro-Doppler signature for target recognition, identification, and classification. University professors, graduate students, and industry professionals are likely to benefit from this tutorial. Undergraduate training in engineering or science is assumed.

INSTRUCTORS

Victor Chen is internationally recognized for his work on micro-Doppler signatures and time-frequency analysis. He has published more than 130 papers and articles in books, chapters in books, journals and proceedings including the text “Time-Frequency Transforms for Radar Imaging and Signal Analysis” and the recent new text “Micro-Doppler Effect in Radar - Principles and Applications”. Dr. Chen is a Fellow of the IEEE.

David Tahmoush of the US Army Research Laboratory is contributing work on micro-Doppler signatures and classification analysis as well as example radar data. Dr. Tahmoush has published more than 30 papers and articles, and organizes the Workshop on Dismount Detection and Classification.

Direct Detection Laser Radar Systems for Imaging Applications

SC1032

Course level: Advanced
CEU .65 Member $525 / Non-member $615 USD
Tuesday 8:30 am to 5:30 pm

As laser radar detection and ranging (LADAR) technologies continue to mature, more and more these systems are being applied to military, commercial and scientific applications. From simple time of flight range measurements to high resolution terrain mapping and 3-dimensional imaging, the utility of LADAR is being investigated across a wide range of applications.

In direct detection LADAR the measurements depend solely on the amplitude of the returned signal. This course is designed to teach students the basics of direct detection LADAR and how to transform customer or mission requirements into LADAR system performance specifications. Tools for modeling LADAR systems are introduced through the lecture material that allows quantification of important system performance metrics.

The course begins with the LADAR range equation and how it can be used to evaluate the impact factors such as atmospheric turbulence on LADAR performance. Students are introduced to direct detection LADAR modeling methods which help to explain how various LADAR subsystems affect LADAR range accuracy. A number of representative systems will be introduced as examples throughout the lectures. This course closely follows the included text *Direct Detection LADAR Systems*, SPIE Vol. TT85. The examples and problems presented in the book will be explored more fully during the course.

LEARNING OUTCOMES

This course will enable you to:

- compute the amount of laser power reflected from a target to a LADAR receiver
- calculate the expected signal to noise ratio obtained by a LADAR receiver
- determine the probability of detection and false alarm for different kinds of LADAR receivers
- explain the effects of atmospheric turbulence on LADAR system performance
- compare the performance of different algorithms for extracting range information from LADAR signals
- predict the effects of reflection from different surfaces on the performance of LADAR systems
- explain the functional differences between different types of 3-D LADAR systems.

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to learn more about how to evaluate the performance of direct detection laser radar systems and to quantify the impact that various effects have on LADAR performance as well as university professors who wish to offer courses in LADAR. Undergraduate training in engineering or science is assumed.

INSTRUCTORS

Richard Richmond worked in the Electro-Optics Technology Division of the Air Force Research Laboratory prior to his retirement in 2009. He was the Team Leader for Laser Radar Technology in the Multi-function Electro-optics Branch. Mr. Richmond has been the Project Engineer or Program Manager on numerous laser radar development and research efforts. Application areas of the various efforts have included both ground-based and airborne wind sensing, imaging and vibration sensing of hard targets, and remote chemical sensing. He has over 30 years experience in the development and application of laser based remote sensing, and is a Fellow of the MSS.

Stephen Cain is an associate professor of electrical engineering at the Air Force Institute of Technology. He received his B.S.E.E. from the University of Notre Dame in 1992, his M.S.E.E. from Michigan Technological University in 1994 and a Ph.D. in Electrical Engineering from the University of Dayton in 2001. He has served as a Captain in the United States Air Force, a Senior Scientist at Wyle Laboratories and a Senior Engineer at ITT/Aerospace and Communication Division. Dr. Cain has published a number of papers related to LADAR imaging and ranging and teaches a course on LADAR systems at AFIT.

COURSE PRICE INCLUDES the text *Direct Detection LADAR Systems* (SPIE Press, 2010) by Richard Richmond and Stephen Cain.

Optical Phased Array Technologies and Systems

SC1033

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

This course is an introduction to Optical Phased Arrays and their applications in active electro-optical systems, including high energy laser systems, long range laser imaging and laser communications. The course will develop an understanding of high resolution imaging using multiple sub-apertures, high resolution laser beam projection using multiple sub-apertures, optical phased array beam steering, phased array beam propagation, adaptive optics as applied to phased arrays, and modeling of phased array systems.

Phased array component technologies to be covered will include fiber laser sources, high and low bandwidth imaging cameras, beam transport in fibers, non-mechanical beam steering elements, and other system elements. Some systems issues discussed will include system efficiencies, optical isolation for transmitters and imagers, acquisition, tracking and pointing (ATP), phased array fire control, and system weight and volume estimation.

LEARNING OUTCOMES

This course will enable you to:

- design methods for phasing multiple optical sub-apertures to create a high resolution far field laser beam
- design wide angle, high efficiency, non-mechanical beam steering subsystems
- utilize methods for phasing multiple optical sub-apertures to create high resolution images
- describe optical phased array propagation for weapons, sensing, and communications
- design phased array adaptive optics
- utilize phased array HEL performance modeling, including isolation, steering, laser sources, ATP, and fire control
- design phased array subsystems including laser sources, high and low bandwidth imaging cameras, beam transport and phasing elements, and thermal and power management subsystems
- evaluate phased array systems and applications, including generic and mission specific system architectures

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to learn more about how to design or use optical phased array based EO systems. Undergraduate training in engineering or science is assumed.

INSTRUCTORS

Kevin Probst is president and founder of The CORE Group, an independent defense consulting firm. He has spent over seven years in phased array research, modeling, analysis, and concept development. Previous experience includes the Airborne Laser Lab (ALL), Charles Stark Draper Labs, the AFRL Beam Control Division, the LEAPS Division, and the Strategic Defense Initiative Office (SDIO) where he served as the head of the ATP/FC division. Mr. Probst also served as Chief Scientist on the Zenith Star Space Based Laser program. For AFRL and DARPA he has worked on Phased Array beam control under programs such as Steered Agile Beam (STAB), Phased Array of Phased Arrays (PAPA), the JTO HIPOP/HIPAT projects, the AFRL/RY Phased Array Aperture Study, and the DARPA Adaptive Photonic Phase Locked Elements (APPLE) program. He also served on the initial Beam Control Technology Area Working Group (TAWG) for JTO, and at the DDR&E Directed Energy Group. Kevin is a retired Air Force officer.

Paul McManamon is an independent consultant and works half time as the Technical Director of the Ladar and Optical Communications institute, LOCI, at the University of Dayton. Until May of 2008 he was chief scientist for the Sensors Directorate, Air Force Research Laboratory, Air Force Material Command, Wright-Patterson Air Force Base, Ohio. Dr. McManamon is a Fellow of SPIE, IEEE, OSA, the Air Force Research Laboratory, and the Military Sensing Symposia, MSS. He was the 2006 President of SPIE. Dr. McManamon received the WRG Baker award from the IEEE in 1998 for the best paper in any refereed IEEE journal or publication. He was Vice Chairman of a recently concluded National Academy of Sciences study called “Seeing Photons”.

Military Laser Safety

SC1035

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Wednesday 8:30 am to 5:30 pm

This course explains the basic hazards associated with the use of lasers commonly encountered by military and law enforcement personnel, with particular emphasis on operation in an outdoor environment. Both laser classification and certification of laser products will be covered. The Department of Defense has an exemption from the Food and Drug Administration that allows manufacturers to produce military specific laser devices not available to the general public. The rules for using the Department of Defense exemption or obtaining a variance to purchase these special purpose products are explained.

LEARNING OUTCOMES

This course will enable you to:

- describe how a laser could cause personal injury to either the eye or skin
- describe how laser exposure limits were developed
- describe visual interference levels
- describe nominal ocular hazard distance and nominal skin hazard distance
- list differences in laser classification according to the:
  - Food and Drug Administration (FDA),
  - International Electrotechnical Commission (IEC), and
  - American National Standards Institute (ANSI)
- describe eye protection specifications for glasses and filters, such as optical density and visual transmission
- classify military applications of lasers, such as range finding, designating targets, dazzling
- manufacture and sell a federally compliant laser product
- learn the origin of the military exemption - 76 EL-01 DOD
- know whether your product meets the criteria for a military specific product
- know what features are required for a military specific product
- purchase a military specific laser product from a manufacturer
- dispose of a military specific laser product that has been manufactured under 76 EL-01 DOD
- evaluate the variance process for making a product not fully in compliance with federal product performance standards
- request evaluation of a system designed for joint military service use

INTENDED AUDIENCE

Engineers, scientists, technicians and managers involved in the development of laser-based defense related products who need to understand the regulatory process for certifying these devices. Military and civilian personnel, involved in operations, range safety, and procurement, who want to understand the safety issues involved with the field use of lasers.

INSTRUCTOR

Wesley Marshall has been involved with military laser safety for almost 40 years and has been involved with the development of laser safety standards and military products. He has evaluated hundreds of military specific laser systems and has published dozens of articles in peer reviewed technical journals. He has taught laser safety courses for the US Army, Occupational Safety and Health Administration, North Atlantic Treaty Organization, Laser Institute of America, and Rockwell Laser Industries. For over three years, he served as manager for the Army Institute of Health Laser/Optical Radiation Program (formerly known as CHPPM).

Diode Pumped Alkali Lasers

SC1036

Course level: Intermediate
CEU .35 Member $275 / Non-member $325 USD
Wednesday 1:30 to 5:30 pm

The quest for a high power, electrically driven laser with excellent thermal management, lightweight packaging, and high brightness for tactical military applications may be realized with the advent of the Diode Pumped Alkali Laser (DPAL). The concept of using a gas phase medium for the phasing of large diode arrays via a highly efficient, cyclical photon engine combines the best features of electrically driven lasers with the inherent thermal management advantages of a gas lasers. Indeed, the DPAL concept has sparked great interest within the Directed Energy community resulting in a number of recent low power, highly efficient laser demonstrations. A modest national effort is underway to exploit this technology for military applications.

Early laser demonstrations of the Diode Pumped Alkali Laser achieved output powers of 1-3 W in both rubidium and cesium with slope efficiencies as high as 82%. More recently, cw output powers as high as 145 W with in-band slope efficiencies of 28% have been reported. The system is a three level laser pumped by diode bars on the D2 transition, exciting the first 2P3/2 state of the alkali atom. Collisional relaxation to the 2P1/2 state is accomplished with a spin orbit relaxing gas such as ethane or methane, while pressure broadening of the absorption line has routinely been accomplished with He. The excited alkali atom then lases on the D1 line back to the ground state. Terminating the laser level at the ground state requires the gain volume to be fully bleached before achieving an inversion between the 2P1/2 and 2S1/2 states, resulting in pump threshold values of ~1 kW/cm^2.

This course will develop the background spectroscopy and kinetics of the DPAL system, summarize recent laser demonstrations, discuss narrow banding of diode pump sources, develop the key performance and scaling equations, and outline several issues in the development of these devices.

LEARNING OUTCOMES

This course will enable you to:
- describe the history of optically pumped alkali laser development
- describe the operating principles of Diode Pumped Alkali Lasers
- calculate the DPAL absorption and stimulated emission cross-sections
- explain the hyperfine structure of the D1 and D2 lines of alkali atoms
- be familiar with narrow banding of diode pump sources
- use the DPAL kinetic database for laser modeling
- quantify the performance of DPAL devices including threshold, slope efficiency, and intensity scaling
- identify alternative schemes for infrared and visible optically pumped alkali lasers
- evaluate the prospects for scaling DPAL systems to high power
- assess the impact of atmospheric transmission at DPAL wavelengths

INTENDED AUDIENCE

Scientists and engineers with a basic understanding of lasers who seek understanding of the principles, performance limitations and applications of optically pumped alkali vapor lasers.

INSTRUCTOR

Glen Perram has served as Professor of Physics at the Air Force Institute of Technology since 1989. His research interests include chemical lasers, high power gas lasers, optical remote sensing of battlespace combustion events, and the modeling and simulation of laser weapons. He is the author of the recently released textbook entitled “Introduction to Laser Weapons Systems” and a fellow of the Directed Energy Professional Society. He received his PhD in applied physics from the Air Force Institute of Technology in 1986.

Sensor Data and Information Exploitation

Fundamentals of Automatic Target Recognition

SC158

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

This course is an overview of ATR systems, architecture, and components. Throughout the course various ATR sensors are discussed including: FLIR, SAR, LIDAR, and others. First, the course describes ATR system architecture. The course provides an overview of various ATR modules: preprocessing, image and signal enhancement, target detection, segmentation, feature extraction, and classifications. The course describes various features extraction techniques and classification methods, ranging from traditional statistical pattern recognition approaches to model-based techniques. The course presents an overview of advanced ATR concepts such as: multi-sensor systems, modeling and phenomenology, adaptive and neural net based methods, and other artificial intelligence techniques are described. Finally, we discuss evaluation techniques of ATR systems.

LEARNING OUTCOMES

This course will enable you to:
- have a broad understanding of ATR systems and technology
- have knowledge of current technology limitations
- describe key research areas and trends

INTENDED AUDIENCE

This course is for engineers entering the field or currently working in ATR, managers and marketing personnel, and program managers.

INSTRUCTOR

Firooz Sadjadi is a senior staff research scientist at Lockheed Martin Corporation where he is engaged in theoretical and experimental research related to Signal and Image Processing, automatic target recognition, target tracking and information fusion. He has served as the Chairman of the annual ATR Conference for the past 20 years. He has authored more than 150 publications, holds 11 US and International Patents and is the author of seven book chapters and editor of several books: Automatic Target Recognition Systems (2000), Sensor and Data Fusion (1996), Performance Evaluations of Signal and Image Processing Systems (1993), and The Physics of Automatic Target Recognition (2007). He received a BSEE from Purdue University in 1972, MSEE in 1974, and DEE in 1976 from the University of Southern California. He is a Fellow of SPIE.

Predicting Target Acquisition Performance of Electro-Optical Imagers

SC181

Course level: Advanced
CEU .65 Member $520 / Non-member $610 USD
Tuesday 8:30 am to 5:30 pm

This course describes how to predict and evaluate electro-optical (EO) imager performance. Metrics that quantify imager resolution are described. The detection, recognition, and identification tasks are discussed, and the meaning of acquisition probabilities is explained. The basic theory of operation of thermal imagers, image intensifiers, and video cameras is presented. This course describes how to quantify the resolution and noise characteristics of an EO imager. The theory and analysis of sampled imagers is emphasized. Image quality metrics are described, and the relationship between image quality and target acquisition performance is explained. The course provides a complete overview of how to analyze and evaluate the performance of EO imagers.

LEARNING OUTCOMES

This course will enable you to:
- describe what a target acquisition model does
- describe the operation of thermal sensors, video cameras and other EO imagers
- analyze the impact of sampling on targeting performance
- evaluate the targeting performance of an EO imager

INTENDED AUDIENCE

This course is intended for the design engineer or system analyst who is interested in quantifying the performance of EO imagers. Some background in linear systems analysis is helpful but not mandatory.

INSTRUCTOR

Richard Vollmerhausen recently retired from the Army's Night Vision and Electronic Sensors Directorate. He is currently consulting. Mr. Vollmerhausen is the developer of the current generation of target acquisition models used by the Army.

COURSE PRICE INCLUDES the text *Analysis of Sampled Imaging Systems* (SPIE Press, 2010) by Richard H. Vollmerhausen, Ronald G. Driggers, and Don Reago.

Multispectral and Hyperspectral Image Sensors

SC194

Course level: Advanced
CEU .35 Member $275 / Non-member $325 USD
Wednesday 8:30 am to 12:30 pm

This course will describe the imaging capabilities and applications of the principal types of multispectral (MS) and hyperspectral (HS) sensors. The focus will be on sensors that work in the visible, near-infrared and shortwave-infrared spectral regimes, but the course will touch on longwave-infrared applications. A summary of the salient features of classical color imaging (human observation) will also be provided in an appendix.

LEARNING OUTCOMES

This course will enable you to:
- understand many of the applications and advantages of multispectral (MS) and hyperspectral (HS) imaging
- describe and categorize the properties of the principal MS / HS design types (multi-band scanner, starers with filter wheels, dispersive, wedge, and Fourier transform imagers with 2D arrays, etc.)
- list and define the relevant radiometric radiometric quantities, concepts and phenomenology
- understand the process of translating system requirements into sensor hardware constraints and specifications
- analyze signal-to-noise ratio, modulation-transfer-function, and spatial / spectral sampling for MS and HS sensors
- define, understand and apply the relevant noise-equivalent figures-of-merit (Noise-equivalent reflectance difference, Noise-equivalent temperature difference, Noise-equivalent spectral radiance, Noise-equivalent irradiance, etc.)
- describe the elements of the image chain from photons-in to bits-out (photon detection, video signal manipulation, analog processing, and digitization)
- list and review key imager subsystem technology elements (optical, focal plane, video electronics, and thermal)
- formulate a detailed end-to-end design example of a satellite imaging scanning HS sensor
- provide an appendix that summarizes color imaging principles and sensor associated elements for human observation applications (e.g. color television, still cameras, etc.)

INTENDED AUDIENCE

Engineers, scientists, and technical managers who are interested in understanding and applying multispectral and hyperspectral sensors in advanced military, civil, scientific and commercial applications.

INSTRUCTOR

Terrence Lomheim holds the position of Distinguished Engineer at The Aerospace Corp. He has 32 years of hardware and analysis experience in visible and infrared electro-optical systems, focal plane technology, and applied optics, and has authored and co-authored 53 publications in these technical areas. He is a Fellow of the SPIE.

COURSE PRICE INCLUDES the text *CMOS/CCD Sensors and Camera Systems, 2nd edition* (SPIE Press, 2011) by Terrence Lomheim and Gerald Holst.

Multisensor Data Fusion for Object Detection, Classification and Identification

SC994

Course level: Introductory
CEU .65 Member $550 / Non-member $640 USD
Tuesday 8:30 am to 5:30 pm

This course describes sensor and data fusion methods that improve the probability of correct target detection, classification, and identification. The methods allow the combining of information from collocated or dispersed sensors that utilize similar or different signature-generation phenomenologies. Examples provide insight as to how different phenomenology-based sensors enhance a data fusion system.

After introducing the JDL data fusion and resource management model, sensor and data fusion architectures are described in terms of sensor-level, central-level, and hybrid fusion, and pixel-, feature-, and decision-level fusion. The data fusion algorithm taxonomies that follow provide an introduction to the descriptions of the algorithms and methods utilized for detection, classification, identification, and state estimation and tracking - the Level 1 fusion processes. These algorithms support the higher-level data fusion processes of situation and threat assessment.

Subsequent sections of the course more fully develop the Bayesian, Dempster-Shafer, and voting logic data fusion algorithms. Examples abound throughout the material to illustrate the major techniques being presented. The illustrative problems demonstrate that many of the data fusion methods can be applied to combine information from almost any grouping of sensors as long as they can supply the input data required by the fusion algorithm. Practitioners who want to identify the input quantities or parameters needed to implement data fusion will benefit from taking this course.

LEARNING OUTCOMES

This course will enable you to:
- identify multisensor data fusion principles, algorithms, and architectures for new and existing systems
- describe the advantages of multisensor data fusion for object discrimination and state estimation
- select appropriate sensors for specific sensor and data fusion applications

- identify potential algorithms for target detection, classification, identification, and tracking
- formulate sensor and data fusion approaches for many practical applications
- compare the detection and classification ability of many data fusion algorithms to those available without data fusion
- acquire the skills needed to develop and apply data fusion algorithms to more complex situations

INTENDED AUDIENCE

Engineers, scientists, managers, systems designers, military operations personnel, and other users of multisensor data fusion for target detection, classification, identification, and tracking of airborne, ground-based, and underwater targets will benefit from this course. Undergraduate training in engineering, science, or mathematics is assumed.

INSTRUCTOR

Lawrence Klein specializes in developing multiple sensor systems for tactical and reconnaissance military applications and homeland defense. His interests also include application of sensor and data fusion concepts to intelligent transportation systems. While at Hughes Aircraft Company, Dr. Klein developed missile deployment strategies and sensors for missile guidance. As Chief Scientist at Aerojet ElectroSystems TAMS Division, he was responsible for programs that integrated active and passive millimeter-wave and infrared multispectral sensors in satellites and smart "fire-and-forget" weapons. At Honeywell, he designed passive millimeter-wave midcourse missile guidance systems and millimeter-wave sensors to trigger land mines. In addition to the course text, Dr. Klein has authored Millimeter-Wave and Infrared Multisensor Design and Signal Processing (Artech House, 1997), Sensor Technologies and Data Requirements for ITS (Artech House, 2001), and the Traffic Detector Handbook for the Federal Highway Administration (2006).

COURSE PRICE INCLUDES the text *Sensor and Data Fusion: A Tool for Information Assessment and Decision Making* (SPIE Press, 2004) by Lawrence A. Klein.

Target Detection Algorithms for Hyperspectral Imagery

SC995

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

This course provides a broad introduction to the basic concept of automatic target and object detection and its applications in Hyperspectral Imagery (HSI). The primary goal of this course is to introduce the well known target detection algorithms in hyperspectral imagery. Examples of the classical target detection techniques such as spectral matched filter, subspace matched filter, adaptive matched filter, orthogonal subspace, support vector machine (SVM) and machine learning are reviewed. Construction of invariance subspaces for target and background as well as the use of regularization techniques are presented. Standard atmospheric correction and compensation techniques are reviewed. Anomaly detection techniques for HSI and dual band FLIR imagery are also discussed. Applications of HSI for detection of mines, targets, humans, chemical plumes and anomalies are reviewed.

LEARNING OUTCOMES

This course will enable you to:
- describe the fundamental concepts of target detection algorithms as applied to HSI
- learn the procedure to use the generalized maximum likelihood ratio test to design spectral detectors
- describe the fundamental differences between different detection algorithms based on their model representations
- develop statistical models as well as subspace models for HSI data
- explain the difference between anomaly detection and classification
- distinguish between linear and nonlinear approaches (SVM and Kernel learning techniques)
- develop anomaly detection techniques for different environmental scenarios
- describe linear models and unmixing techniques for abundance measures
- plot ROC curves to evaluate the performance of the algorithms

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to learn more about target detection in hyperspectral, multispectral or dual-band FLIR imagery. Undergraduate training in engineering or science is assumed.

INSTRUCTOR

Nasser Nasrabadi is a senior research scientist (ST) at US Army Research Laboratory (ARL). He is also an adjunct professor in the Electrical and Computer Engineering Department at the Johns Hopkins University. He is actively engaged in research in image processing, neural networks, automatic target recognition, and video compression and its transmission over high speed networks. He has published over 200 papers in journals and conference proceedings. He has been an associate editor for the IEEE Transactions on Image Processing,IEEE Transactions on Circuits and Systems for Video Technology and IEEE Transactions for Neural Networks. He is a Fellow of IEEE and SPIE.

Radar Micro-Doppler Signatures - Principles and Applications

SC1031

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Monday 1:30 to 5:30 pm

This course explains basic principles and applications of the micro-Doppler signatures of radar targets. A micro-Doppler signature is a distinctive characteristic of the intricate frequency modulations generated from each component part of a target and is represented in the joint time and Doppler frequency domain. Micro-Doppler signatures provide unique target features that are complementary to those made available by existing methods.

The primary goals of the course are to describe the radar micro-Doppler effect, the mathematical and dynamic models of targets with various motions and the analysis of micro-Doppler signatures. The course will present current applications of radar micro-Doppler signature analysis to target detection, characterization, and classification. Radar data returned from rigid body motion and non-rigid body motion will be used in the presentation examples as well as simulations. Examples are shown from state-of-the-art radars in both anechoic chambers and realistic environments.

LEARNING OUTCOMES

This course will enable you to:
- describe the motion and Doppler effect resulting from rigid and non-rigid body motion
- determine the Micro-Doppler effect observed by a radar
- describe the radar EM scattering from a body with motion
- perform micro-Doppler processing, estimation, and analysis
- describe Mono-static, bi-static and multi-static micro-Doppler signatures
- evaluate the micro-Doppler of simple rigid body motions like a windmill or the rotating rotor blades of a helicopter
- interpret the micro-Doppler signature of human walking and various other various human motions
- compare and classify the micro-Doppler signatures of humans, vehicles, and animals
- model the multi-static micro-Doppler signature
- perform micro-Doppler signature classification
- explain the role of angle of motion and lookdown angle on micro-Doppler

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to understand the micro-Doppler effect in radar, the analysis of micro-Doppler signature of targets, and the applications of micro-Doppler signature for target recognition, identification, and classification. University professors, graduate students, and industry professionals are likely to benefit from this tutorial. Undergraduate training in engineering or science is assumed.

INSTRUCTORS

Victor Chen is internationally recognized for his work on micro-Doppler signatures and time-frequency analysis. He has published more than 130 papers and articles in books, chapters in books, journals and proceedings including the text "Time-Frequency Transforms for Radar Imaging and Signal Analysis" and the recent new text "Micro-Doppler Effect in Radar - Principles and Applications". Dr. Chen is a Fellow of the IEEE.

David Tahmoush of the US Army Research Laboratory is contributing work on micro-Doppler signatures and classification analysis as well as example radar data. Dr. Tahmoush has published more than 30 papers and articles, and organizes the Workshop on Dismount Detection and Classification.

Military Laser Safety

SC1035

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Wednesday 8:30 am to 5:30 pm

This course explains the basic hazards associated with the use of lasers commonly encountered by military and law enforcement personnel, with particular emphasis on operation in an outdoor environment. Both laser classification and certification of laser products will be covered. The Department of Defense has an exemption from the Food and Drug Administration that allows manufacturers to produce military specific laser devices not available to the general public. The rules for using the Department of Defense exemption or obtaining a variance to purchase these special purpose products are explained.

LEARNING OUTCOMES

This course will enable you to:
- describe how a laser could cause personal injury to either the eye or skin
- describe how laser exposure limits were developed
- describe visual interference levels
- describe nominal ocular hazard distance and nominal skin hazard distance
- list differences in laser classification according to the:
  - Food and Drug Administration (FDA),
  - International Electrotechnical Commission (IEC), and
  - American National Standards Institute (ANSI)
- describe eye protection specifications for glasses and filters, such as optical density and visual transmission
- classify military applications of lasers, such as range finding, designating targets, dazzling
- manufacture and sell a federally compliant laser product
- learn the origin of the military exemption - 76 EL-01 DOD
- know whether your product meets the criteria for a military specific product
- know what features are required for a military specific product
- purchase a military specific laser product from a manufacturer
- dispose of a military specific laser product that has been manufactured under 76 EL-01 DOD
- evaluate the variance process for making a product not fully in compliance with federal product performance standards
- request evaluation of a system designed for joint military service use

INTENDED AUDIENCE

Engineers, scientists, technicians and managers involved in the development of laser-based defense related products who need to understand the regulatory process for certifying these devices. Military and civilian personnel, involved in operations, range safety, and procurement, who want to understand the safety issues involved with the field use of lasers.

INSTRUCTOR

Wesley Marshall has been involved with military laser safety for almost 40 years and has been involved with the development of laser safety standards and military products. He has evaluated hundreds of military specific laser systems and has published dozens of articles in peer reviewed technical journals. He has taught laser safety courses for the US Army, Occupational Safety and Health Administration, North Atlantic Treaty Organization, Laser Institute of America, and Rockwell Laser Industries. For over three years, he served as manager for the Army Institute of Health Laser/Optical Radiation Program (formerly known as CHPPM).

Signal, Image, and Neural Net Processing

Fundamentals of Electronic Image Processing

SC066

Course level: Introductory
CEU .65 Member $550 / Non-member $640 USD
Monday 8:30 am to 5:30 pm

Many disciplines of science and manufacturing acquire and evaluate images on a routine basis. Typically these images must be processed so that important features can be measured or identified This short course introduces the fundamentals of electronic image processing to scientists and engineers who need to know how to manipulate images that have been acquired and stored within a digital computer.

LEARNING OUTCOMES

This course will enable you to:
- understand image storage, acquisition, and digitization
- become familiar with image transforms such as Fourier, Hough, Walsh, Hadamar, Discrete Cosine, and Hotelling
- understand the difference between the types of linear and non-linear filters and when to use each
- learn the difference between types of noise in the degradation of an image
- apply color image processing techniques to enhance key features in color and gray scale images
- recognize image segmentation techniques and how they are used to extract objects from an image
- understand software approaches to image processing
- demonstrate how to use the UCFImage image processing software program included with the course.

INTENDED AUDIENCE

This course will be useful to engineers and scientists who have a need to understand and use image processing techniques, but have no formal training in image processing. It will give the individual insight into a number of complex algorithms as it applies to several different applications of this very interesting and important field.

INSTRUCTOR

Arthur Weeks holds an associate professor position with the Dept. of Electrical and Computer Engineering at the Univ. of Central Florida. He recently left his position as a vice president of corporate technology to continue his research in image processing and bio-medical signal processing. He has published over 30 articles and three books in image processing.

COURSE PRICE INCLUDES the text *Fundamentals of Electronic Image Processing* (SPIE Press, 1996) by Arthur Weeks.

Super Resolution in Imaging Systems

SC946

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Tuesday 8:30 to 5:30 pm

This course provides an introduction to the signal processing methods used to increase image resolution. Specifically, it provides attendees with the practical knowledge to estimate the benefits of using super resolution in an imaging system as well as the guidance to select the right super resolution method for a given application.

The course is divided into three parts. In the first part, we describe the fundamental limits to resolution in an imaging system and establish the necessity of using signal processing as a mean to achieve super resolution. In the second part we focus on different super resolution techniques. Specifically, we cover defocus based techniques, zoom based techniques, photometry based techniques and edge enhancement based techniques.

In the third part of the course we provide some real life examples from various imaging fields to establish how the super resolution techniques work. The attendee will therefore benefit from a concise and realistic overview of current signal processing methods for super resolution, and thus be able to make the right decision when it comes to accessing the potential use of super resolution for a specific product development.

LEARNING OUTCOMES

This course will enable you to:
- explain the concept of point-spread function (PSF), modulation transfer function (MTF) and other key imaging functions along with the principles of image processing
- choose the right resolution enhancement method for your application from the range of available technologies in signal processing
- choose the right technology for the right performance/computation cost ratio
- compare the benefits and limitations of each resolution enhancement technology and describe the fundamentals of each method
- describe where signal processing for super resolution is applied today and where it may be applied tomorrow

INTENDED AUDIENCE

This course is intended for scientists, engineers, researchers, physicists, product development managers, directors of engineering, development engineers, or anyone who is interested in increasing resolution of imaging systems. The course helps the students to understand why, when and how to use signal processing to increase resolution in existing imaging systems and/or product lines and new product development programs, in order to decrease production costs, increase optical performance, or simply find new solutions to existing technological problems.

INSTRUCTORS

Saeed Bagheri (PhD) is with the IBM Thomas J. Watson Research Center in Yorktown Heights, NY. He received his B.S. from Sharif University of Technology in 2004. Later that year he joined Massachusetts Institute of Technology for his graduate studies where he graduated with two M.S. and a Ph.D. in 2007 majoring in Optics and Optimization. He has been with IBM since then. He has several refereed published articles as well as conference papers.

Bahram Javidi (PhD) is Board of Trustees Distinguished Professor at the University of Connecticut. He received his B.S. in Electrical Engineering from George Washington University in 1980 and his M.S. and Ph.D. in Electrical Engineering from the Pennsylvania State University in 1982 and 1986, respectively. Prof. Javidi is fellows of seven professional societies, including IEEE, OSA and SPIE. He has authored more than 620 book, chapter, refereed published articles, and conference papers. He was awarded the Alexander von Humboldt Prize for senior US scientists. He has received the SPIE Gabor Award and SPIE Technology Achievement award.

Applications of Detection Theory

SC952

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

The fundamental goal of this course is to enable you to assess and explain the performance of sensors, detectors, diagnostics, or any other type of system that is attempting to give, with some level of confidence, a determination of the presence or absence of a "target." In this case the term "target" may be a wide variety of types (e.g. a biological pathogen or chemical agent; or a physical target of some sort; or even just some electronic signal). We will rigorously cover the theory and mathematics underlying the construction of the "Receiver Operating Characteristic" (ROC) curve, including dichotomous test histograms, false positives, false negatives, sensitivity, specificity, and total accuracy. In addition, we will discuss in depth the theory behind "Decision Tree Analysis" culminating with an in class exercise. Decision tree analysis allows one to "fuse together" multivariate signals (or results) in such a manner as to produce a more accurate outcome than would have been attained with any one signal alone. This course includes two major in class exercises: the first will involve constructing a ROC curve from real data with the associated analysis; the second will involve constructing a complete decision tree including the new (improved) ROC curve. The first exercise will be ~30min in length, and the second will be ~60min.

LEARNING OUTCOMES

This course will enable you to:
- define false positives, false negatives and dichotomous test
- define sensitivity, specificity, limit-of-detection, and response time
- comprehend and analyze a dose-response curve
- construct and analyze a Receiver Operating Characteristic (ROC) curve from raw data
- define Positive Predictive Value (PPV) and Negative Predictive Value (NPV)
- analyze statistical data and predict results
- describe the process and theory underlying decision tree analysis
- construct and analyze a decision tree using real data
- construct a "Spider Chart" from system-level attributes
- interpret sensor performance trade-offs using a ROC curve

INTENDED AUDIENCE

This course designed for scientists, engineers, and researchers that are involved in sensor design and development, particular from the standpoint of complex data analysis. Application areas for which Detection Theory is most relevant includes biological detection, medical diagnostics, radar, multi-spectral imaging, explosives detection and chemical agent detection. A working knowledge of basic freshman-level statistics is useful for this course.

INSTRUCTOR

John Carrano is President of Carrano Consulting. Previously, he was the Vice President, Research & Development, Corporate Executive Officer, and Chairman of the Scientific Advisory Board for Luminex Corporation, where he led the successful development of several major new products from early conception to market release and FDA clearance. Before joining Luminex, Dr. Carrano was as a Program Manager at DARPA, where he created and led several major programs related to bio/chem sensing, hyperspectral imaging and laser systems. He retired from the military as a Lieutenant Colonel in June 2005 after over 24 years' service; his decorations include the "Defense Superior Service Medal" from the Secretary of Defense. Dr. Carrano is a West Point graduate with a doctorate in Electrical Engineering from the University of Texas at Austin. He has co-authored over 50 scholarly publications and has 3 patents pending. He is the former DSS Symposium Chairman (2006-2007), and is an SPIE Fellow.

COURSE PRICE INCLUDES a free PDF copy of the report, "Chemical and Biological Sensor Standards Study" (Principal author, Dr. John C. Carrano.)

Multisensor Data Fusion for Object Detection, Classification and Identification

SC994

Course level: Introductory
CEU .65 Member $550 / Non-member $640 USD
Tuesday 8:30 am to 5:30 pm

This course describes sensor and data fusion methods that improve the probability of correct target detection, classification, and identification. The methods allow the combining of information from collocated or dispersed sensors that utilize similar or different signature-generation phenomenologies. Examples provide insight as to how different phenomenology-based sensors enhance a data fusion system.

After introducing the JDL data fusion and resource management model, sensor and data fusion architectures are described in terms of sensor-level, central-level, and hybrid fusion, and pixel-, feature-, and decision-level fusion. The data fusion algorithm taxonomies that follow provide an introduction to the descriptions of the algorithms and methods utilized for detection, classification, identification, and state estimation and tracking - the Level 1 fusion processes. These algorithms support the higher-level data fusion processes of situation and threat assessment.

Subsequent sections of the course more fully develop the Bayesian, Dempster-Shafer, and voting logic data fusion algorithms. Examples abound throughout the material to illustrate the major techniques being presented. The illustrative problems demonstrate that many of the data fusion methods can be applied to combine information from almost any grouping of sensors as long as they can supply the input data required by the fusion algorithm. Practitioners who want to identify the input quantities or parameters needed to implement data fusion will benefit from taking this course.

LEARNING OUTCOMES

This course will enable you to:
- identify multisensor data fusion principles, algorithms, and architectures for new and existing systems
- describe the advantages of multisensor data fusion for object discrimination and state estimation
- select appropriate sensors for specific sensor and data fusion applications
- identify potential algorithms for target detection, classification, identification, and tracking
- formulate sensor and data fusion approaches for many practical applications
- compare the detection and classification ability of many data fusion algorithms to those available without data fusion
- acquire the skills needed to develop and apply data fusion algorithms to more complex situations

INTENDED AUDIENCE

Engineers, scientists, managers, systems designers, military operations personnel, and other users of multisensor data fusion for target detection, classification, identification, and tracking of airborne, ground-based, and underwater targets will benefit from this course. Undergraduate training in engineering, science, or mathematics is assumed.

INSTRUCTOR

Lawrence Klein specializes in developing multiple sensor systems for tactical and reconnaissance military applications and homeland defense. His interests also include application of sensor and data fusion concepts to intelligent transportation systems. While at Hughes Aircraft Company, Dr. Klein developed missile deployment strategies and sensors for missile guidance. As Chief Scientist at Aerojet ElectroSystems TAMS Division, he was responsible for programs that integrated active and passive millimeter-wave and infrared multispectral sensors in satellites and smart “fire-and-forget” weapons. At Honeywell, he designed passive millimeter-wave midcourse missile guidance systems and millimeter-wave sensors to trigger land mines. In addition to the course text, Dr. Klein has authored Millimeter-Wave and Infrared Multisensor Design and Signal Processing (Artech House, 1997), Sensor Technologies and Data Requirements for ITS (Artech House, 2001), and the Traffic Detector Handbook for the Federal Highway Administration (2006).

COURSE PRICE INCLUDES the text *Sensor and Data Fusion: A Tool for Information Assessment and Decision Making* (SPIE Press, 2004) by Lawrence A. Klein.

Target Detection Algorithms for Hyperspectral Imagery

SC995

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

This course provides a broad introduction to the basic concept of automatic target and object detection and its applications in Hyperspectral Imagery (HSI). The primary goal of this course is to introduce the well known target detection algorithms in hyperspectral imagery. Examples of the classical target detection techniques such as spectral matched filter, subspace matched filter, adaptive matched filter, orthogonal subspace, support vector machine (SVM) and machine learning are reviewed. Construction of invariance subspaces for target and background as well as the use of regularization techniques are presented. Standard atmospheric correction and compensation techniques are reviewed. Anomaly detection techniques for HSI and dual band FLIR imagery are also discussed. Applications of HSI for detection of mines, targets, humans, chemical plumes and anomalies are reviewed.

LEARNING OUTCOMES

This course will enable you to:
- describe the fundamental concepts of target detection algorithms as applied to HSI
- learn the procedure to use the generalized maximum likelihood ratio test to design spectral detectors
- describe the fundamental differences between different detection algorithms based on their model representations
- develop statistical models as well as subspace models for HSI data
- explain the difference between anomaly detection and classification
- distinguish between linear and nonlinear approaches (SVM and Kernel learning techniques)
- develop anomaly detection techniques for different environmental scenarios
- describe linear models and unmixing techniques for abundance measures
- plot ROC curves to evaluate the performance of the algorithms

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to learn more about target detection in hyperspectral, multispectral or dual-band FLIR imagery. Undergraduate training in engineering or science is assumed.

INSTRUCTOR

Nasser Nasrabadi is a senior research scientist (ST) at US Army Research Laboratory (ARL). He is also an adjunct professor in the Electrical and Computer Engineering Department at the Johns Hopkins University. He is actively engaged in research in image processing, neural networks, automatic target recognition, and video compression and its transmission over high speed networks. He has published over 200 papers in journals and conference proceedings. He has been an associate editor for the IEEE Transactions on Image Processing,IEEE Transactions on Circuits and Systems for Video Technology and IEEE Transactions for Neural Networks. He is a Fellow of IEEE and SPIE.

Sensing for Industry, Environment, and Health

Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies

SC719

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Monday 8:30 am to 12:30 pm

This course introduces chemical and biological detection and identification techniques which are commonly utilized for military and civil applications. Remote and sampled detection, discrimination, and identification techniques are introduced with design parameters and performance models. A sampling of specific technology applications for chemical point, chemical standoff, biological point, and biological standoff sensing will be described. These technologies include Mass Spectrometry, Ion Mobility Spectrometry, Raman Spectroscopy, Fourier Transform Infrared Spectroscopy, Differential Absorption Lidar, Laser-Induced Fluorescence, Laser-Induced Breakdown Spectroscopy and others. The course will include a brief overview of chemical and biological agents and features which may be interrogated by detection systems.

LEARNING OUTCOMES

This course will enable you to:
- list and analyze chemical/biological detection and discrimination techniques
- describe the trade space for point and standoff detection
- estimate spatial, spectral, and temporal variations in chemical/biological media
- formulate fundamental design and performance equations for chemical/biological sensors
- compare mass and mobility techniques for point detection
- compare active and passive techniques for standoff detection

INTENDED AUDIENCE

This course is intended for those interested in the design and development of chemical and biological sensors for applications ranging from military to industrial sensing. It is an overview course with a survey of a broad class of sensing techniques. Mathematical models for the various sensors will be presented and discussed; however, this course does not require an in-depth understanding of the mathematical principles to appreciate the technological benefits of the various approaches. Some background in electro-optical and infrared systems is helpful, but not required.

INSTRUCTOR

Patrick Gardner is a program manager for the Charles Stark Draper Laboratory. He received a B.S. from the University of Florida and a M.S. and Ph.D. in Electrical Engineering from the Air Force Institute of Technology. He is a retired Lt. Colonel, U.S. Air Force, with 25 years of active-duty service. He was assigned to the U.S. Special Operations Command as a technical liaison officer for both the U.S. Air Force and the U.S. Dept. of Energy. Following active duty he served as Chief Scientist for General Dynamics ATP, Chemical & Biological Detection and Countermeasures. He is an adjunct professor for the electrical engineering department at Western Carolina University and regularly teaches professional short courses in chemical and biological detection for Georgia Tech University and others.

The information contained in this written material was developed from a compilation of sources available in the open literature. The information delivered in written and oral form does not represent the official position or interests of, or endorsement by any Federal or state departments or affiliated agencies. Specific vendor products are used as representative examples only and are not intended as critiques or endorsements of specific products and technologies.

Applications of Detection Theory

SC952

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

The fundamental goal of this course is to enable you to assess and explain the performance of sensors, detectors, diagnostics, or any other type of system that is attempting to give, with some level of confidence, a determination of the presence or absence of a "target." In this case the term "target" may be a wide variety of types (e.g. a biological pathogen or chemical agent; or a physical target of some sort; or even just some electronic signal). We will rigorously cover the theory and mathematics underlying the construction of the "Receiver Operating Characteristic" (ROC) curve, including dichotomous test histograms, false positives, false negatives, sensitivity, specificity, and total accuracy. In addition, we will discuss in depth the theory behind "Decision Tree Analysis" culminating with an in class exercise. Decision tree analysis allows one to "fuse together" multivariate signals (or results) in such a manner as to produce a more accurate outcome than would have been attained with any one signal alone. This course includes two major in class exercises: the first will involve constructing a ROC curve from real data with the associated analysis; the second will involve constructing a complete decision tree including the new (improved) ROC curve. The first exercise will be ~30min in length, and the second will be ~60min.

LEARNING OUTCOMES

This course will enable you to:
- define false positives, false negatives and dichotomous test
- define sensitivity, specificity, limit-of-detection, and response time
- comprehend and analyze a dose-response curve
- construct and analyze a Receiver Operating Characteristic (ROC) curve from raw data
- define Positive Predictive Value (PPV) and Negative Predictive Value (NPV)
- analyze statistical data and predict results
- describe the process and theory underlying decision tree analysis
- construct and analyze a decision tree using real data
- construct a "Spider Chart" from system-level attributes
- interpret sensor performance trade-offs using a ROC curve

INTENDED AUDIENCE

This course designed for scientists, engineers, and researchers that are involved in sensor design and development, particular from the standpoint of complex data analysis. Application areas for which Detection Theory is most relevant includes biological detection, medical diagnostics, radar, multi-spectral imaging, explosives detection and chemical agent detection. A working knowledge of basic freshman-level statistics is useful for this course.

INSTRUCTOR

John Carrano is President of Carrano Consulting. Previously, he was the Vice President, Research & Development, Corporate Executive Officer, and Chairman of the Scientific Advisory Board for Luminex Corporation, where he led the successful development of several major new products from early conception to market release and FDA clearance. Before joining Luminex, Dr. Carrano was as a Program Manager at DARPA, where he created and led several major programs related to bio/chem sensing, hyperspectral imaging and laser systems. He retired from the military as a Lieutenant Colonel in June 2005 after over 24 years' service; his decorations include the "Defense Superior Service Medal" from the Secretary of Defense. Dr. Carrano is a West Point graduate with a doctorate in Electrical Engineering from the University of Texas at Austin. He has co-authored over 50 scholarly publications and has 3 patents pending. He is the former DSS Symposium Chairman (2006-2007), and is an SPIE Fellow.

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Target Detection Algorithms for Hyperspectral Imagery

SC995

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

This course provides a broad introduction to the basic concept of automatic target and object detection and its applications in Hyperspectral Imagery (HSI). The primary goal of this course is to introduce the well known target detection algorithms in hyperspectral imagery. Examples of the classical target detection techniques such as spectral matched filter, subspace matched filter, adaptive matched filter, orthogonal subspace, support vector machine (SVM) and machine learning are reviewed. Construction of invariance subspaces for target and background as well as the use of regularization techniques are presented. Standard atmospheric correction and compensation techniques are reviewed. Anomaly detection techniques for HSI and dual band FLIR imagery are also discussed. Applications of HSI for detection of mines, targets, humans, chemical plumes and anomalies are reviewed.

LEARNING OUTCOMES

This course will enable you to:
- describe the fundamental concepts of target detection algorithms as applied to HSI
- learn the procedure to use the generalized maximum likelihood ratio test to design spectral detectors
- describe the fundamental differences between different detection algorithms based on their model representations
- develop statistical models as well as subspace models for HSI data
- explain the difference between anomaly detection and classification
- distinguish between linear and nonlinear approaches (SVM and Kernel learning techniques)
- develop anomaly detection techniques for different environmental scenarios
- describe linear models and unmixing techniques for abundance measures
- plot ROC curves to evaluate the performance of the algorithms

INTENDED AUDIENCE

Scientists, engineers, technicians, or managers who wish to learn more about target detection in hyperspectral, multispectral or dual-band FLIR imagery. Undergraduate training in engineering or science is assumed.

INSTRUCTOR

Nasser Nasrabadi is a senior research scientist (ST) at US Army Research Laboratory (ARL). He is also an adjunct professor in the Electrical and Computer Engineering Department at the Johns Hopkins University. He is actively engaged in research in image processing, neural networks, automatic target recognition, and video compression and its transmission over high speed networks. He has published over 200 papers in journals and conference proceedings. He has been an associate editor for the IEEE Transactions on Image Processing,IEEE Transactions on Circuits and Systems for Video Technology and IEEE Transactions for Neural Networks. He is a Fellow of IEEE and SPIE.

Lab-on-a-Chip Technology - Towards Portable Detection Systems

SC1034

NEW

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Friday 8:30 am to 12:30 pm

The miniaturization of analytical systems ultimately targets sample-in/result-out systems for the complete analysis of biological samples. Besides the enhanced performance of those systems - namely combining sample preparation, biological reaction, and the detection itself in one device - miniaturization enables the construction of portable systems for on-site analysis of suspicious samples. This course will provide a broad overview of the underlying technologies enabling the realization of a miniaturized integrated biological lab. It starts with the history over two decades of microfluidics and goes on to describe the fabrication technologies for miniaturized devices.

The main focus is the application of microfluidic components in biotechnology (e.g. separation techniques, PCR, Lab-on-a-Chip etc.) and chemistry (e.g. micro reactors, micro mixers etc.), leading finally to the challenges in their use for mobile detection of biological pathogens. Guidelines for the efficient development of microfluidic devices for mobile detection of biological agents will be presented, based on the microfluidic tool box concept. Finally, some hands-on tests with microfluidic devices will give the attendee an opportunity to get in touch with this novel technology.

LEARNING OUTCOMES

This course will enable you to:
- describe the basic physical and chemical principles of microfluidics
- identify the most interesting microfluidic components and their challenging applications in chemistry and life sciences
- review current products and development issues
- efficiently design microfluidic devices based on the microfluidic toolbox concept
- have microfluidic components fabricated for your own application

INTENDED AUDIENCE

This course will be of value for engineers and researchers from industry and academia, business developers, general managers with a need to learn about novel technologies, potential investors in microtechnology / microfluidics and anyone who is interested in the realization, application or commercialization of microfluidic components.

INSTRUCTOR

Claudia Gärtner PhD studied chemistry and biology at the University of Duesseldorf, Germany. She obtained her PhD in biochemistry and became involved with microtechnologies at the Institute of Microtechnology Mainz (IMM). In 1999 she took over the position of the director of the newly founded Application Center for Microtechnology Jena, Germany (amt). She was involved in the founding of the biotechnology start-up “x-zyme” (2001) and the microfluidic company “microfluidic ChipShop” (2002). In 2002 she was nominated for the German Founders Prize and decorated with the Thuringian award for the best business concept for microfluidic ChipShop. In March 2006 Dr. Gaertner was named CEO for microfluidic ChipShop. She is involved in a wide variety of research projects in the field of lab-on-a-chip systems. Furthermore, she is leading several collaborative R&D aiming in the development of portable systems for the detection of B-agents.

Information Systems and Networks: Processing, Fusion, and Knowledge Generation

Applications of Detection Theory

SC952

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

The fundamental goal of this course is to enable you to assess and explain the performance of sensors, detectors, diagnostics, or any other type of system that is attempting to give, with some level of confidence, a determination of the presence or absence of a "target." In this case the term "target" may be a wide variety of types (e.g. a biological pathogen or chemical agent; or a physical target of some sort; or even just some electronic signal). We will rigorously cover the theory and mathematics underlying the construction of the "Receiver Operating Characteristic" (ROC) curve, including dichotomous test histograms, false positives, false negatives, sensitivity, specificity, and total accuracy. In addition, we will discuss in depth the theory behind "Decision Tree Analysis" culminating with an in class exercise. Decision tree analysis allows one to "fuse together" multivariate signals (or results) in such a manner as to produce a more accurate outcome than would have been attained with any one signal alone. This course includes two major in class exercises: the first will involve constructing a ROC curve from real data with the associated analysis; the second will involve constructing a complete decision tree including the new (improved) ROC curve. The first exercise will be ~30min in length, and the second will be ~60min.

LEARNING OUTCOMES

This course will enable you to:
- define false positives, false negatives and dichotomous test
- define sensitivity, specificity, limit-of-detection, and response time
- comprehend and analyze a dose-response curve
- construct and analyze a Receiver Operating Characteristic (ROC) curve from raw data
- define Positive Predictive Value (PPV) and Negative Predictive Value (NPV)
- analyze statistical data and predict results
- describe the process and theory underlying decision tree analysis
- construct and analyze a decision tree using real data
- construct a "Spider Chart" from system-level attributes
- interpret sensor performance trade-offs using a ROC curve

INTENDED AUDIENCE

This course designed for scientists, engineers, and researchers that are involved in sensor design and development, particular from the standpoint of complex data analysis. Application areas for which Detection Theory is most relevant includes biological detection, medical diagnostics, radar, multi-spectral imaging, explosives detection and chemical agent detection. A working knowledge of basic freshman-level statistics is useful for this course.

INSTRUCTOR

John Carrano is President of Carrano Consulting. Previously, he was the Vice President, Research & Development, Corporate Executive Officer, and Chairman of the Scientific Advisory Board for Luminex Corporation, where he led the successful development of several major new products from early conception to market release and FDA clearance. Before joining Luminex, Dr. Carrano was as a Program Manager at DARPA, where he created and led several major programs related to bio/chem sensing, hyperspectral imaging and laser systems. He retired from the military as a Lieutenant Colonel in June 2005 after over 24 years' service; his decorations include the "Defense Superior Service Medal" from the Secretary of Defense. Dr. Carrano is a West Point graduate with a doctorate in Electrical Engineering from the University of Texas at Austin. He has co-authored over 50 scholarly publications and has 3 patents pending. He is the former DSS Symposium Chairman (2006-2007), and is an SPIE Fellow.

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Multisensor Data Fusion for Object Detection, Classification and Identification

SC994

Course level: Introductory
CEU .65 Member $550 / Non-member $640 USD
Tuesday 8:30 am to 5:30 pm

This course describes sensor and data fusion methods that improve the probability of correct target detection, classification, and identification. The methods allow the combining of information from collocated or dispersed sensors that utilize similar or different signature-generation phenomenologies. Examples provide insight as to how different phenomenology-based sensors enhance a data fusion system.

After introducing the JDL data fusion and resource management model, sensor and data fusion architectures are described in terms of sensor-level, central-level, and hybrid fusion, and pixel-, feature-, and decision-level fusion. The data fusion algorithm taxonomies that follow provide an introduction to the descriptions of the algorithms and methods utilized for detection, classification, identification, and state estimation and tracking - the Level 1 fusion processes. These algorithms support the higher-level data fusion processes of situation and threat assessment.

Subsequent sections of the course more fully develop the Bayesian, Dempster-Shafer, and voting logic data fusion algorithms. Examples abound throughout the material to illustrate the major techniques being presented. The illustrative problems demonstrate that many of the data fusion methods can be applied to combine information from almost any grouping of sensors as long as they can supply the input data required by the fusion algorithm. Practitioners who want to identify the input quantities or parameters needed to implement data fusion will benefit from taking this course.

LEARNING OUTCOMES

This course will enable you to:
- identify multisensor data fusion principles, algorithms, and architectures for new and existing systems
- describe the advantages of multisensor data fusion for object discrimination and state estimation
- select appropriate sensors for specific sensor and data fusion applications
- identify potential algorithms for target detection, classification, identification, and tracking
- formulate sensor and data fusion approaches for many practical applications
- compare the detection and classification ability of many data fusion algorithms to those available without data fusion
- acquire the skills needed to develop and apply data fusion algorithms to more complex situations

INTENDED AUDIENCE

Engineers, scientists, managers, systems designers, military operations personnel, and other users of multisensor data fusion for target detection, classification, identification, and tracking of airborne, ground-based, and underwater targets will benefit from this course. Undergraduate training in engineering, science, or mathematics is assumed.

INSTRUCTOR

Lawrence Klein specializes in developing multiple sensor systems for tactical and reconnaissance military applications and homeland defense. His interests also include application of sensor and data fusion concepts to intelligent transportation systems. While at Hughes Aircraft Company, Dr. Klein developed missile deployment strategies and sensors for missile guidance. As Chief Scientist at Aerojet ElectroSystems TAMS Division, he was responsible for programs that integrated active and passive millimeter-wave and infrared multispectral sensors in satellites and smart "fire-and-forget" weapons. At Honeywell, he designed passive millimeter-wave midcourse missile guidance systems and millimeter-wave sensors to trigger land mines. In addition to the course text, Dr. Klein has authored Millimeter-Wave and Infrared Multisensor Design and Signal Processing (Artech House, 1997), Sensor Technologies and Data Requirements for ITS (Artech House, 2001), and the Traffic Detector Handbook for the Federal Highway Administration (2006).

COURSE PRICE INCLUDES the text *Sensor and Data Fusion: A Tool for Information Assessment and Decision Making* (SPIE Press, 2004) by Lawrence A. Klein.

Innovative Defense and Security Applications for Displays

Head-Mounted Displays: Design and Applications

SC159

Course level: Introductory
CEU .65 Member $515 / Non-member $605 USD
Wednesday 8:30 am to 5:30 pm

Head-mounted displays (HMD) and the military counterpart helmet-mounted displays, are personal information-viewing devices that can provide information in a way that no other display can because the information is always available for viewing. By making the imagery reactive to head and body movements we replicate the way humans view, navigate and explore the world. This unique capability lends itself to applications such as Virtual Reality for creating artificial environments, medical visualization as an aid in surgical procedures, military vehicles for viewing sensor imagery, aircraft simulation and training, and for fixed and rotary wing avionics display applications.

This course covers design fundamentals for head-mounted displays from the user's point of view starting with the basics of human perception, head and neck biomechanics, image sources, optical design and head mounting. We will also discuss the impact of user task requirements and applications on various HMD parameters, as well as a detailed discussion of HMD optical designs (pupil and non-pupil forming, see-through and non-see-through, monocular, biocular and binocular, exit pupil and eye relief).

From there we will delve into various image source technologies, discussing advantages and disadvantages of the various approaches and methods for producing color imagery, with their implications for use in the near-eye presentation of imagery. We will also discuss head/neck anatomy and biomechanics and the implications of HMD weight and center of gravity on crash and ejection safety. Also presented will be guidelines for preventing eye fatigue, neck strain, cybersickness and other adverse physiological effects that have been attributed to poor HMD design. Throughout the course, we will use examples of current HMD systems and hardware to illustrate these issues.

LEARNING OUTCOMES

This course will enable you to:
- define basic components and attributes of head-mounted displays and visually coupled systems
- describe important features and enabling technologies of an HMD and their impact on user performance and acceptance
- identify key user-oriented performance requirements and link their impact on HMD design parameters
- list basic features of the human visual system and biomechanical attributes of the head and neck and the guidelines to follow to prevent fatigue or strain
- identify key tradeoffs for monocular, binocular and biocular systems
- classify current image source technologies and their methods for producing color imagery
- describe methods of producing wide field of view, high resolution HMDs
- evaluate tradeoffs for critical display performance parameters

INTENDED AUDIENCE

This course is intended for managers, engineers and scientists involved in the procurement, evaluation, specification or design of HMDs for air or ground-based applications.

INSTRUCTORS

James Melzer is Manager of Research and Technology at Rockwell Collins Optronics, in Carlsbad, California. He has extensive experience in optical and displays engineering, and is an expert in display design for head-mounted systems, aviation life-support, and user interface. He has authored over 35 technical papers and holds four patents in HMD design. He was recently IPT lead for the US Army's Future Force Warrior and Air Warrior Integrated Headgear Product teams.

Michael Browne is the Vice President of Product Development at SA Photonics in San Francisco, California. He has a Ph.D. in Optical Engineering from the University of Arizona's Optical Sciences Center. Mike has been involved in the design, test, and measurement of head mounted display systems since 1991. At Kaiser Electronics, Mike led the design of numerous head mounted display and rear-projection display systems, including those for the F-35 Joint Strike Fighter. Mike leads SA Photonics' efforts in the design and development of person-mounted information systems, including body-worn electronics, head-mounted displays and night vision systems. Mike's current research includes investigations into binocular rivalry in head mounted displays, simulator sickness prediction and prevention, and the design of wide field of view night vision systems.

COURSE PRICE INCLUDES the text *Head Mounted Displays: Designing for the User* (2011) by James Melzer and Kirk Moffitt.

Unmanned, Robotic, and Layered Systems

Incorporating GPS Technology into Commercial and Military Applications

SC549

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Wednesday 1:30 to 5:30 pm

The Global Positioning System (GPS) has evolved from its military roots to an ideal example of dual-use technology. This course briefly describes the GPS theory and the state of art in GPS technology. The issues involved in incorporating GPS in various commercial and military applications will be highlighted and various technologies will be illustrated using case studies.

LEARNING OUTCOMES

This course will enable you to:
- understand the basic principles and capabilities of GPS
- understand the GPS technology available for commercial and military applications
- be exposed to the latest advances in GPS
- identify the conditions under which certain levels of performance are achievable with current hardware and software

- identify commercially available GPS chipsets and modules
- evaluate concepts of GPS integration with other sensors
- evaluate the suitability of GPS as an alternative means of positioning, attitude, and time determination

INTENDED AUDIENCE

This course is for engineers, systems designers, and managers who wish to understand the recent innovations in GPS technology and how to design systems that take advantage of these capabilities for commercial and military applications. Some familiarity with basic GPS operation is helpful. Examples will be presented from airborne systems for remote sensing and other applications.

INSTRUCTOR

Zhen Zhu received a Ph. D. in Electrical Engineering from Ohio University, Athens, Ohio. Currently he is a Senior Research Engineer with the Ohio University Avionics Engineering Center and an adjunct assistant professor with the School of Electrical Engineering and Computer Science. He is a member of ION, IEEE and Sigma Xi. His research interests include GPS and augmentation systems, software radio technology, GPS interference and multipath, computer vision and laser based navigation, automatic navigation and guidance. He has also been involved in research of artificial intelligence, neural networks and machine learning.

Applications of Detection Theory

SC952

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

The fundamental goal of this course is to enable you to assess and explain the performance of sensors, detectors, diagnostics, or any other type of system that is attempting to give, with some level of confidence, a determination of the presence or absence of a "target." In this case the term "target" may be a wide variety of types (e.g. a biological pathogen or chemical agent; or a physical target of some sort; or even just some electronic signal). We will rigorously cover the theory and mathematics underlying the construction of the "Receiver Operating Characteristic" (ROC) curve, including dichotomous test histograms, false positives, false negatives, sensitivity, specificity, and total accuracy. In addition, we will discuss in depth the theory behind "Decision Tree Analysis" culminating with an in class exercise. Decision tree analysis allows one to "fuse together" multivariate signals (or results) in such a manner as to produce a more accurate outcome than would have been attained with any one signal alone. This course includes two major in class exercises: the first will involve constructing a ROC curve from real data with the associated analysis; the second will involve constructing a complete decision tree including the new (improved) ROC curve. The first exercise will be ~30min in length, and the second will be ~60min.

LEARNING OUTCOMES

This course will enable you to:
- define false positives, false negatives and dichotomous test
- define sensitivity, specificity, limit-of-detection, and response time
- comprehend and analyze a dose-response curve
- construct and analyze a Receiver Operating Characteristic (ROC) curve from raw data
- define Positive Predictive Value (PPV) and Negative Predictive Value (NPV)
- analyze statistical data and predict results
- describe the process and theory underlying decision tree analysis
- construct and analyze a decision tree using real data
- construct a "Spider Chart" from system-level attributes
- interpret sensor performance trade-offs using a ROC curve

INTENDED AUDIENCE

This course designed for scientists, engineers, and researchers that are involved in sensor design and development, particular from the standpoint of complex data analysis. Application areas for which Detection Theory is most relevant includes biological detection, medical diagnostics, radar, multi-spectral imaging, explosives detection and chemical agent detection. A working knowledge of basic freshman-level statistics is useful for this course.

INSTRUCTOR

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Introduction to GPS Receivers

SC996

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Wednesday 8:30 am to 12:30 pm

This course is an introduction to the principles of the Global Positioning System (GPS) and GPS receivers. It includes a brief introduction to GPS and other related Global Satellite Navigation systems and the history of GPS receiver development. The architecture of a typical commercial GPS receiver will be explained, followed by a more detailed comparison of different types of receivers with respect to their performance, cost and special features. The newest technologies in GPS receivers will also be presented. The course will help to answer questions such as "Can I benefit from using GPS?", or "How do I choose the right GPS receiver for my application?"

LEARNING OUTCOMES

This course will enable you to:
- describe the principles of satellite navigation
- learn how GPS receivers work
- decide when and how GPS would help in your application
- compare the cost/benefit of different types of receivers
- choose the right receiver for the application
- combine GPS with other sensors
- know what to expect from future GPS receivers

INTENDED AUDIENCE

Current and potential users of GPS who are using, or may need GPS receivers for:
- Position calculation and surveying
- Surveillance and target tracking
- Precise time keeping
- Airborne, land-based and marine-based vehicle navigation
- Location, installation, initialization and calibration of other sensors

INSTRUCTOR

Zhen Zhu received a Ph. D. in Electrical Engineering from Ohio University, Athens, Ohio. Currently he is a Senior Research Engineer with the Ohio University Avionics Engineering Center and an adjunct assistant professor with the School of Electrical Engineering and Computer Science. He is a member of ION, IEEE and Sigma Xi. His research interests include GPS and augmentation systems, software radio technology, GPS interference and multipath, computer vision and laser based navigation, automatic navigation and guidance. He has also been involved in research of artificial intelligence, neural networks and machine learning.

Emerging Technologies

Lab-on-a-Chip Technology - Towards Portable Detection Systems

SC1034

NEW

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Friday 8:30 am to 12:30 pm

The miniaturization of analytical systems ultimately targets sample-in/result-out systems for the complete analysis of biological samples. Besides the enhanced performance of those systems - namely combining sample preparation, biological reaction, and the detection itself in one device - miniaturization enables the construction of portable systems for on-site analysis of suspicious samples. This course will provide a broad overview of the underlying technologies enabling the realization of a miniaturized integrated biological lab. It starts with the history over two decades of microfluidics and goes on to describe the fabrication technologies for miniaturized devices.

The main focus is the application of microfluidic components in biotechnology (e.g. separation techniques, PCR, Lab-on-a-Chip etc.) and chemistry (e.g. micro reactors, micro mixers etc.), leading finally to the challenges in their use for mobile detection of biological pathogens. Guidelines for the efficient development of microfluidic devices for mobile detection of biological agents will be presented, based on the microfluidic tool box concept. Finally, some hands-on tests with microfluidic devices will give the attendee an opportunity to get in touch with this novel technology.

LEARNING OUTCOMES

This course will enable you to:
- describe the basic physical and chemical principles of microfluidics
- identify the most interesting microfluidic components and their challenging applications in chemistry and life sciences
- review current products and development issues
- efficiently design microfluidic devices based on the microfluidic toolbox concept
- have microfluidic components fabricated for your own application

INTENDED AUDIENCE

This course will be of value for engineers and researchers from industry and academia, business developers, general managers with a need to learn about novel technologies, potential investors in microtechnology / microfluidics and anyone who is interested in the realization, application or commercialization of microfluidic components.

INSTRUCTOR

Claudia Gärtner PhD studied chemistry and biology at the University of Duesseldorf, Germany. She obtained her PhD in biochemistry and became involved with microtechnologies at the Institute of Microtechnology Mainz (IMM). In 1999 she took over the position of the director of the newly founded Application Center for Microtechnology Jena, Germany (amt). She was involved in the founding of the biotechnology start-up "x-zyme" (2001) and the microfluidic company "microfluidic ChipShop" (2002). In 2002 she was nominated for the German Founders Prize and decorated with the Thuringian award for the best business concept for microfluidic ChipShop. In March 2006 Dr. Gaertner was named CEO for microfluidic ChipShop. She is involved in a wide variety of research projects in the field of lab-on-a-chip systems. Furthermore, she is leading several collaborative R&D aiming in the development of portable systems for the detection of B-agents.

Scanning Microscopy and Forensics

Scanning Microscopy in Forensic Science

SC954

NEW

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Monday 8:30 am to 5:30 pm

This one day short course will be devoted to the use of scanning microscopies including scanning electron microscopy (SEM), scanning optical profilometry, and energy dispersive x-ray (EDS) and x-ray fluorescence (XRF) spectrometry to forensic sample analyses including counter terrorism, explosives, pyrotechnics, counterfeit drugs and food and product tampering. The course is presented in four sections. Section one will provide the students with an understanding of the value and pitfalls of relying on instrument software in the examination of varying samples types and analysis conditions. Emphasis will be place on issues of instrument quality assurance including calibration, operation and understanding your instrument's data and compliance with certification organizations including ISO and ASCLD/LAB. Section two will be devoted to a presentation of sample handling and preparation as well as "unknown white powder" case analyses and other cases involving counterfeit drugs, food and product tampering. Section three will cover the issues of gunshot residue (GSR) analysis and more "unknown white powder" analyses related to pyrotechnic devices and flares as well as a presentation on improvised acid/foil bombs. Section four will include additional approaches to the analyses of "unknown white powder" cases so common today, the capabilities of a forensic laboratory in supporting emergency responders, and a number of illustrative case histories. Additional topics may cover a Scientific Working Group on Gun Shot Residue (SWGGSR) update report and perspective on instant shooter GSR kits. This course will be jointly presented by four instructors, all recognized experts in their respective area of scanning microscopy and applications to forensic science.

LEARNING OUTCOMES

This course will enable you to:
- use a variety of techniques (many being very simple) to collect, isolate, and process suspect trace evidence particles and fibers for SEM/EDS analysis
- take back to your laboratory a number of effective tips and analytical approaches to small particle handling and analyses including the "unknown white powder"
- evaluate critical factors related to SEM/EDS calibration and how they relate to the accuracy of your measurements and subsequent analyses
- learn the state-of-the-art procedures in the analysis of GSR data by SEM/EDS
- learn the current guidelines in interpretation of GSR data
- relate and compare your personal analytical case work or quality control analyses to illustrated forensic cases and analytical approaches

INTENDED AUDIENCE

This course is directed at the laboratory analyst using scanning electron microscopy and energy dispersive x-ray spectrometry analyses as well as other types of scanning probe instrumentation in the analysis of trace evidence including unknown surfaces, individual particles, "unknown white powder" and gunshot residue. Individuals employed in other related fields including forensic laboratory accreditation, quality management, environmental sample and microchemical analyses will find this course beneficial. All analysts using SEM/EDS, regardless of their discipline, will find this course interesting and readily see how SEM/EDS analyses of forensic samples applies to many types of laboratory and environmental investigations.

INSTRUCTORS

S. Frank Platek is a Research Biologist in the Trace Examination Section of the U.S. FDA's Forensic Chemistry Center. Prior to his 20 years with the FDA, he served 15 years as a research biologist with the National Institute for Occupation Safety and Health (NIOSH) specializing in SEM/TEM/EDS analysis of fine particles and fibers. Since 1993, he has been a member of the editorial review board of the Journal SCANNING and chairperson for the Scanning Microscopy in Forensic Science Session and course for the International SCANNING meeting. He has served as a national touring speaker for the Microbeam Analysis Society and the Microscopy Society of America. He lectures in Forensic Science Applications of SEM at the Lehigh University Microscopy School and has taught SEM/EDS analysis at Northern Kentucky University for over 30 years. He is a member of the American Academy of Forensic Science, Mid-Western Association of Forensic Science, Microscopy Society of America, and Microscopy Society of the Ohio River Valley.

Michael Trimpe has worked at the Hamilton County Coroner's Lab for 31 years. He is a Past President of the Midwestern Association of Forensic Scientists and received the Distinguished Scientist Award. He conducted the FBI GSR Symposium in 2005. He is the founder and chairman of the International Scientific Working Group for Gunshot Residue. He is a Fellow member of the American Academy of Forensic Sciences, and is the recipient of the Mary E. Cowen Award in the Criminalistics Section in 2010. His other scientific memberships include the European Network of Forensic Scientists, TWGFEX, and the International Association of Arson Investigators. Mr. Trimpe has taught the analysis of gunshot residue all over the country and has frequently been asked to speak at GSR Seminars all over the world.

Michael McVicar is an Assistant Section Head in the Chemistry Section of the Centre of Forensic Sciences (CFS) in Toronto, Canada. He has worked as a forensic chemist at the CFS for 24 years, reporting in trace evidence casework involving glass, paint, polymers, fire debris, building materials, metals, and gunshot residue. He has applied scanning electron microscopy to trace evidence examination for over 20 years. He is a member of the Scientific Working Group for Gunshot Residue, is the Chemistry Section Chair of the Canadian Society of Forensic Science, a Member of the Technical Advisory Committee to ASCLD/LAB, an invited speaker at the 2008 ENFSI Firearms/GSR meeting, an invited speaker at the 2006 Ontario Bar Association panel discussion on Gunshot Residue, and an invited speaker at the 2005 Osgoode Hall Law School Panel on "Best Practices for Collecting, Compiling and Communicating Expert Evidence." He was a presenter on the Forensic Applications of SEM at the 2006, 2007, and 2008 Scanning Conferences.

Michael Postek is the Chief of the Mechanical Metrology Division within the new National Institute of Standards and Technology (NIST) Physical Measurement Laboratory. Dr. Postek was the Assistant to the NIST Director for Nanotechnology and is both a nationally and internationally recognized expert in nanometrology and scanning electron microscope (SEM) critical dimension (CD) metrology.

Optical and Optomechanical Engineering

Introduction to Optical Alignment Techniques

SC010

Course level: Introductory
CEU 1.30 $890 / Non-member $1110 USD
Monday–Tuesday 8:30 am to 5:30 pm

This course discusses the equipment, techniques, tricks, and skills necessary to align optical systems and devices. You learn to identify errors in an optical system, and how to align lens systems.

LEARNING OUTCOMES

This course will enable you to:
- determine if errors in the optical system are due to misalignment errors or other factors such as fabrication, design, or mounting problems
- recognize and understand the fundamental imaging errors associated with optical systems
- diagnose (qualitatively and quantitively) what is wrong with an optical system by simply observing these fundamental imaging errors
- use the variety of tools available for aligning optical systems, and more importantly, how to "tweak" logically the adjustments on these devices so that the alignment proceeds quickly and efficiently
- align basic lens systems and telescopes
- align more complex optical systems such as those containing off-axis aspheric surfaces, and maintain alignment using automatic mounting techniques

INTENDED AUDIENCE

This course is directed toward engineers and technicians needing basic practical information and techniques to achieve alignment of simple optical systems, as well as seemingly more complicated off-axis aspheric mirrors. To benefit most from this course you will need a basic knowledge of the elementary properties of lenses and optical systems (i.e. focal lengths, f/numbers, magnification, and other imaging properties) and a working knowledge of simple interferometry. Some familiarity with the basic aberrations such as spherical aberration, coma, and astigmatism will be helpful.

INSTRUCTOR

Mitchell Ruda Ph.D., is president of Ruda-Cardinal, Inc., an optical engineering consulting firm, located in Tucson, Arizona. He is a fellow of SPIE.

Introduction to Optomechanical Design

SC014

Course level: Introductory
CEU 1.30 $890 / Non-member $1110 USD
Wednesday/Thursday 8:30 am to 5:30 pm

This course will provide the training needed for the optical engineer to work with the mechanical features of optical systems. The emphasis is on providing techniques for rapid estimation of optical system performance. Subject matter includes material properties for optomechanical design, kinematic design, athermalization techniques, window design, lens and mirror mounting.

LEARNING OUTCOMES

This course will enable you to:
- select materials for use in optomechanical systems
- determine the effects of temperature changes on optical systems, and develop design solutions for those effects
- design high performance optical windows
- design low stress mounts for lenses
- select appropriate mounting techniques for mirrors and prisms
- describe different approaches to large and lightweight mirror design

INTENDED AUDIENCE

Engineers who need to solve optomechanical design problems. Optical designers will find that the course will give insight into the mechanical aspects of optical systems. The course will also interest those managing projects involving optomechanics. Short course SC001, Optical System Design: Layout Principles and Practice, or a firm understanding of its content, is required as background to this course.

INSTRUCTOR

Daniel Vukobratovich is a senior principal engineer at Raytheon. He has over 20 years of experience in optomechanics, is a founding member of the SPIE working group in optomechanics, and is fellow of SPIE. He has taught optomechanics in 11 countries, consulted with over 50 companies and written over 50 publications in optomechanics.

Basic Optics for Engineers

SC156

Course level: Introductory
CEU .65 Member $520 / Non-member $610 USD
Monday 8:30 am to 5:30 pm

This course introduces each of the following basic areas of optics, from an engineering point of view: geometrical optics, image quality, flux transfer, sources, detectors, and lasers. Basic calculations and concepts are emphasized.

LEARNING OUTCOMES

This course will enable you to:
- compute the following image properties: size, location, fidelity, brightness
- estimate diffraction-limited imaging performance
- explain optical diagrams
- describe the factors that affect flux transfer efficiency, and their quantitative description
- compute the spectral distribution of a source
- describe the difference between photon and thermal detectors
- calculate the signal to noise performance of a sensor (D* and noise equivalent power)
- differentiate between sensitivity and responsivity
- explain the main factors of laser beams: monochromaticity, collimation, and propagation

INTENDED AUDIENCE

This class is intended for engineers, technicians, and managers who need to understand and apply basic optics concepts in their work. The basics in each of the areas are covered, and are intended for those with little or no prior background in optics, or for those who need a fundamental refresher course.

INSTRUCTOR

Alfred Ducharme is a professor of optics and electrical engineering in the College of Engineering and Computer Science at the University of Central Florida. He received a B.S. in Electrical Engineering from the University of Massachusetts - Lowell, and both a M.S. and Ph.D. in Electrical Engineering from the University of Central Florida - School of Optics (CREOL). Dr. Ducharme is the Program Coordinator for the 4-year undergraduate program in Photonics (BSEET-Photonics) offered by the Engineering Technology Department.

COURSE PRICE INCLUDES the text *Basic Electro-Optics for Electrical Engineers* (SPIE Press, 1998) by Glenn D. Boreman.

Introduction to Radiometry and Photometry

SC178

Course level: Introductory
CEU .35 Member $390 / Non-member $440 USD
Monday 8:30 am to 12:30 pm

In this half-day course the basic quantities of radiometry, their units, and their relationships to electro-magnetic field quantities are presented. Photometry, its units, and conversion factors to older units are also addressed. The course covers the fundamentals of blackbody radiation generation and transfer. The basic equations needed to set up and solve problems are discussed.

The course introduces radiometric and photometric sources, detectors of optical radiation, instrumentation, and calibration. The supplementary textbook, *Introduction to Radiometry and Photometry* by Ross McCluney, is provided with the course and offers more detail in detector optical/ electrical characterization, color theory, and optical properties of specific materials.

This course is an ideal lead-in to SC944 The Radiometry Case Files, which provides many applied examples of the concepts introduced here.

LEARNING OUTCOMES

This course will enable you to:
- learn the methodology used for quantifying and describing electromagnetic radiation from the extreme UV through the visible portions of the spectrum and into the far IR
- become conversant with the concepts, terminology, and units of both radiometry and photometry
- master key radiometric laws and approximations
- master the basics of photometry, the system of terminology and units used whenever the eye is the detector
- describe the characterization of optical properties of surfaces, materials, and objects
- gain insight into the design and calibration of radiometers and photometers

INTENDED AUDIENCE

This course is for engineers and scientists who deal with electromagnetic radiation who need to quantify this radiation using international standard units and terminology. The course is for teachers, students, and researchers interested in using proper methods, terminology, symbols, and units in their courses and their research work. It is also for practitioners solving problems in radiation transfer, and in measuring radiant and luminous flux in optical systems and in nature.

INSTRUCTOR

Barbara Grant is the co-author, with Jim Palmer, of *The Art of Radiometry*. For more than twenty years she has applied her engineering skills to solve problems in industries as diverse as aerospace and indoor tanning. A consultant in electro-optics, she received the M.S. degree in Optical Sciences from the University of Arizona and two NASA awards for her work on the GOES weather satellite imager and sounder. Her previous work for SPIE includes developing and chairing a special session on FLIR image analysis.

COURSE PRICE INCLUDES the text *Introduction to Radiometry and Photometry* (Artech House, 1994) by Ross McCluney.

Optical Alignment Mechanisms

SC220

Course level: Intermediate
CEU .35 Member $275 / Non-member $325 USD
Wednesday 8:30 am to 12:30 pm

This is a practical “how to” course dealing with the design and fabrication of precision optical alignment and adjustment devices. The course uses example optical systems to identify typical alignment requirements and provides a catalog of proven adjustment techniques.

LEARNING OUTCOMES

This course will enable you to:
- learn to assess degrees-of-freedom an optical element must have to align it in its system
- define range-of-adjustment vs. resolution-of-adjustment for these mechanisms
- identify appropriate design guidelines and pitfalls
- understand material choices, important tolerances, and mount stability
- determine where to get the hardware made.

INTENDED AUDIENCE

This course is intended to help the mechanical or opto-mechanical design engineer identify and characterize the degrees-of-freedom necessary to align an optical system and to provide him with a catalog of proven configurations. While the course primarily addresses small optics, the concepts apply to larger systems as well. A general knowledge of optics is required; familiarity with optical measurement and mounting techniques is highly recommended.

INSTRUCTOR

Robert Guyer specializes in the design and manufacture of precision opto-mechanical systems/llasers, gimbaled systems, stable optical

mounts, and precision mechanisms. He is an SPIE Fellow and an Engineering Fellow at BAE Systems in Nashua, New Hampshire. His 50 years military, space, and commercial opto-mechanical product development experience was gained working at BAE Systems, RCA, GE, Lockheed Martin, and AFAB Group. Mr. Guyer is a registered Professional Engineer and committed Corvette enthusiast.

Integrated Opto-Mechanical Analysis

SC254

Course level: Advanced
CEU .65 Member $530 / Non-member $620 USD
Thursday 8:30 am to 5:30 pm

This course presents opto-mechanical analysis methods to design, analyze, and optimize the performance of imaging systems subject to environmental influences. Emphasized is the application of finite element techniques to develop efficient and practical models for optical elements and support structures from early design concepts to final production models. Students will learn how to design, analyze, and predict performance of optical systems subject to the influence of gravity, pressure, stress, harmonic, random, transient, and thermal loading. The integration of optical element thermal and structural response quantities into optical design software including ZEMAX and CODEV is also presented that allow optical performance metrics such as wavefront error to be computed as a function of the environment and mechanical design variables. Advanced techniques including the modeling of adaptive optics and design optimization are also discussed. Examples will be drawn from ground-based, airborne, and spaceborne optical systems.

LEARNING OUTCOMES

This course will enable you to:
- efficiently model optical mounts, flexures, and metering structures
- design and analyze optical bonds including structural adhesives and RTV
- predict optical errors and line-of-sight jitter in random environments
- design and analyze vibration isolation systems
- perform thermo-elastic analysis of optical systems
- predict the effects of stress birefringence on optical performance
- develop diagnostic analyses and back-outs for test and assembly induced errors
- effectively model lightweight mirrors
- integrate thermal and structural results into optical models
- predict and represent the distortion of optical surfaces using Zernike polynomials
- model adaptive optics, predict system correctability and system performance
- use numerical optimization techniques to improve designs

INTENDED AUDIENCE

This course is intended for mechanical and optical engineers interested in learning about opto-mechanical analysis techniques and the use of modern software tools including finite element analysis and optical design software to design and analyze optical systems. Working knowledge or familiarity with finite element software and/or optical design software is recommended.

INSTRUCTORS

Victor Genberg has over 40 years' experience in the application of finite element methods to high-performance optical structures and is a recognized expert in opto-mechanics. He is currently President of Sigmadyne, Inc. and a Professor of Mechanical Engineering at the University of Rochestor where he teaches courses in optomechanics, finite element analysis, and design optimization. He has over 40 publications in this field including two chapters in the CRC Handbook of Optomechanical Engineering. Prior to founding Sigmadyne, Dr. Genberg spent 28-years at Eastman Kodak serving as a technical specialist for military and commercial optical systems.

Keith Doyle has 20 years' experience in the field of optical engineering, specializing in opto-mechanics and the multidisciplinary modeling of optical systems. He has authored or co-authored over 30 publications in this field. He is currently employed as an Assistant Group Leader of the Engineering Analysis Group at MIT Lincoln Laboratory. Previously he served as Vice President of Sigmadyne Inc. and as a Senior Systems Engineer at Optical Research Associates. He received his Ph.D. in engineering mechanics with a minor in optical sciences from the University of Arizona in 1993.

COURSE PRICE INCLUDES the text *Integrated Optomechanical Analysis* (SPIE Press, 2002) by Keith Doyle, Victor Genberg, and Gregory Michels. The text includes an accompanying CD-ROM with examples.

Understanding Reflective Optical Design

SC659

Course level: Intermediate
CEU .65 Member $480 / Non-member $570 USD
Thursday 8:30 am to 5:30 pm

This course provides attendees with a working knowledge of reflective optical system design. The morning session concentrates on analytical differences from refractive systems, including basic 1st order layout considerations and optimization techniques. It provides an overview of the conceptual development of various reflective designs, and provides an understanding of the basic capabilities, advantages and disadvantages of many common reflective forms. The afternoon session offers insights into departing from symmetry, understanding aberration forms with off axis apertures, a discussion of segmented mirror systems, and a brief overview of assembly and test considerations and manufacturing techniques.

LEARNING OUTCOMES

This course will enable you to:
- develop and analyze the appropriate set of 1st order parameters for reflective systems
- identify the advantages and constraints of various common reflective forms
- list analysis parameters unique to reflective system design
- trace the logical progression of reflective system from the single to multiple mirrors
- establish reasonable starting point layouts for 3 mirror design forms
- identify situations that may call for departing from symmetry in the design and understand the advantages and limitations of this technique
- recognize aberration forms in off-axis apertures and how to mitigate them
- classify the basic advantages and constraints of designs with segmented mirrors
- identify key strategies for integration I&T of reflective architectures
- describe fundamental manufacturing techniques and considerations, including diamond turning methods and mirror material properties

INTENDED AUDIENCE

This material is intended for anyone who needs to design or specify reflective optical systems, or who works with optical designers on a regular basis. A basic understanding of 1st order optics is helpful; a brief overview will be provided. No optical design experience is required, but a basic knowledge of optical aberrations will be assumed for the optical design specific discussions. The more in depth, design oriented portions of the course will include summary information valuable to engineers in non-optical disciplines. Those who have either little optical design experience or just minimal reflective design experience will find this course especially valuable.

INSTRUCTOR

James Contreras is a principal optical engineer at Exotic Electro-Optics, a subsidiary of II-VI Incorporated in Murrieta, CA. He has extensive experience in the design, analysis and fabrication of reflective optical systems for a variety of applications ranging from military platforms to the James Webb Space Telescope. His current projects include conceptual optical design of multiple wavelength band sensors for military and commercial applications, design for manufacturability of existing products, and investigation of replicated mirror technologies.

Infrared Optics and Zoom Lenses

SC755

Course level: Intermediate
CEU .35 Member $320 / Non-member $370 USD
Thursday 8:30 am to 12:30 pm

This course describes the fundamental properties of the infrared region of the spectrum and explains the techniques involved in the design and analysis of representative infrared zoom lenses. The use of computer optimization is discussed with examples to illustrate the step-by-step development of any optical system and zoom lenses in particular. It gives attendees an insight into zoom lens characteristics in general and the design and analysis process involved in developing an infrared zoom lens system. Civil and military applications are discussed which match the optics with infrared detectors and sensors. Recent trends include the advent of focal plane arrays and the shift to the near infrared spectral region. 32 refractive zoom lens systems and 9 representative reflective zoom systems are presented, along with many new diagrams.

LEARNING OUTCOMES

After completing this course, attendees will be able to:
- describe the fundamental properties of zoom lenses as to whether they are mechanically or optically compensated and with regard to positive or negative moving groups
- describe the relevant issues that are unique to the infrared region of the spectrum, including sources, detectors, CCD arrays, optical materials, athermalization, narcissus, and coatings
- gain an insight into the optical design techniques utilized in the design of infrared zoom lenses, including achieving high magnification ratios, achromatization, aberration control, the use of aspherics and diffractive optical elements, compactness techniques, computer optimization, global search, scaling, and tolerances
- classify infrared zoom lenses according to their application: scanning telescopes, target simulators, surveillance systems, target recognition, battlefield detection, imaging systems, solar observatories, laser beam expanders, and cell phone cameras
- establish requirements for your particular application
- decide whether a given zoom lens optical system meets your requirements and matches the capabilities of the detector

INTENDED AUDIENCE

This course is for engineers and scientists interested in learning more about the infrared region of the spectrum and about infrared zoom lenses and their applications.

INSTRUCTOR

Allen Mann has over forty years' experience in the design and analysis of optical systems, including visual and infrared zoom lenses. Mr. Mann has written several papers on the subject of infrared zoom lenses and is the editor for the SPIE Milestone Volume on Zoom Lenses. He was chairman of SPIE Zoom Lens Conference I and co-chair of Zoom Lens Conference II. He is retired from Hughes Aircraft Company and is now an independent consultant. Mr. Mann has been elected to be a Fellow of SPIE.

COURSE PRICE INCLUDES the text *Infrared Optics and Zoom Lenses, Second Edition* (SPIE, 2009) by Allen Mann.

Optomechanical Analysis

SC781

Course level: Advanced
CEU .65 Member $480 / Non-member $570 USD
Wednesday 8:30 am to 5:30 pm

This course teaches the basic requirements for accurately predicting the influences of thermal, structural and servo system designs on the performance and quality of optical imaging systems. It is based upon the instructor's forty years' experience in designing, analyzing and building complex optical systems, especially for the Federal market place. It incorporates elements from some of his earlier tutorials, "Finite Element Methods in Optics," "Optical Flexures" and "Optomechanics and the Tolerancing of Instruments." The instructor will review the goals of "Integrated Analysis" as promoted by NASA and DoD since the early 90's. Strengths and weakness of various approaches will be discussed. Special optomechanical modeling tools (the Optomechanical Constraint Equations and the Optical Analog) will be presented in some detail. Analytical error functions will be developed and evaluated. Sources of analytical error will be discussed and analyzed. Analytical error budgets will be developed and compared for various approaches to end-to-end analysis of systems. A candidate strategy will be presented for consideration.

The course will be illuminated with both text book-type problems and actual examples of applications from the instructor's experiences. The students will learn the strengths and weakness of the analytical methods in the various disciplines, how to estimate the sources and magnitudes of errors in various approaches to analysis, how to put together an error budget for a proposed analytical effort and how to select the most appropriate methods for end-to-end system analysis.

LEARNING OUTCOMES

This course will enable you to:
- plan and execute multidisciplinary analytical procedures
- know the strengths and weakness of individual analytical routines
- estimate the errors contributed by various steps in the analytical process
- make a complete error budget for end-to-end analysis of optical systems
- evaluate alternative approaches to the system analysis process

INTENDED AUDIENCE

Optics professionals (engineers, scientists, and their managers) who are responsible for planning, designing and building optical instruments.

INSTRUCTOR

Alson Hatheway is a mechanical engineer and president of his own company. He has over forty years experience in designing, analyzing and building new optical and photonic products. He has authored 59 technical papers, presented three different tutorials and holds four patents. He is a fellow of SPIE, a founder of the Optomechanical / Instrument Technical Group and currently its chairman.

The Radiometry Case Files

SC944

Course level: Introductory
CEU .35 Member $350 / Non-member $400 USD
Monday 1:30 to 5:30 pm

This course takes basic radiometric principles and applies them to calculate the amount of radiation reaching a system's entrance aperture or focal plane for a variety of source-system combinations. It provides a wide array of examples from which solutions to related problems may be drawn. It encompasses the UV, visible, and infrared regions of the electromagnetic spectrum, and includes several cases taken directly from the instructor's industrial experience.

Typical applications to be addressed include solar and overcast sky irradiance, IR system calibration, tanning lamp output, lighting illumination, sensor signals from specular and diffuse reflectors, star detection on orbit, solar simulators and integrating spheres.

LEARNING OUTCOMES

This course will enable you to:
- identify approaches to problem-solving based on source and geometry considerations
- calculate the amount of light received from single and multiple sources
- determine the effects of source material properties on calculations
- apply atmospheric and system spectral response characteristics to solution formulation
- operate a radiation slide rule
- qualify the limitations of your solution

INTENDED AUDIENCE

This class is designed for the practicing engineer or technologist who is expected to solve radiometric problems but is unsure what factors to identify in formulating a solution, or where to locate examples of similar problems. Though taught at an introductory level, the course assumes a basic familiarity with radiometric terminology.

INSTRUCTOR

Barbara Grant is the co-author, with Jim Palmer, of *The Art of Radiometry*. For more than twenty years she has applied her engineering skills to solve problems in industries as diverse as aerospace and indoor tanning. A consultant in electro-optics, she received the M.S. degree in Optical Sciences from the University of Arizona and two NASA awards for her work on the GOES weather satellite imager and sounder. Her previous work for SPIE includes developing and chairing a special session on FLIR image analysis.

COURSE PRICE INCLUDES the text *The Art of Radiometry* (SPIE Press, 2009) by James M. Palmer and Barbara G. Grant.

Cost-Conscious Tolerancing of Optical and IR Systems

SC947

Course level: Introductory
CEU .65 Member $480 / Non-member $570 USD
Wednesday 8:30 to 5:30 pm

The purpose of this course is to present concepts, tools, and methods that will help attendees determine optimal tolerances for opto-mechanical systems in optical applications. Detailed topics in the course apply to all volumes of systems being developed - from single systems to millions of units. The importance of tolerancing throughout the design process is discussed in detail, including determining robustness of the specification and design for manufacture and operation. The course also provides a background to effective tolerancing with discussions on variability and relevant applied statistics. A treatment of third-order aberrations is included, with emphasis on understanding their origins and how to influence cost and production yield by considering their impacts. Tolerance analysis and assignment with strong methodology and examples are discussed, including the development of a design trade for a simple IR system. References and examples are included to help researchers, designers, engineers, and technicians practically apply the concepts to plan, design, engineer, and build high-quality cost-competitive optical systems.

LEARNING OUTCOMES

This course will enable you to:
- identify key system requirements for tolerancing
- develop insight into cost and sensitivity factors early in the design process
- define variability and comprehend its impact on nominal systems
- utilize fundamental applied statistics in tolerancing
- construct tolerance analysis budgets
- perform detailed tolerance analysis
- summarize different design of experiment and statistical process control strategies

INTENDED AUDIENCE

This material is intended for managers, engineers, and technical staff involved in product design from concept through manufacturing.

INSTRUCTORS

Richard Youngworth Ph.D. is the Director of Optical Engineering at Light Capture, Inc., an optical and optomechanical design firm providing consulting, innovation incubation, and product development services. His industrial experience spans diverse topics including optical metrology, design, manufacturing, and analysis. In particular, Dr. Youngworth has spent significant time working on optical systems in the challenging transition from ideal design to successful volume manufacturing. He is widely considered an expert, due to his research, lectures, publications, and industrial work on the design, producibility, and tolerance analysis of optical components and systems. He has a B.S. in electrical engineering from the University of Colorado at Boulder and earned his Ph.D. in optics at the University of Rochester by researching tolerance analysis of optical systems.

James Contreras is a Principal Optical Engineer at Exotic Electro-Optics in Murrieta, CA, where he serves as the project lead for all opto-mechanical assembly projects. He has extensive experience in the design, analysis and fabrication of reflective and refractive optical systems for a variety of applications ranging from tactical military platforms to the James Webb Space Telescope. His primary expertise is in reflective and IR optical design, specializing in design for manufacturability. He is actively involved in teaching for SPIE and mentoring junior engineers. He was trained in Physics at Rensselaer Polytechnic Institute (B.S.) and the Georgia Institute of Technology (M.S.); the majority of his career has been in the defense and aerospace industry at companies such as Hughes Aircraft Company and Ball Aerospace Corp.

Infrared Imaging Radiometry

SC950

Course level: Advanced
CEU .65 Member $480 / Non-member $570 USD
Tuesday 8:30 am to 5:30 pm

This course will enable the user to understand how an infrared camera system can be calibrated to measure radiance and/or temperature and how the digital data is converted into radiometric data. The user will learn how to perform their own external, “by hand” calibrations on a science-grade infrared camera system using area or cavity blackbodies and an Excel spreadsheet provided by the instructor. The influences of lenses, ND and bandpass filters, windows, emissivity, reflections and atmospheric absorption on the system calibration will be covered. The instructor will use software to illustrate these concepts and will show how to measure emissivity using an infrared camera and how to predict system performance outside the calibration range.

LEARNING OUTCOMES

This course will enable you to:
- classify the measurement units of radiometry and thermography
- describe infrared camera transfer functions - electrical signal output versus radiance signal input
- determine which cameras, lenses and both cold and warm filters to select for your application
- assess effects of ND filters and bandpass filters on calibrations, and calculate which ND warm filter you need for a given temperature range of target
- perform radiometric calibration of camera systems using cavity and area blackbodies
- convert raw data to radiometric data, and convert radiometric data to temperatures
- measure target emissivity and calibrate emissivity into the system
- gauge and account for reflections and atmospheric effects on measurements

INTENDED AUDIENCE

This material is intended for engineers, scientists, graduate students and range technicians that are working with science-grade infrared cameras in the lab, on military test ranges, or similar situations.

INSTRUCTOR

Austin Richards is a senior research scientist at FLIR Commercial Vision Systems in Santa Barbara, and has specialized in scientific applications of infrared imaging technology for over 9 years. He holds a Ph.D. in astrophysics from UC Berkeley and is the author of the SPIE monograph *Alien Vision: Exploring the Electromagnetic Spectrum with Imaging Technology*.

Introduction to Infrared and Ultraviolet Imaging Technology

SC1000

Course level: Introductory
CEU .35 Member $310 / Non-member $360 USD
Monday 1:30 to 5:30 pm

The words infrared and ultraviolet are coming into much more widespread use, as ideas about the technology penetrates the public's awareness and becomes part of popular culture through TV and film. In industry and academia, applications for infrared and ultraviolet cameras are multiplying rapidly, because both of the continued reduction in system cost as the technology penetrates the commercial marketplace, and the forward march of technology. At the same time, there is a fairly limited body of information about applications for these cameras. This is because camera manufacturers tend focus on the products themselves, not applications, and because most textbooks on IR and UV technology are outdated and tend to emphasize the basics of radiometry and detection by single detectors, not imaging applications.

This course gives a non-technical overview of commercial infrared and ultraviolet camera systems, the "taxonomy" of infrared and ultraviolet wavebands, and the wide variety of applications for these wavebands. The course relies heavily on interesting imagery captured by the presenter over the last ten years and uses a SPIE monograph written by the author as a supplementary textbook.

LEARNING OUTCOMES

This course will enable you to:
- identify the different wavebands of the infrared and ultraviolet spectrum and describe their differences
- gain familiarity with the different types of cameras, sensors and optics used for imaging in the infrared and ultraviolet wavebands
- describe some of the key imaging applications for different wavebands of the infrared and ultraviolet

INTENDED AUDIENCE

The course is suitable both for technology professionals and non-technical persons that are new to infrared and ultraviolet imaging and want a very basic, qualitative overview of the fields with minimal mathematics. Little to no mathematic background is required.

INSTRUCTOR

Austin Richards is a senior research scientist at FLIR Systems in Santa Barbara, CA. He holds a PhD in Astrophysics from UC Berkeley, and has worked in the commercial infrared industry for over 10 years. He is also the CTO of Oculus Photonics, a small company devoted to near-ultraviolet imaging systems manufacturing, sales and support. Richards is the author of the SPIE monograph *Alien Vision: Exploring the Electromagnetic Spectrum with Imaging Technology* and an adjunct professor at the Brooks Institute of Photography in Santa Barbara.

COURSE PRICE INCLUDES the text *Alien Vision: Exploring the Electromagnetic Spectrum with Imaging Technology* (SPIE Press, 2001) by Austin A. Richards.

Basic Optics for Non-Optics Personnel

WS609

Course level: Introductory
CEU .20 $100 / Non-member $150 USD
Tuesday 1:30 to 4:00 pm

This course will provide the technical manager, sales engineering, marketing staff, or other non-optics personnel with a basic understanding of the terms, specifications, and measurements used in optical technology to facilitate effective communication with optics professionals on a functional level. Topics to be covered include basic concepts such as interference, diffraction, polarization and aberrations, definitions relating to color and optical quality, and an overview of the basic measures of optical performance such as MTF and wavefront error. The material will be presented with a minimal amount of math, rather emphasizing working concepts, definitions, rules of thumb, and visual interpretation of specifications. Specific applications will include defining basic imaging needs such as magnification and depth-of-field, understanding MTF curves and interferograms, and interpreting radiometric terms.

LEARNING OUTCOMES

This course will enable you to:
- read and understand optical system descriptions and papers
- ask the right questions about optical component performance
- describe basic optical specifications for lenses, filters, and other components
- select the right off-the-shelf lenses, filters, and beam directing optics
- interpret optical data such as interferogram, MTF and aberration reports

INTENDED AUDIENCE

This course is intended for the non-optical professional who needs to understand basic optics and interface with optics professionals.

INSTRUCTOR

Kevin Harding has been active in the optics industry for over 30 years, and has taught machine vision and optical methods for over 25 years in over 70 workshops and tutorials, including engineering workshops on machine vision, metrology, NDT, and interferometry used by vendors and system houses to train their own engineers. He has been recognized for his leadership in optics and machine vision by the Society of Manufacturing Engineers, Automated Imaging Association, and Engineering Society of Detroit. Kevin is a Fellow of SPIE and was the 2008 President of the Society.

INDUSTRY WORKSHOPS

Business & Professional Development

Advanced Topics in U.S. International Trade Regulations

WS1037

Course level: Intermediate
CEU .35 Member $275 / Non-member $325 USD
Thursday 8:30 am to 12:30 pm

U.S. businesses are subject to increasing regulatory controls on the export of their products, services and technical data, as well as their sales activities in foreign jurisdictions. Recent increases in penalty amounts and coordination among federal agencies have sharpened the ability of export enforcement authorities to target wrongdoers. These developments coincide with a dramatic up-tick in investigative and enforcement activity involving businesses of every size.

During this fast-paced program, you will be provided with cutting edge information designed to forestall enforcement activities against your company. Real world situations and lessons learned will be provided, as well as practical tips on best practices.

LEARNING OUTCOMES

This course will enable you to:

- acquire a big-picture overview of the Export Administration Regulations, International Traffic in Arms Regulations, Antiboycott Regulations, and the Foreign Corrupt Practices Act, and how each regulatory regime impacts both your domestic and foreign activities
- establish methods for determining which regulatory regime applies to your business activities, both domestic and foreign
- devlop the key ingredients of an effective compliance program to deal with the full panoply of U.S. international trade laws and regulations
- review recent enforcement trends and lessons learned from recent enforcement actions
- review the current status of U.S. export control reform efforts and future prospects
- avoid pitfalls and grow your business free of enforcement activity

INTENDED AUDIENCE

Owners, executives, scientists, engineers, and technicians that wish to learn how to grow business while effectively and efficiently navigating U.S. international trade laws and regulations. This course expands upon WS933 Complying with the ITAR: A Case Study. Attendance at WS933 is helpful but not a prerequisite.

INSTRUCTOR

Kerry Scarlott is a Director at the law firm of Goulston & Storrs, and is an industry leader in International Trade, Export Controls and Compliance. His practice, based in Boston, MA and Washington, D.C., focuses on business law and international trade law, with particular expertise in assisting technology-based companies. He serves as general outside counsel to companies and entrepreneurs, providing guidance in connection with entity formation, debt and equity financings and private offerings, mergers and acquisitions, day-to-day commercial contract matters, strategic alliances, private label manufacturing, and intellectual property protection and utilization. Kerry has particular expertise in counseling technology-based clients in navigating the Export Administration Regulations (EAR) and the International Traffic in Arms Regulations (ITAR). He lectures and writes regularly on international trade matters, including export compliance, foreign distribution and sale of products, and related topics.

Complying with the ITAR: A Case Study

WS933

Course level: Introductory
CEU .35 Member $275 / Non-member $325 USD
Wednesday 8:30 am to 12:30 pm

In the world of international trade, it's what you don't know that can hurt you. With the U.S. government's focus on homeland security and its increasing reliance on photonics for the development and production of defense-related products and services, your activities may well be subject to the ITAR.

This workshop will begin with a brief contextual overview of U.S. export controls, including the Export Administration Regulations, the ITAR, and special sanction programs administered by the Treasury Department's Office of Foreign Assets Control. We will then transition into a case study focused on the ITAR. Real world situations and lessons learned will be shared. Various aspects of the case study will likely be familiar to you in the context of your own experiences, allowing you to learn effectively how to spot ITAR issues before they negatively impact your business. You will also learn about current enforcement trends and best practices for avoiding violations.

LEARNING OUTCOMES

This course will enable you to:

- determine at least on a preliminary basis whether your products, services and/or technical data are subject to the ITAR
- know when a deemed export might arise and what to do about it
- communicate effectively with government and private contracting entities, including prime and subprime contractors, in order to know when the ITAR may apply
- determine what type of government license or approval must be obtained in particular circumstances
- implement best practices to handle ITAR-controlled products, services or technical data and avoid negative enforcement outcomes

INTENDED AUDIENCE

Owners, executives, managers and engineers engaged in photonics research, development or manufacturing activities.

INSTRUCTOR

Kerry Scarlott is a Director at the law firm of Goulston & Storrs. With an office in Boston, MA and Washington, D.C., Kerry focuses his practice on business law and international trade law, with particular expertise in assisting technology-based companies. He serves as general outside counsel to companies and entrepreneurs, providing guidance in connection with entity formation, debt and equity financings and private offerings, mergers and acquisitions, day-to-day commercial contract matters, strategic alliances, private label manufacturing, and intellectual property protection and utilization. Kerry has particular expertise in counseling technology-based clients in navigating the Export Administration Regulations (EAR) and the International Traffic in Arms Regulations (ITAR). He lectures and writes regularly on international trade matters, including export compliance, foreign distribution and sale of products, and related topics.

Leading Successful Product Innovation

WS951

Course level: Intermediate
CEU .35 Member $275 / Non-member $325 USD
Tuesday 8:30 am to 12:30 pm

The fundamental goal of this course is to answer the question: "How do I take an idea off the white-board and turn it into a windfall product?" We will explore and apply the principles of good leadership to create a culture of excellence within your organization-the most basic ingredient for success. A special emphasis will be placed on learning how to develop and construct an effective new project pitch using the instructor's "Disciplined Creativity" concept and framework. We will then describe the "Spiral Development Process" for rapid, effective, and successful prototype development, followed by an in-depth examination of the life-cycle approach to product development. This course will also enable you to conduct a "red teaming" exercise to identify competitive threats, identify weaknesses in your company, and most importantly, develop solution strategies. We will also place an emphasis on how to properly vet an idea and how to ask tough-minded questions designed to ferret out shortcomings.

LEARNING OUTCOMES

This course will enable you to:
- apply the key principles of leadership to create a culture of excellence for your organization
- develop a project "pitch" to champion your idea with venture capitalists, and funding agencies
- construct a "spiral development" process that is executable, manageable, and successful
- identify best practices for the life-cycle approach to product management
- conduct a "red teaming" exercise
- apply the principles of strategic planning to develop a successful technology roadmap
- conduct an "After Action Review" and distill out critical "lessons learned"
- demonstrate how to run an effective meeting
- formulate a "product requirements document"
- demonstrate effective project management skills
- define and list the key elements of "Design for Manufacturing"

INTENDED AUDIENCE

This course designed for R&D managers at all levels. It is also appropriate for other senior department managers with responsibility for aspects of product development (e.g. marketing, manufacturing, business development). Start-up companies, or anyone contemplating starting their own venture will find the material relevant and useful. Scientists and engineers aspiring to management track positions will also benefit from this course.

INSTRUCTOR

John Carrano is President of Carrano Consulting. Previously, he was the Vice President, Research & Development, Corporate Executive Officer, and Chairman of the Scientific Advisory Board for Luminex Corporation, where he led the successful development of several major new products from early conception to market release and FDA clearance. Before joining Luminex, Dr. Carrano was as a Program Manager at DARPA, where he created and led several major programs related to bio/chem sensing, hyperspectral imaging and laser systems. He retired from the military as a Lieutenant Colonel in June 2005 after over 24 years' service; his decorations include the "Defense Superior Service Medal" from the Secretary of Defense. Dr. Carrano is a West Point graduate with a doctorate in Electrical Engineering from the University of Texas at Austin. He has co-authored over 50 scholarly publications and has 3 patents pending. He is the former DSS Symposium Chairman (2006-2007) and is an SPIE Fellow.

Basic Optics for Non-Optics Personnel

WS609

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LEARNING OUTCOMES

This course will enable you to:
- read and understand optical system descriptions and papers
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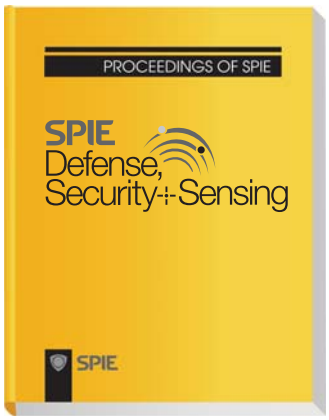

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