



2012 Defense Security+Sensing

23–27 April 2012

Technical Program

spie.org/dss



Location

Baltimore Convention Center
Baltimore, Maryland, USA

Conferences and Courses

23–27 April 2012

Exhibition

24–26 April 2012



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Conferences and Courses:
23–27 April 2012
Exhibition: 24–26 April 2012
Baltimore Convention Center
Baltimore, Maryland, USA



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SPIE is the international society for optics and photonics, a not-for-profit organization founded in 1955 to advance light-based technologies. The Society serves nearly 225,000 constituents from approximately 150 countries, offering conferences, continuing education, books, journals, and a digital library in support of interdisciplinary information exchange, professional growth, and patent precedent. SPIE provided over \$2.5 million in support of education and outreach programs in 2011.

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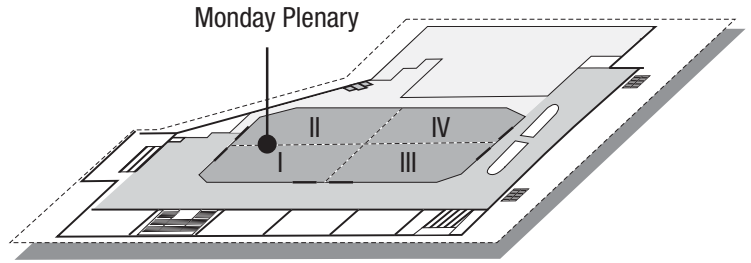
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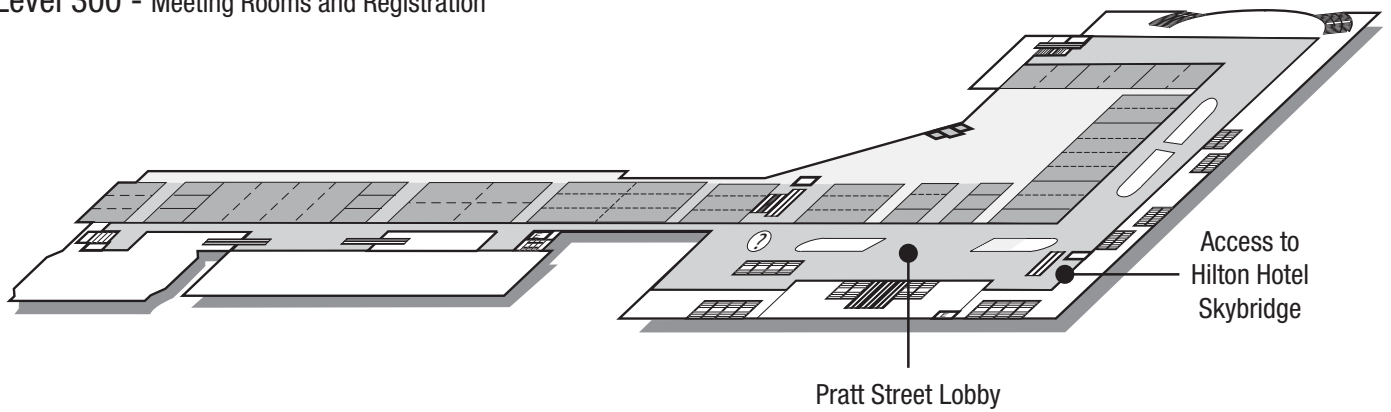
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Level 400 - Ballroom Level

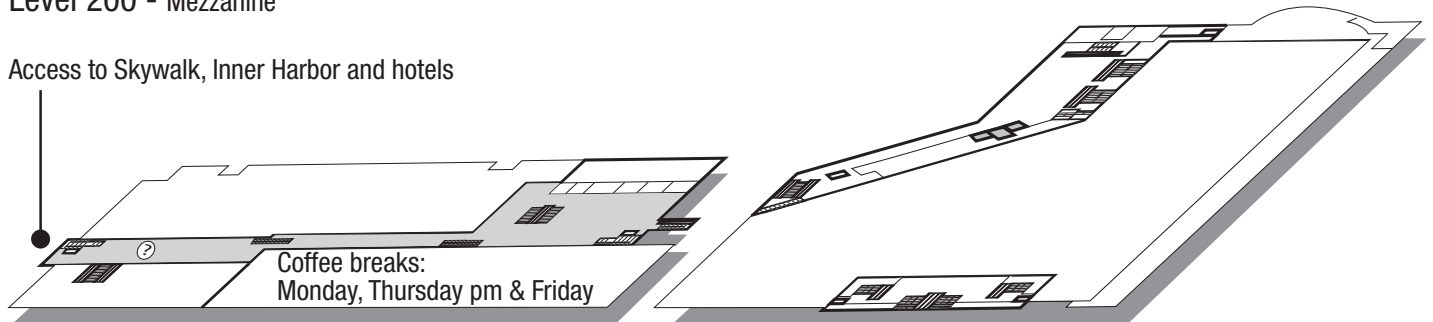


Level 300 - Meeting Rooms and Registration

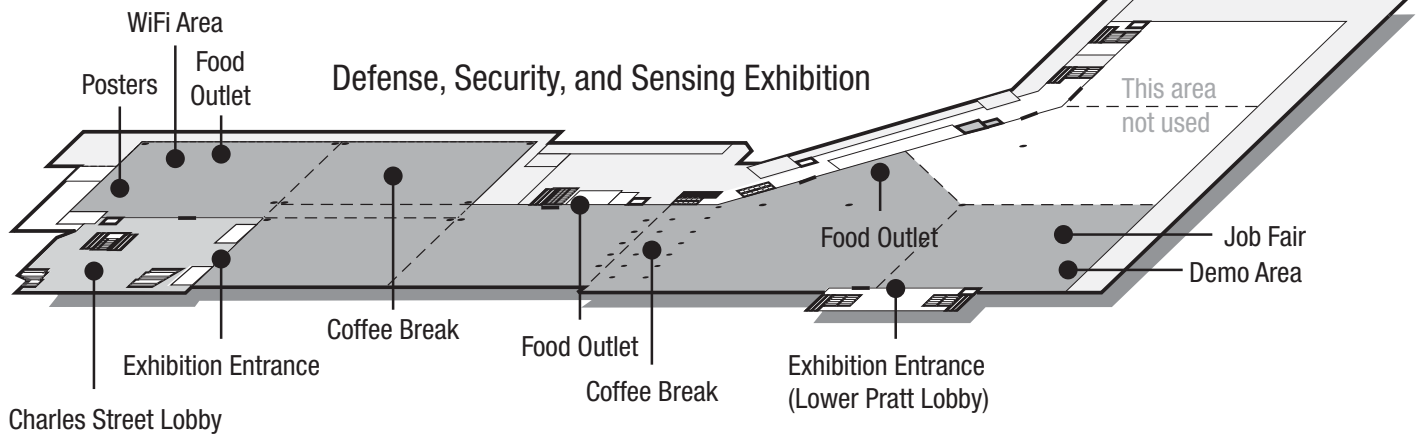


Level 200 - Mezzanine

Access to Skywalk, Inner Harbor and hotels

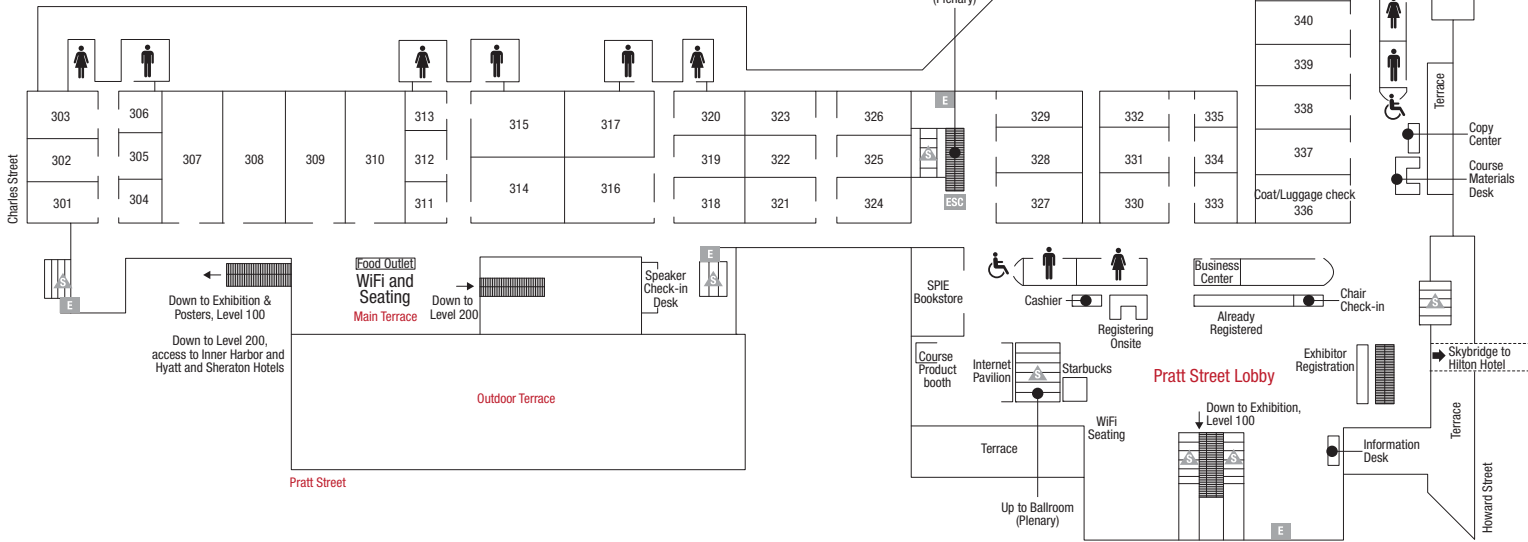


Level 100 - Exhibition Level



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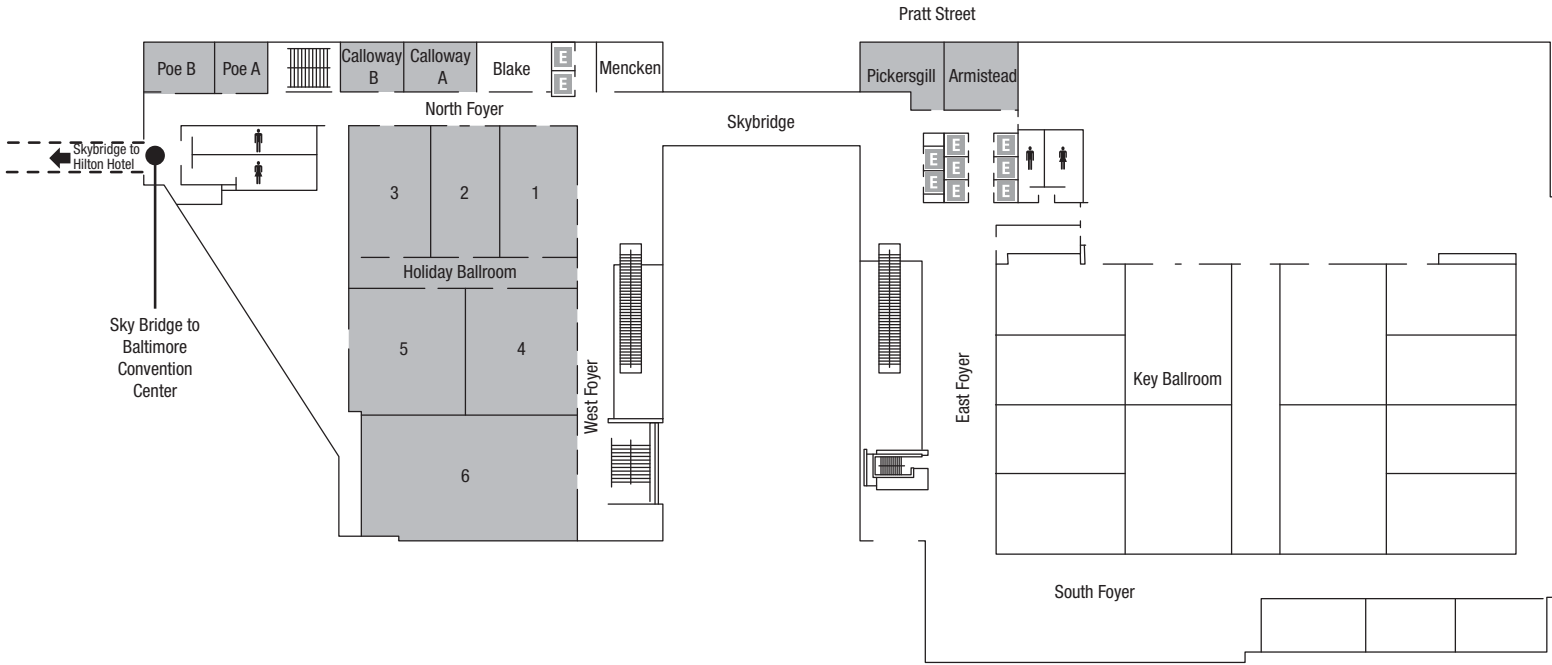
LEVEL 300 – Conference Level



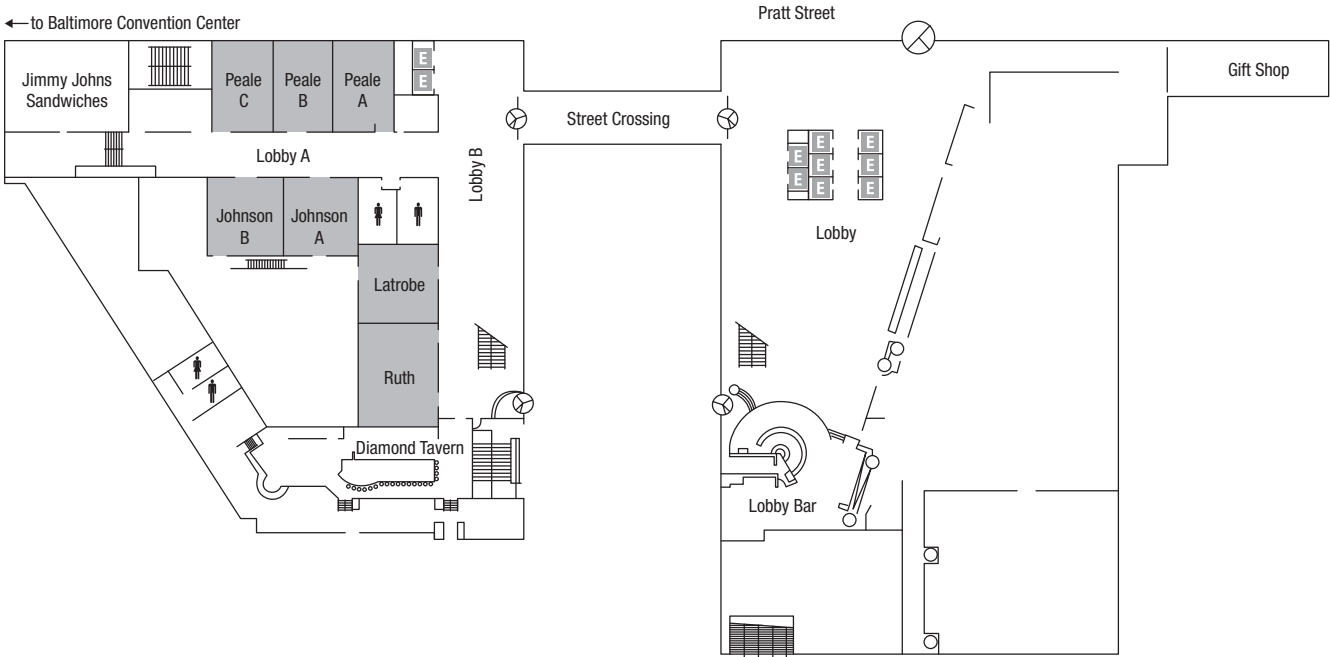
Level 100 – Exhibition Level



SECOND FLOOR



FIRST FLOOR



Technical Conference Index

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NEW

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Cutting-edge developments in photonics-driven green technologies and applications, such as energy, sustainability, conservation, and environmental monitoring.

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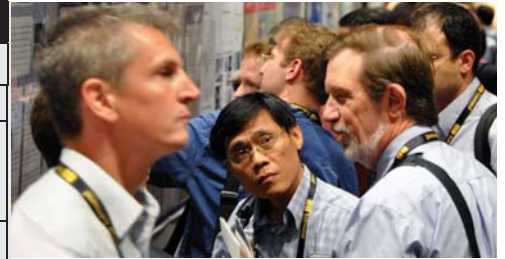


Special Events Daily Schedule

Monday 23 April	Tuesday 24 April	Wednesday 25 April
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Keynote Presentation (Conf. 8373): MesoDynamic Architectures (Meso) Program (Rogers) Paper 8373-1	Keynote Presentation (Conf. 8359): Intersubband lasers diodes from IR to THZ: recent advances and future trends (Razeghi) Paper 8359-14	Keynote Presentation (Conf. 8373): Materials research at DARPA (Holloway) Paper 8373-38
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Special Events Daily Schedule

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TECHNICAL EVENTS

Poster Sessions

Baltimore Convention Ctr · Hall A

Tuesday 24 April

Thursday 26 April

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 one-on-one with poster authors. Enjoy light refreshments while networking with colleagues in your field.

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Don't Miss the Exhibition, p. 22

Baltimore Convention Ctr · Level 100

500 Companies

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Exhibition Hours

- Tuesday • 10:00 am to 5:00 pm
- Wednesday • 10:00 am to 5:00 pm
- Thursday • 10:00 am to 2:00 pm

JOB FAIR

SPIE Defense, Security, and Sensing

Sponsored by SPIE Career Center

Meet. Discuss. Impress.

Talk with representatives from companies currently looking to hire.

See us in the Exhibition Hall

Tuesday 24 April
10:00 am to 5:00 pm
Wednesday 25 April
10:00 am to 5:00 pm

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Visit the SPIE Career Center, **Booth #318**, Wednesday, 25 April to participate in the Optikos Game Challenge.



Special Events

MONDAY 23 April

PANEL DISCUSSION

Motion Imagery Overview and Strategies (Conf. 8386)

Monday • 8:30 to 10:15 am • Conv. Ctr. 315

Panel Moderator: **Donnie Self**, National Geospatial-Intelligence Agency (USA)

Panelists:

The Air Force vision for full motion video exploitation

Samuel Oliver, U.S. Air Force (USA)

Optimizing video quality for battlespace awareness

Kevin West, Office of the Undersecretary of Defense for Intelligence (USA)

Use of motion imagery sensing systems in overseas contingency operations

Phil Suarez, U.S. Army (USA)

Vendor Presentations and Reception (Conf. 8354)

Monday • 1:00 to 4:40 pm • Conv. Ctr. 309

The session will feature brief presentations from hardware and software vendors whose product lines impact thermal imaging applications. Unlike the technical sessions, there are no “commercial content” restrictions in these presentations. 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 exhibitors are eligible to present. The Vendors Session was started eight 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 10-15 minute presentations and is followed by a reception and mixer with snacks and soft drinks.

CONFIRMED PRESENTATIONS

CI Systems, Inc. (Booth 2211)

New remote sensing products from CI Systems

Presenter: Garrick Matheson

AIM Infrarot Module GmbH (Booth 1725)

Latest products from AIM

Presenter: Rolf Mütter

Thermoteknix Systems LTD. (Booth 2511)

Thermoteknix greatest hits

Presenter: Alistair Brown, Imaging Products Manager

IRCAMERAS LLC (Booth 1902)

The benefits of warm midwave digital focal planes in today’s infrared cameras

Presenter: Arn Adams, Technical Director

Lambda Research Corp. (Booth 2228)

Techniques to find stray light and ghosts problems in infrared systems and how to eliminate them

Presenter: Michael Gauvin, VP, Sales and Marketing

New Infrared Technologies, LTD. (Booth 2429)

Solution for high-speed MWIR spectroscopy based on uncooled IR detectors manufactured by NIT

Presenter: Rodrigo Linares, Business Development Manager

TELOPS (Booth 1529)

Applications in infrared imaging using the TELPOS Hypervision Systems

Presenter: Paul Chabot, VP, Sales and Marketing

StingRay Optics, LLC (Booth 1634)

StingRay MWIR Standard Products; Lens Assemblies & Accessories

Overview of StingRay standard lens assemblies compatible with commercially available thermal imaging cameras and cores. Waveband ranges include VNIR, SWIR, MWIR, LWIR cooled and uncooled along with accessories such as filters holders and adapters.

Presenters: Jennifer Myers, Sales and Marketing Manager; **Sam Wyman**, Sales Manager

Xenics Infrared Solutions (Booth 1013)

New Xenics developments

Presenter: Jan Vermeiren

JENOPTIK Optical Systems GmbH (Booth 539)

The new VarioTHERM InSb and other new JENOPTIK products

Presenter: Heiko Richter

SCD.USA, LLC (Booth 1927)

Detector developments at semiconductor devices. We present our newest detector products including digital readouts, HD formats, wide-band (MWIR + LWIR) and high-sensitivity uncooled, and multifunction FPAs that combine infrared imaging with ladar functionality.

Presenter: Robert McDaniel, President and CEO

MONDAY 23 April

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Open to All Attendees

exhibition visitors,
exhibitors, and technical
conference attendees



NRO Overview

Bruce Carlson

Director, National Reconnaissance Office

Bruce Carlson was appointed the 17th Director of the National Reconnaissance Office (DNRO) on June 12, 2009. Prior to his appointment, after retiring from the United States Air Force in January 2009, he served as a defense industry consultant and as a member of the Board of Directors of EADS North America. The DNRO provides direction, guidance, and supervision over all matters pertaining to the NRO and executes other authorities specifically delegated by the Secretary of Defense and the Director of National Intelligence.

Director Carlson began his military career as a commissioned officer in 1971 after graduating with distinction from the Air Force ROTC program at the University of Minnesota, Duluth. He is a command pilot with more than 3,700 flying hours in 10 different aircraft, and saw combat as a forward air controller in the OV-10 Bronco. His various flying assignments included commanding the 49th Fighter Wing at Holloman AFB in New Mexico, the Air Force's first stealth fighter wing. His staff assignments included positions at Tactical Air Command, Headquarters U.S. Air Force, and the offices of the Secretary of the Air Force and Secretary of Defense. He also served as the Director of Force Structure, Resources and As-

essment on the Joint Staff; Commander, 8th Air Force, Barksdale AFB, Louisiana; and Joint Functional Component Commander for Space and Global Strike, U.S. Strategic Command, Offutt AFB, Nebraska. Prior to his retirement from the U.S. Air Force, General Carlson served as Commander Air Force Materiel Command, Wright-Patterson AFB, Ohio, which is responsible for development, testing, acquisition and sustainment of Air Force weapons systems. In that role, he had responsibility for 74,000 people and \$59 billion annually. He was promoted from Lieutenant General to General, pinning on his fourth star, on September 1, 2005.

Among Director Carlson's many awards and decorations are the Defense Distinguished Service Medal with oak leaf cluster, Distinguished Service Medal with oak leaf cluster, Legion of Merit, the Meritorious Service Medal with two oak leaf clusters, the Air Force Commendation Medal with two oak leaf clusters, and the Order of the Sword, Air Force Materiel Command.

Director Bruce Carlson holds a Bachelor of Arts Degree from the University of Minnesota, Duluth, and a Master of Arts Degree, Webster University, St. Louis, Missouri. He also is a graduate of the U.S. Air Force Fighter Weapons School, Nellis AFB, Nevada and a Distinguished Graduate, Naval War College, Newport, Rhode Island. Director Carlson was born in Hibbing, Minnesota. He and his wife, Vicki, have three children and 10 grandchildren.

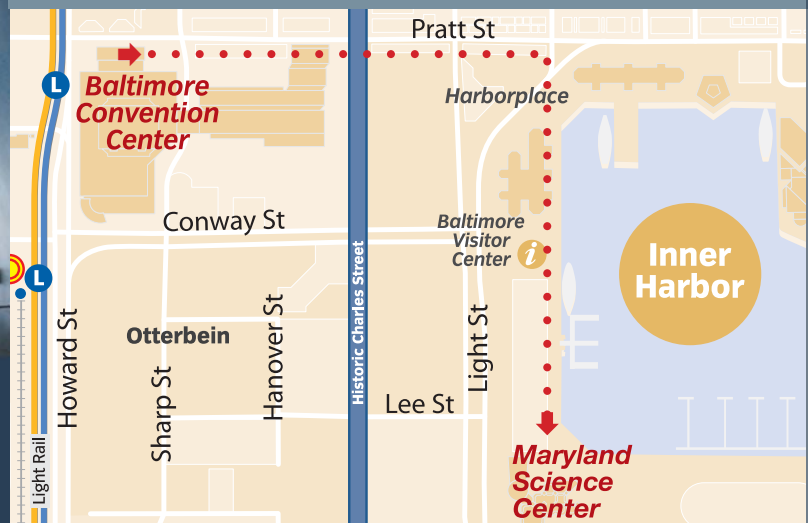
All Symposium Welcome Reception • Maryland Science Center

Monday • 6:30 to 8:00 pm



All attendees are invited. Relax, socialize, and enjoy the refreshments and all that the museum has to offer.

Please remember to wear your registration badges. Dress is casual.



Contributing Sponsor:



TUESDAY 24 April

PANEL DISCUSSION

Standards: The Foundation of the Future (Conf. 8386)

Tuesday • 1:45 to 3:10 pm • Conv. Ctr. 315

Panel Moderator: **Donnie Self**, National Geospatial-Intelligence Agency (USA)

Panelists: **Randy L. Richard**, Defense Information Systems Agency (USA); **Jim Antonisse**, Booz Allen Hamilton Inc. (USA); **Scott Randall**, Booz Allen Hamilton Inc. (USA)

PANEL DISCUSSION

Getting Hired in 2012 and Beyond

Tuesday • 2:00 to 3:00 pm

Hilton: Holiday Ballroom 1

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

INVITED PANEL DISCUSSION

Real-World Issues and Challenges in Social/Cultural Modeling with Applications to Information Fusion

(Conf. 8392)

Tuesday • 7:30 to 9:45 pm

Hilton: Holiday Ballroom 1

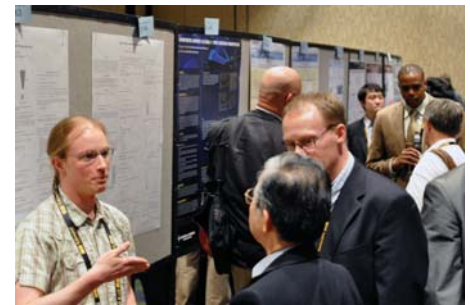
Panel Moderators: **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA); **John J. Salerno, Jr.**, Air Force Research Lab. (USA)

Panelists: **Erik Blasch**, Air Force Research Lab. (Canada); **Mica Endsley**, SA Technologies (USA); **Laurie H. Fenstermacher**, Air Force Research Lab. (USA); **Lynne L. Grewe**, California State Univ., East Bay (USA); **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA); **John J. Salerno, Jr.**, Air Force Research Lab. (USA); **Shanchieh Jay Yang**, Rochester Institute of Technology (USA)

Panel Organizers: **John J. Salerno, Jr.**, Air Force Research Lab. (USA); **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA)

The panel will address salient real-world issues and challenges in bringing the human aspect into the fusion area. A number of invited experts will discuss their ideas, research and identify current challenges in bringing such information to the assessment process. Accurate situation assessment cannot be accomplished without bringing the human into the picture. For a long time the fusion community modeled physical

systems and attempted to use this evidence to understand the current situation and the impact and project this situation to forecast potential impacts or threats. The human cannot be left out of this understanding since it is the human performing the actions. The objective of this panel is to bring to the attention of the fusion community, the role of social/cultural modeling, the challenges and its potential benefits. 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.



Posters-Tuesday

Tuesday • 6:00 to 7:30 pm • Conv. Ctr. Hall A

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.



MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

POSTER SESSION/WORKSHOP

Locating and Tracking of Explosive Threats Using Wireless Sensors and Networks

Tuesday 10:00am to 7:30 pm · Room: Conv. Ctr. 330

Organizer: **Mr. Steve Tupper**, Missouri University of Science and Technology

This poster session/workshop will report on 15 projects bundled in a cooperative agreement program to research, develop and transition technologies critical in thrust areas: human system integration, chemical/biological sensors and detection, RF detection and localization, embedded systems and networking, and security. This session reports the progress and integration at the 18 month mark of the two-year program.

Sponsors:

U.S. Army Research Lab. and U.S. Army Night Vision & Electronic Sensors Directorate



WEDNESDAY 25 April



WORKSHOP

Early Stage Technology Commercialization

Wednesday • 8:30 to 10:00 am • Conv. Ctr. 330

Panelists from U.S. government laboratories, the venture capital community, and industry discuss ways to speed the commercialization and deployment of early-stage Defense and Homeland Security applications focused on mid-infrared technologies. Listen and interact with the leaders in the IR community, and come to share your ideas.

Moderator:



Joseph X. Montemarano, Executive Director, MIRTHE, Princeton Univ. (USA)

Joseph X. Montemarano has been involved in state-of-the-art research and commercialization efforts related to health-care, defense and homeland security, advanced materials, computer science and photonic applications throughout his career. Mr. Montemarano has helped large and small companies, and government researchers access emerging technologies, faculty and other university resources resulting in a significant increase in sponsored research, the launch of several spin-off companies, and successful technology commercialization and fielded applications.

He joined Princeton University in July 1994, and currently serves as Executive Director for the NSF-Engineering Research Center on Mid-InfraRed Technologies for Health and Environment (MIRTHE) led by Princeton University, and Director for Industrial Enterprise for the Princeton Institute for Science and Technology of Materials (PRISM).

Panelists: **Randel Zeller**, Department of Homeland Security (USA); **Ralph E. Taylor-Smith**, General Partner, Battelle Ventures (USA)

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- ◆ Passive head cooling to minimize convective turbulence
- ◆ Tilting touchscreen interface with speed jog knob
- ◆ Bluetooth handheld controller (optional)

WEDNESDAY 25 April



Government Funding Session • Wednesday • 3:30 to 5:30 pm • Conv. Ctr. 309



Moderator: Paul F. McManamon, Exciting Technology, LLC (USA)

The purpose of this session is to assist industry in determining potentially profitable areas where they might invest to develop technology of interest to government funding agencies. Please attend this session to gain insights in future interests and directions for the various agencies represented.

PRESENTERS INCLUDE:



Anthony S. Lombardo, Deputy Director, Intelligence, Surveillance and Reconnaissance Programs, Under Secretary of Defense for Intelligence, Portfolio, Programs & Resources, Office of the Under Secretary of Defense for Intelligence, Pentagon, Washington, DC (USA)

Colonel Tony Lombardo is Deputy Director for Intelligence, Surveillance and Reconnaissance Programs. He leads a division of professionals conducting acquisition oversight for the Department of Defense intelligence combat support agencies-the Defense Intelligence Agency, the National Geospatial-Intelligence Agency and the National Security Agency-and the National Reconnaissance Office. Colonel Lombardo previously served as the Military Assistant to Deputy Under Secretary of Defense for Intelligence, Portfolio, Programs & Resources, Office of the Under Secretary of Defense for Intelligence. In this capacity he assisted a Deputy Under Secretary in developing and implementing Department of Defense intelligence policy, planning and guidance and provided governance and oversight of Defense Intelligence resources. Prior to his current assignment, he commanded the 17th Training Group at Goodfellow Air Force Base Texas. He led the Air Force and DoD-directed intelligence and cryptologic training, basic and advanced fire protection training and special instruments training. Annually, he managed over 10,000 students for over 260 courses. He oversaw seven squadrons' facilities and budgets in excess of \$55 million as well as a \$40 million training system acquisition program.

Colonel Lombardo began his military career in 1985 when he was commissioned through the Air Force Officers Training School. His career includes assignments at a joint command, coalition air operations centers, an Air Force major command and field operating agency, and flying squadron and wing levels. He has been deployed or directly participated in ten named combat operations involving United States Air Force air power or joint and combined combat capabilities. In addition, he has served as an air intelligence officer for over 30 local combat exercises/inspections and over 35 NATO wartime exercises.



Donald Woodbury, Director, Strategic Technology Office, Defense Advanced Research Projects Agency (USA)

Mr. Donald Woodbury is the Director of the Strategic Technology Office (STO), in the Defense Advanced Research Projects Agency (DARPA). Mr. Woodbury manages programs that research and develop innovative technologies to support U.S. Combatant Commanders in current and emerging strategic areas including Finding Difficult Targets; Communications, Electronic Warfare, and Networks; Shaping the Environment; and Foundational Strategic Technologies.

Mr. Woodbury previously served as a program manager and senior scientist in DARPA's Tactical Technology Office, where he managed programs that were focused on the development and demonstration of breakthrough capabilities in manned and unmanned systems, directed energy weapons, space supremacy, and tactical multipliers.

Prior to DARPA, Mr. Woodbury was a technology program manager within the Army Research Laboratory, where he developed and transitioned advanced technologies for aircraft, ground vehicle, and munitions programs.

Mr. Woodbury received a BS in Chemistry and an MS in Physical Chemistry from Clarkson University, and an MS in Technical Management from The Johns Hopkins University. He is a graduate of the Defense System Management College's Program Manager Course.



A. Fenner Milton, Director, Night Vision and Electronic Sensors Directorate Communications-Electronics Research, Development & Engineering Center U.S. Army Research, Development & Engineering Command Fort Belvoir, Virginia (USA)

Milton was appointed to his present position as head of the Night Vision and Electronic Sensors Directorate in 1998. He is responsible for a laboratory that develops all aspects of electro-optical technology for the Army to include Image Intensifiers, Infrared Sensors and Tactical Lasers. He is also responsible for the development of Countermine and Humanitarian Demining technology.

Previously, Dr. Milton served in the Pentagon as the Deputy Assistant Secretary for Research and Technology, Chief Scientist of the Army in the Office of the Assistant Secretary of the Army, Research, Development and Acquisition. He was responsible for the Army's entire science and technology program spanning twenty-one (21) Laboratories and Research, Development and Engineering centers, with approximately 10,000 scientists/engineers and an annual budget of \$1.4 billion. He was also the principal scientific advisor to the Secretary of the Army and the Assistant Secretary of the Army Research, Development and Acquisition.

He came to the Pentagon as a member of the Senior Executive Service in 1990 as Director for Technology in the Office of the Assistant Secretary of the Army for Research, Development and Acquisition. Dr. Milton received his Ph.D. in Applied Physics from Harvard University. He serves as Chairman of the Military Sensing Symposia (MSS), is a Fellow of MSS, and has published extensively concerning integrated optics and focal plane arrays.



Richard S. Matlock, Program Executive for Advanced Technology, Missile Defense Agency (USA)

Mr. Richard Matlock, Program Executive for Advanced Technology, is leading the development of the next generation of cutting-edge missile defense technologies and proving their benefit to the warfighter through realistic experiments. Some of Mr. Matlock's other Senior Executive assignments included the Program Director for the Ballistic Missile Defense System Kill Vehicles program, Program Director for Modeling and Simulation and Technical Director for Kinetic Energy Interceptor.

Mr. Matlock's 35-year career in government service includes major acquisition and scientific positions with the U.S. Navy, the Ballistic Missile Defense Organization, the Strategic Defense Initiative Organization and the U. S. Air Force. At Naval Sea Systems Command, Mr. Matlock was the Program Manager for the Department of Defense's U.S./Japan Cooperative Ballistic Missile Defense Research Project. He led the development and implementation of this joint missile defense research program with the Japan Defense Agency. Prior to employment with the Navy, Mr. Matlock was Program Manager for Interceptor Technology Integration in the Ballistic Missile Defense Organization (BMDO).

Mr. Matlock has also held positions in the Department of the Air Force, both as an officer and civil servant, including Chief of Integration and Analysis at the Air Force Rocket Propulsion Laboratory and Technology Director, Space Based Interceptor System Program Office at Air Force Systems Command's Space Division.

Banquet and Award Announcements

Wednesday • 7:00 to 9:30 pm • Hilton: Holiday Ballroom 4-6

Dinner will start at 7:00 pm followed by DSS Lifetime Achievement Award presentation.

Please join your colleagues for the presentation of the DSS Lifetime Achievement Award to Paul G. Kaminski!



Technology Transitions and Transformations

Paul G. Kaminski

Chairman and CEO of Technovation, Inc.

Paul G. Kaminski is Chairman and CEO of Technovation, Inc., a small consulting company dedicated to fostering innovation, and to the development of business and investment strategies related to the application of advanced technology in the aerospace and defense sectors.

Dr. Kaminski served as the Under Secretary of Defense for Acquisition and Technology from October 3, 1994 to May 16, 1997. He was responsible for all Department of Defense (DOD) research, development, and acquisition programs. He also had responsibility for DOD logistics, environmental security, international programs, the defense industrial base, and military construction. The annual budget for these entities exceeded \$100 billion

Dr. Kaminski has had a continuing career involving large program management, and the development and application of advanced technology in both the private and public sectors. He served as Chairman and Chief Executive Officer of Technology Strategies and Alliances, a technology - oriented investment banking and consulting firm. He has served as a consultant and advisor to a wide variety of government agencies and as chairman, director or trustee of several defense and technology-oriented companies.

His previous government experience includes a 20-year career as an officer in the U.S. Air Force. During 1981-1984, he served as Director for Low Observables Technology, with responsibility for overseeing the development, production and fielding of major "stealth" systems (e.g., F-117, B-2). He also led the initial development of a National Reconnaissance Office space system and related sensor technology. Early in his career, he was responsible for test and evaluation of inertial guidance components for the Minuteman missile and terminal guidance systems for the first precision guided munitions.

Dr. Kaminski is a member of the President's Intelligence Advisory Board, is Chairman of the Defense Science Board, and serves as a member of the DNI's Senior Advisory Board, FBI Director's Advisory Board, Senate Select Committee on Intelligence Technical Advisory Board, National Academies Air Force Studies Board, and the Atlantic Council. He is a member of the National Academy of Engineering, a Fellow of the Institute for Electrical and Electronics Engineers, and a Fellow of the American Institute of Aeronautics & Astronautics. He Chairs the Boards of the RAND Corporation, Exostar and HRL (former Hughes Research Labs); and is a Director of General Dynamics, Bay Microsystems, CoVant Technologies, and the USAF Academy Endowment. He serves as an advisor to the Johns Hopkins Applied Physics Lab, and MIT Lincoln Laboratory. He has authored publications dealing with inertial and terminal guidance system performance, simulation techniques, Kalman filtering and numerical techniques applied to estimation problems.

Dr. Kaminski has received the following awards: National Medal of Technology 2006, Department of Defense Medal for Distinguished Public Service (3 awards), Defense Distinguished Service Medal, Director of Central Intelligence Director's Award, Defense Intelligence Agency Director's Award, Legion of Merit with Oak Leaf Cluster, Air Force Academy 2002 Distinguished Graduate Award, the Ronald Reagan Award for Missile Defense, the International Strategic Studies Association Possony Medal for Outstanding Contributions

to Strategic Progress through Science and Technology, the AOC Gold Medal, the Netherlands Medal of Merit in Gold, the French Republic Legion d'Honneur, and the Air Force Systems Command Scientific Achievement Award. He has been recognized as a Pioneer of National Reconnaissance and a Pioneer of Stealth.

Dr. Kaminski was born in Cleveland, Ohio. He received a Bachelor of Science from the Air Force Academy, Master of Science degrees in Aeronautics and Astronautics and in Electrical Engineering from the Massachusetts Institute of Technology, and a Ph.D. in Aeronautics and Astronautics from Stanford University. He and his wife, Julie, have two children, and five grandchildren.

Ticket Required

Banquet tickets \$95

Tickets for the banquet and presentation are sold separately from the conference registration fees. Tickets may be purchased onsite at the SPIE Cashier. Banquet tickets must be purchased by Monday 23 April at 5:00 pm.



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Special Events

THURSDAY 26 April

Microscopy for STEM Educators

Thursday • 8:30 am to 12:30 pm
Conv. Ctr. 312

All meeting attendees are invited to attend.

Session Chairs:

Michael T. Postek, National Institute of Standards and Technology (USA)

Mary Satterfield, National Institute of Standards and Technology (USA)

The future of our nation hinges on our ability to prepare our next generation to be innovators in science, technology, engineering and math (STEM). Excitement for STEM begins in the earliest stages of our education process. Yet, today far too few of our students are prepared for the challenges ahead. The special session "Microscopy for STEM Educators" is a general interest forum with several notable invited speakers discussing their successful programs implementing microscopy in STEM education to foster student interest and excitement. A hands-on session with tabletop scanning electron microscopes will be held at the end of the presentations and the attendees are encouraged to bring samples of interest and operate the instruments. STEM educators will receive one-day reduced registration fees and will be able to visit the exposition where other microscopes may be on display.

PANEL DISCUSSION

The Role of Geospatial Information Fusion in Activity-based Intelligence Analysis (Conf. 8396)

Thursday • 1:30 to 3:00 pm
Conv. Ctr. 329

Panel Moderator: **Shiloh L. Dockstader**, ITT Exelis Inc. (USA)

One of the emerging trends within the defense and intelligence communities is increased prominence of activity-based intelligence (ABI) processing, exploitation, and dissemination (PED). Activity-based intelligence focuses on the understanding and analysis of spatio-temporal patterns, events, and characteristics and has proven to be an especially useful tool with applications ranging from asymmetric warfare mitigation to wide-area network discovery and infiltration. ABI also plays a key role in wide-area persistent surveillance (WAPS) and large-volume streaming data (LVSD) applications, offering methods and technologies that help address the overwhelming data management functions faced by these systems. However, the recent proliferation of airborne persistent surveillance systems has introduced a certain amount of ambiguity and lack of differentiation between WAPS and ABI PED analysis. True ABI analysis performs a comprehensive evaluation and integration of numerous structured and unstructured sources potentially including, but not limited to: GMTI, LIDAR, open source, financial, and social data and transactions.

We will assemble a group of panelists to review and assess the current state-of-the art in ABI analysis and to further discuss the role that multi-source, multi-int fusion must play for ABI analysis to successfully address future defense and intelligence challenges. Specific emphasis is placed on ABI quality and information fusion metrics, novel methods for incorporating both structured and unstructured data, and the relative importance and criticality of successful motion imaging pre-processing algorithms.

Electro-Optics Alliance (EOA) Annual Meeting

Co-located
meeting with

SPIE
Defense,
Security+ Sensing

April 26, 2012 • Baltimore, Maryland

The Electro-Optics Alliance (EOA) is a collaborative network of U.S.-based industrial, academic and government organizations that forms a critical link between research and development and the commercialization required to advance DoD critical electro-optics Manufacturing Science and Technology, transition that technology successfully to industry, and to promote U.S. preeminence in all areas of electro-optics. To meet that goal, the EOA is designed to facilitate formation of dynamic, geographically distributed teams comprised of EOA members from government, industry and academia best qualified to address specific issues and opportunities.

Get more information about the meeting online at
<http://www.eoc.psu.edu/events>

Meeting data: http://eoc.psu.edu/events/201204_Save_the_Date.pdf
EOA Information: http://www.eoc.psu.edu/eoa/eoa_index.html
EOC Information: <http://www.eoc.psu.edu>

Dave Ditto, Deputy Director-Programs
Karl Harris, EOC Director

Please note that this meeting is restricted to EOA members only, but there is still time to become an Alliance member before the meeting.

PENNSTATE



The Electro-Optics Center
A Manufacturing Technology
Center of Excellence

Infrared Materials Standards Working Group

Thursday • 4:00 to 5:30 pm
Hilton: Johnson A

Workshop Chair: **Gary Wiese**,
Lockheed Martin Corp. (USA)

STATEMENT OF PURPOSE

The Infrared Materials Standards Working Group is an interactive network of scientists and engineers who manufacture, test, and use IR materials. The purpose of this group is to develop standards for properties of optical materials used in the infrared (IR) spectral region (nominally, wavelengths 0.7 - 20 microns). Although typical properties have been published in the technical literature and have been incorporated in various databases, much of this information is decades old. Furthermore, the trend toward multispectral imaging systems for DoD applications has made the need for updated properties more acute. The properties of interest encompass all optical, mechanical, thermal, and thermo-optical characteristics, but the initial primary focus is on the optical and thermo-optical properties used for the design of infrared imaging systems - most notably index of refraction, dn/dT , dispersion, attenuation coefficient, inhomogeneity, and inclusions. Some materials that transmit in the IR are also used at wavelengths outside of the IR range. Therefore, standards developed by the group may include characteristics at wavelengths outside of this region.

The initial goals are to:

1. Update the nominal values of material properties
2. Determine the blank-to-blank variations in the material properties
3. Develop standard sampling and test protocols for measuring material properties
4. Foster the development of cost-effective methods for measuring material properties
5. Advise and assist the US Technical Advisory Group (TAG) to TC172/SC3 in developing US positions on ISO standards related to IR materials, including offering potential experts to represent the US at international meetings of TC172/SC3.

PANEL DISCUSSION

Social Networking Innovations in Persistent ISR (Conf. 8389)

Thursday • 4:30 to 5:30 pm
Conv. Ctr. 313

Panel Moderator: **Robert Williams**,
Air Force Research Lab. (USA)

Social networks are becoming a major force for information gathering, interpretation and sharing in a largely open environment. Whereas Persistent ISR has traditionally focused on more conventional sensor-based technologies operating in the electromagnetic and acoustic spectrums, it is clear that the emergence of social networks has created new opportunities and technology challenges for expanded Persistent ISR capabilities. This panel will consider potential social network innovations for Persistent ISR and discuss areas of promising future research.

WORKSHOP

Night Vision Integrated Performance Model (NIV-IPM) (Conf. 8355)

Thursday • 5:30 to 6:30 pm
Conv. Ctr. 301

Moderators: **Joseph P. Reynolds**,
Brian P. Teaney, U. S. Army RDECOM
CERDEC Night Vision & Electronics Sensors
Directorate



Posters-Thursday

Thursday • 6:00 to 7:30 pm
Conv. Ctr. Hall A

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.

JOB FAIR

SPIE Defense, Security, and Sensing

Sponsored by SPIE Career Center

Meet. Discuss. Impress.

Talk with representatives
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See us in the Exhibition Hall

Baltimore Convention Center, Baltimore, Maryland, USA

Tuesday 24 April, 10:00 am to 5:00 pm

Wednesday 25 April, 10:00 am to 5:00 pm

Win a Kindle Fire

SPIE Defense, Security, and Sensing
Game Challenge

hosted by



Visit the SPIE Career Center, Booth #318, Wednesday,
25 April to participate in the Optikos Game Challenge.

By participating in the game challenge, your name will be entered
into a drawing to win an Amazon Kindle!

Make sure to stop by and talk with representatives about job
opportunities and hiring resources.

Meet with representatives
from these companies:



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spie.org/dssjobfair

Network

Networking Receptions · Student Social Events · SPIE Member Events



Join your colleagues and develop new relationships at these relaxed-atmosphere networking events.



SPIE Fellows Luncheon

Monday 23 April • 12:00 to 1:30 pm • Hilton: Holiday Ballroom 4

All SPIE Fellows are invited to join your colleagues for this second annual SPIE hosted luncheon. The new Defense, Security, and Sensing fellows will be introduced and receive their fellow plaques. Please join us for this informal gathering and a chance to interact with other fellows.



FELLOWS LUNCHEON PRESENTATION:

Crossing the Canyon: Concept to Commercialization

Angelique X. Irvin

President & CEO
Clear Align

Those who aspire to optimize the commercialization process often find the journey daunting. During this interactive talk we will discuss the process and how to improve your odds dramatically with simple techniques learned from working at Bell Laboratories, one of the world's foremost product producers.

Angelique Irvin has over 25 years of professional experience focused on technology businesses. Her experience includes successful corporate and entrepreneurial business launches at companies including Clear Align, Coviant, NEC, AT&T Microelectronics, and AT&T Bell Laboratories. Angelique leads Clear Align, a company that designs, prototypes, and manufactures custom imaging, and laser systems for defense and aerospace clients. Angelique was responsible for a new product launch at AT&T Bell Laboratories where she led a team that built out optical assembly facilities and developed new markets for a \$500 million product line. Angelique graduated with honors from Alfred University, with a Bachelor's degree in Ceramic Engineering and earned an MBA from the Wharton School of Business of the University of Pennsylvania.

All Symposium Welcome Reception

Monday 23 April • 6:30 to 8:00 pm • Maryland Science Center

All attendees are invited to the Welcome Reception at Maryland Science Center. Relax, socialize, and enjoy the refreshments and all that the museum has to offer. Please remember to wear your registration badges. Dress is casual.

STUDENT INTRO SESSION

Getting the most out of your conference experience

Tuesday 24 April • 9:00 to 10:15 am • Hilton: Holiday Ballroom 1

New to conferences or just want some tips on how to maximize the benefits of attending? Enjoy some breakfast and learn how to make the most of your time in Baltimore.

Lunch with the Experts

A STUDENT NETWORKING EVENT

Tuesday 24 April • 12:30 to 1:30 pm • Hilton: Holiday Ballroom 4

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. Seating is limited and will be granted on a first-come, first-served basis.

Women in Optics Presentation and Reception

Tuesday 24 April • 5:00 to 6:30 pm • Hilton: Ruth Room
Open to all conference attendees.



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

Alison Flatau

Experiences of an NSF "Rotator" and Beyond

After working in industry for four years and academia for eight, I had the opportunity to serve as an NSF Program Manager. I returned to academia four years later with the benefit of lessons learned at the NSF - my move from focusing on trees to forests. In my presentation, I'll talk about lessons learned at the NSF and will interweave thoughts on student mentoring, faculty mentoring and my own research on magnetostrictive materials.

Dr. Flatau joined the Univ. Maryland in 2002 after serving as an NSF Program Manager (1998-2002) and as a Professor at Iowa State Univ. (2000-2008). She was the Director of Undergraduate Programs for Aerospace Engineering at UMD (2004-2009) prior to becoming the first Associate Dean of Research for the Clark School of Engineering at Maryland, a position in which she continues to grow and learn, while also serving in the inaugural class of Maryland ADVANCE Professors (2011-2012).

Student Social at Camden Yards

Tuesday 24 April • 7:30 to 9:30 pm • Space is limited

Relax and hang out with new friends and peers while enjoying refreshments and baseball.

Early Career Networking Social

Wednesday 25 April • 5:30 to 6:30 pm • Hilton: Holiday Ballroom 1

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.



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.

Safely Navigating the Deep Waters of International Trade: Legal Best Practices

WS1074 · Course level: Introductory
CEU .35 \$295 Member / \$345 Non-member USD
Wednesday 1:30 to 5:30 pm

If your company's sales activities, products or services come in contact with foreign jurisdictions, this is a must attend program. The stakes have never been higher. Anyone who wants to answer questions such as, "what are the legal pitfalls of doing business internationally?" or "what are best practices for engaging in global trade?" will benefit from taking this course. During this fast-paced course you will be provided with cutting edge information designed to assist you in safely and effectively navigating the legal shoals of doing business internationally. 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, and is an industry leader in International Trade, Export Controls and Compliance.

Complying with the ITAR: A Case Study

WS933 · Course level: Introductory
CEU .35 \$295 Member / \$345 Non-member USD
Thursday 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, and is an industry leader in International Trade, Export Controls and Compliance.

Essential Skills for Engineering Project Leaders

WS846 · Course level: Introductory
CEU .35 \$295 Member / \$345 Non-member USD
Thursday 1:30 to 5:30 pm

This workshop teaches skills needed to lead technical projects, drive innovation, and influence others. Attendees learn the difference between leadership and management, and how to develop specific leadership skills that are important to technical professionals who lead projects or need assistance from others to get things done. Participants engage in exercises that assess their individual leadership abilities and provide guidance for further skill development.

Instructor: **Gary Hinkle** is President and founder of Auxilium, Inc. His experience includes a broad variety of management and staff assignments with small, medium, and large companies involved in the development and manufacturing of high-tech products.

Leading Successful Product Innovation

WS951 · Course level: Intermediate
CEU .35 \$295 Member / \$345 Non-member USD
Wednesday 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.

Basic Optics for Non-Optics Personnel

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

Available in
ONLINE
format

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.



Registration required for workshops

See SPIE Cashier

PRISM20
AWARDS12
Call for Entries
PrismAwards.org



Participate in an international competition that recognizes cutting-edge products that break conventional ideas, solve problems, and improve life through photonics.

Apply online by 14 September 2012:
PrismAwards.org



Plan for the Exhibition

Tuesday 24 April
10:00 am to 5:00 pm

Wednesday 25 April
10:00 am to 5:00 pm

Thursday 26 April
10:00 am to 2:00 pm

See the latest technology innovations for defense, security, sensing, robotics, and environmental applications

Visit with reps from the largest prime contractors, top suppliers, and 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:

- Robotics and unmanned systems, featuring live demonstrations
- 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, including specialized lenses and coatings
- High-speed imaging and sensing
- High-precision optics manufacturing
- Nanotechnology
- Law enforcement technologies





Don't Miss These Free Industry Sessions

No special registration required—your badge will get you into these industry programs and government funding sessions

Early Stage Technology Commercialization Workshop

Wednesday 25 April
8:30 to 10:00 am · Conv. Ctr. 330

Panelists from U.S. government laboratories, venture capital community, and industry discuss ways to speed the commercialization and deployment of early-stage Defense and Homeland Security applications.

Special Government Funding Session

Wednesday 25 April
3:30 to 5:30 pm · Conv. Ctr. 309

Gain insights in future interests and directions for the various agencies represented.



2nd Annual Imaging Gallery Showcase at SPIE Defense, Security, and Sensing 2012

Where: **Exhibition Floor**
When: **Tuesday (4/24) – Thursday (4/26)**

brought to you by



Building on the success of last year's gallery, SPIE and StingRay are once again teaming up to display the finest examples of today's imaging technology... with an artistic flair!

For more details on the 2012 Imaging Gallery, please contact

Mr. Sam Wyman, swyman@stingrayoptics.com, or Jennifer Myers, jmyers@stingrayoptics.com, or call (603) 358 5577 for immediate attention.

(Image courtesy of StingRay Optics, "Three Blind Mice", photographed by Ed Kingsbury, 2011)

Don't Miss the New Technology Demos and Displays on the Exhibition Floor

The Exhibition includes hands-on demos of some amazing new technologies, including:

Princetel – Optically enabled robotic vehicle with 4 cameras

FLIR – Applications for small integrated thermal imaging camera

Mantaro – Telepresence robots, utilizes smartphone interface

Intelligent Optical Systems – Handheld LED defensive weapon

JDSU - MicroNIR, A Handheld Near Infrared Spectrometer

Banners		Welcome Reception
 <p>Booth #813 www.materion.com</p>	 <p>Booth #2021 www.opticalmaterials.umicore.com</p>	<p>Contributing Sponsor</p>  <p>Booth #357, 2010 www.flir.com</p>
Column Wrap		Conference Bag
 <p>Booth #2027 www.imperx.com</p>	 <p>Booth #1625 www.ophiropticinc.com</p>	<p>Raytheon ELCAN Optical Technologies</p> <p>Booth #1921 www.elcan.com</p>
Conference Bag Inserts		
 <p>www.americanelements.com</p>	 <p>Booth # 635, 3074 www.defensenews.com</p>	 <p>Booth #1619 www.cvimellesgriot.com</p>
<p>Raytheon ELCAN Optical Technologies</p> <p>Booth #2921 www.elcan.com</p>		
Exhibition Map/Restaurant Guide		
 <p>Booth #2210 www.asdi.com</p>	 <p>Booth #402 www.calculex.com</p>	<p>SCHOTT</p> <p>Booth #1519 www.us.schott.com/defense</p>
 <p>Booth #1711 www.sofradir.com</p>	 <p>Booth #803 www.temmek.com</p>	 <p>Booth #2426 www.trioptics.com</p>
 <p>Booth #2021 www.opticalmaterials.umicore.com</p>		

Defense, Sensing, and Security Sponsors

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<p>NDIA National Defense Industrial Association</p> <p>Booth #702 www.ndia.org</p>	<p>GO Edmund optics worldwide</p> <p>Booth #1206 www.edmundoptics.com</p>	<p>umicore materials for a better life</p> <p>Booth #2021 www.opticalmaterials.umicore.com</p>
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Popcorn Station		General Refreshment Sponsors
<p>GENERAL DYNAMICS Global Imaging Technologies</p> <p>Booth #1811 www.gd-imaging.com</p>	<p>scd USA SEMI CONDUCTOR DEVICES USA</p> <p>Booth #1927 www.scdusa.com</p>	<p>Adimec Booth #1829 Heraeus Quartz America LLC Booth #2510 Opgal Ltd. Booth #1113</p>
Defense, Security, and Sensing Promotional Partners		
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Product Demos

Product Demonstrations are open to all attendees. Exhibiting companies will showcase products in half-hour demonstrations.

Don't miss these **FREE Demonstrations**

TIME	Tuesday 24 April	Wednesday 25 April	Thursday 26 April
10:00 am		SPECIAL ITAR FORUM Export Controls Highlights and Best Practices – An Open Forum Kerry T. Scarlott, Esq., Goulston & Storrs, P.C.	
10:30 am	Rugged cameras for situational awareness, gimbals and designators Joost van Kuijk, Ph.D., Adimec		Chalcogenide Materials and Aspheric Infrared Optics from SCHOTT produced in the United States Dr. Nathan Carlie, SCHOTT
11:30 am	High resolution surveillance using Vieworks digital cameras Kris Balch, Vision Systems Technology, LLC	Data from the Field: Rifle Scope Image Quality and MTF Ben Wells, Wells Research	
12:30 pm		Imaging Infrared Polarimeter w/ Integrated Realtime Image Processing Dr. Larry Pezzaniti, Polaris Sensor Technologies, Inc.	Broadband AR Coatings from SCHOTT Jayson Nelson, SCHOTT
1:30 pm		MantaroBlocks, a new, modular, power-intelligent wireless sensor node architecture David Riley, Mantaro	
2:30 pm	Preventing condensation and corrosion in Optical and Electro Optical instruments Martin Partridge, AGM/Brownell	High resolution SWIR modules for passive night vision and image fusion applications Hervé Copin, Xenics	EXHIBITION CLOSED
3:30 pm	Optical Design and Assembly Capabilities by SCHOTT Kevin Tabor, SCHOTT	Efficient Generation of Green and Mid-IR Laser Wavelengths for Defence Applications Mark Middleton, Covesion Ltd	
4:30 pm	New LG940 Laser Glass from SCHOTT Matthew Roth, SCHOTT Defense	Introducing New Multi-Application 931 Touchscreen Critical Point Dryer (CPD) Yianni Tousimis, Tousimis Research Corporation	

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Get the training you need to stay competitive in today's job market:

Courses at SPIE Events offer an engaging experience for those who prefer face-to-face instruction, where interaction with the instructor and sharing information with other students provide increased value.

- Featuring 12 new courses and workshops, including all-new content on energy harvesting, high dynamic range imaging, and ITAR/international trade.
- 55 courses and workshops to choose from
- Learn from the best instructors in the industry
- SPIE Student Members get 50% off courses

New Courses for 2012:

NEW

- SC547 **Terahertz Wave Technology and Applications** (Zhang)
 SC967 **High Dynamic Range Imaging: Sensors and Architectures** (Darmont)
 SC1052 **Optical Systems Engineering** (Kasunic)
 SC1068 **Introduction to Night Vision** (Browne)
 SC1069 **GPU for Defense Applications** (Humphrey)
 SC1070 **Radar Waveforms and Signal Processing** (Welstead)
 SC1071 **Understanding Diffractive Optics** (Soskind)
 SC1072 **Statistics for Imaging and Sensor Data** (Bajorski)
 SC1073 **Radiometry and its Practical Applications** (Grant)
 SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk)
 SC1076 **Analog-to-Digital Converters for Digital ROICs** (Veeder)
 WS1074 **Safely Navigating the Deep Waters of International Trade: Legal Best Practices** (Scarlott)

Defense, Homeland Security, and Law Enforcement

- SC719 **Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies** (Gardner, Popa)
 Mon. 8:30 am to 5:30 pm, \$565 / \$660
 SC952 **Applications of Detection Theory** (Carrano)
 Tues. 8:30 am to 5:30 pm, \$565 / \$660
 SC789 **Introduction to Optical and Infrared Sensor Systems** (Shaw) 8:30 am to 5:30 pm, \$565 / \$670
 Wed.
 SC993 **Soil Physics For Non-Soil Engineers: Moisture, Thermal, And Dielectric Soil Properties Affecting IED Detection** (Hendrickx) 8:30 am to 5:30 pm, \$565 / \$660
 Wed.
 SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) 1:30 to 5:30 pm, \$345 / \$395
 Wed.
NEW
 SC1068 **Introduction to Night Vision** (Browne) 8:30 am to 12:30 pm, \$345 / \$395
 Thurs.
NEW
 SC1035 **Military Laser Safety** (Marshall) 8:30 am to 5:30 pm, \$565 / \$660
 Thurs.
 SC995 **Target Detection Algorithms for Hyperspectral Imagery** (Nasrabadi) 8:30 am to 5:30 pm, \$565 / \$660
 Thurs.
 SC547 **Terahertz Wave Technology and Applications** (Zhang)
 Thurs. 8:30 am to 12:30 pm, \$345 / \$395

Emerging Technologies

- SC1071 **Understanding Diffractive Optics** (Soskind)
 Tues. 1:30 to 5:30 pm, \$380 / \$430
NEW
 SC1076 **Analog-to-Digital Converters for Digital ROICs** (Veeder)
 Tues. 8:30 am to 12:30 pm, \$345 / \$395
NEW
 SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) 1:30 to 5:30 pm, \$345 / \$395
 Wed.
NEW
 SC547 **Terahertz Wave Technology and Applications** (Zhang)
 Thurs. 8:30 am to 12:30 pm, \$345 / \$395

IACET Continuing Education Units



SPIE has been approved as an authorized provider of CEUs by IACET, The International Association for Continuing Education and Training (Provider #1002092). In obtaining this approval, SPIE has demonstrated that it complies with the

ANSI/IACET Standard which is widely recognized as the standard of good practice for continuing education.

Money-back Guarantee

We are confident that once you experience an SPIE course for yourself you will look to us for your future education needs. However, if for any reason you are dissatisfied, we will gladly refund your money. We just ask that you tell us what you did not like; suggestions for improvement are always welcome.

SPIE reserves the right to cancel a course due to insufficient advance registration.

Imaging and Sensing

- SC713 **Engineering Approach to Imaging System Design** (Holst)
Mon. 8:30 am to 5:30 pm, \$615 / \$710
- SC1073 **Radiometry and its Practical Applications** (Grant)
Mon. 8:30 am to 5:30 pm, \$640 / \$735
NEW
- SC952 **Applications of Detection Theory** (Carrano)
Tues. 8:30 am to 5:30 pm, \$565 / \$660
- SC720 **Cost-Conscious Tolerancing of Optical Systems**
(Youngworth) 8:30 am to 12:30 pm, \$345 / \$395
- SC950 **Infrared Imaging Radiometry** (Richards) 8:30 am to 5:30 pm,
Tues. \$565 / \$660
- SC157 **MTF in Optical and Electro-Optical Systems** (Ducharme)
Tues. 8:30 am to 5:30 pm, \$605 / \$700
- SC067 **Testing and Evaluation of E-O Imaging Systems** (Holst)
Tues. 8:30 am to 5:30 pm, \$655 / \$740
- SC194 **Multispectral and Hyperspectral Image Sensors** (Lomheim)
Tues. 1:30 to 5:30 pm, \$425 / \$475
- SC1071 **Understanding Diffractive Optics** (Soskind)
Tues. 1:30 to 5:30 pm, \$380 / \$430
NEW
- SC1076 **Analog-to-Digital Converters for Digital ROICs** (Veeder)
Tues. 8:30 am to 12:30 pm, \$345 / \$395
NEW
- SC1069 **GPU for Defense Applications** (Humphrey) 8:30 am to
Wed. 12:30 pm, \$345 / \$395
NEW
- SC789 **Introduction to Optical and Infrared Sensor Systems**
Wed. (Shaw) 8:30 am to 5:30 pm, \$565 / \$660
- SC206 **Polarized Light: A Practical Hands-on Introduction** (Fisher)
Wed. 8:30 am to 5:30 pm, \$565 / \$660
- SC1031 **Radar Micro-Doppler Signatures - Principles and
Applications** (Chen, Tahmoush) 8:30 am to 12:30 pm,
Wed. \$345 / \$395
- SC967 **High Dynamic Range Imaging: Sensors and
Architectures** (Darmont) 1:30 to 5:30 pm,
Wed. \$345 / \$395
NEW
- SC1000 **Introduction to Infrared and Ultraviolet Imaging
Technology** (Richards) 1:30 to 5:30 pm, \$380 / \$430
- SC1070 **Radar Waveforms and Signal Processing** (Welstead)
Thurs. 8:30 am to 12:30 pm, \$345 / \$395
NEW
- SC901 **Sensor Array Signal Processing** (Rao) 8:30 am to 5:30 pm,
Thurs. \$565 / \$660
- SC946 **Super Resolution in Imaging Systems** (Bagheri, Javid) 8:30 am to 5:30 pm,
Thurs. \$565 / \$660
- SC995 **Target Detection Algorithms for Hyperspectral Imagery**
(Nasrabad) 8:30 am to 5:30 pm, \$565 / \$660
- SC547 **Terahertz Wave Technology and Applications** (Zhang)
Thurs. 8:30 am to 12:30 pm, \$345 / \$395
- SC154 **Electro-Optical Imaging System Performance** (Holst)
Fri. 8:30 am to 5:30 pm, \$645 / \$740

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

- SC1072 **Statistics for Imaging and Sensor Data** (Bajorski)
Mon. 8:30 am to 5:30 pm, \$665 / \$760
NEW
- SC952 **Applications of Detection Theory** (Carrano) 8:30 am to
Tues. 5:30 pm, \$565 / \$660
- SC994 **Multisensor Data Fusion for Object Detection,
Classification and Identification** (Klein) 8:30 am to 5:30 pm,
Tues. \$635 / \$730
- SC901 **Sensor Array Signal Processing** (Rao) 8:30 am to 5:30 pm,
Thurs. \$565 / \$660

Innovative Defense and Security Applications for Displays

- SC159 **Head-Mounted Displays: Design and Applications**
Tues. (Meizer, Browne) 8:30 am to 5:30 pm, \$600 / \$695
- SC1069 **GPU for Defense Applications** (Humphrey) 8:30 am to
Wed. 12:30 pm, \$345 / \$395
NEW
- SC967 **High Dynamic Range Imaging: Sensors and
Architectures** (Darmont) 1:30 to 5:30 pm,
Wed. \$345 / \$395
NEW
- SC1068 **Introduction to Night Vision** (Browne) 8:30 am to 12:30 pm,
Thurs. \$345 / \$395
NEW

IR Sensors and Systems

- SC152 **Infrared Focal Plane Arrays** (Dereniak, Hubbs) 1:30 to
Mon. 5:30 pm, \$345 / \$395
- SC278 **Infrared Detectors** (Dereniak) 8:30 am to 12:30 pm,
Mon. \$460 / \$510
- SC713 **Engineering Approach to Imaging System Design** (Holst)
Mon. 8:30 am to 5:30 pm, \$615 / \$710
- SC835 **Infrared Systems - Technology & Design** (Daniels)
Mon.-Tues. 8:30 am to 5:30 pm, \$1085 / \$1305
- SC900 **Uncooled Thermal Imaging Detectors and Systems**
Mon. (Hanson) 8:30 am to 5:30 pm, \$605 / \$700
- SC1073 **Radiometry and its Practical Applications** (Grant)
Mon. 8:30 am to 5:30 pm, \$640 / \$735
NEW
- SC1077 **Introduction to Optical Oceanography** (Hou)
Mon. 1:30 to 5:30 pm, \$345 / \$395
NEW
- SC720 **Cost-Conscious Tolerancing of Optical Systems**
Tues. (Youngworth) 8:30 am to 12:30 pm, \$345 / \$395
- SC950 **Infrared Imaging Radiometry** (Richards)
Tues. 8:30 am to 5:30 pm, \$565 / \$660
- SC067 **Testing and Evaluation of E-O Imaging Systems** (Holst)
Tues. 8:30 am to 5:30 pm, \$645 / \$740
- SC194 **Multispectral and Hyperspectral Image Sensors**
Tues. (Lomheim) 1:30 to 5:30 pm, \$425 / \$475
- SC1071 **Understanding Diffractive Optics** (Soskind)
Tues. 1:30 to 5:30 pm, \$380 / \$430
NEW
- SC1076 **Analog-to-Digital Converters for Digital ROICs** (Veeder)
Tues. 8:30 am to 12:30 pm, \$345 / \$395
NEW
- SC789 **Introduction to Optical and Infrared Sensor Systems**
Wed. (Shaw) 8:30 am to 5:30 pm, \$565 / \$660
- SC206 **Polarized Light: A Practical Hands-on Introduction**
Wed. (Fisher) 8:30 am to 5:30 pm, \$565 / \$660
- SC181 **Predicting Target Acquisition Performance of Electro-
Optical Imagers** (Vollmerhausen) 8:30 am to 5:30 pm,
Wed. \$620 / \$715
- SC993 **Soil Physics For Non-Soil Engineers: Moisture, Thermal,
and Dielectric Soil Properties Affecting IED Detection**
Wed. (Hendrickx) 8:30 am to 5:30 pm, \$565 / \$660
- SC1000 **Introduction to Infrared and Ultraviolet Imaging
Technology** (Richards) 1:30 to 5:30 pm, \$380 / \$430
- SC892 **Infrared Search and Track Systems** (Schwering)
Thurs. 8:30 am to 5:30 pm, \$565 / \$660
- SC1068 **Introduction to Night Vision** (Browne) 8:30 am to 12:30 pm,
Thurs. \$345 / \$395
NEW
- SC1035 **Military Laser Safety** (Marshall) 8:30 am to 5:30 pm,
Thurs. \$565 / \$660
- SC154 **Electro-Optical Imaging System Performance** (Holst)
Fri. 8:30 am to 5:30 pm, \$645 / \$740

Laser Sensors and Systems

- SC1032 **Direct Detection Laser Radar Systems for Imaging Applications** (*Richmond, Cain*) 8:30 am to 5:30 pm, \$610 / \$705
- SC167 **Introduction to Laser Radar** (*Kammerman*) 8:30 am to 12:30 pm, \$345 / \$395
- SC160 **Precision Stabilized Pointing and Tracking Systems** (*Hilkert*) 8:30 am to 5:30 pm, \$565 / \$660
- SC720 **Cost-Conscious Tolerancing of Optical Systems** (*Youngworth*) 8:30 am to 12:30 pm, \$345 / \$395
- SC1071 **Understanding Diffractive Optics** (*Soskind*)
Tues. 1:30 to 5:30 pm, \$380 / \$430
NEW
- SC789 **Introduction to Optical and Infrared Sensor Systems** (*Shaw*) 8:30 am to 5:30 pm, \$565 / \$660
- SC1031 **Radar Micro-Doppler Signatures - Principles and Applications** (*Chen, Tahmoush*) 8:30 am to 12:30 pm, \$345 / \$395
- SC997 **High Power Laser Beam Quality** (*Ross*) 8:30 am to 12:30 pm, \$345 / \$395
- SC1035 **Military Laser Safety** (*Marshall*) 8:30 am to 5:30 pm, \$565 / \$660

Optical and Optomechanical Engineering

- SC156 **Basic Optics for Engineers** (*Ducharme*) 8:30 am to 5:30 pm, \$605 / \$700
- SC010 **Introduction to Optical Alignment Techniques** (*Ruda*)
Mon.-Tues. 8:30 am to 5:30 pm, \$940 / \$1160
- SC1073 **Radiometry and its Practical Applications** (*Grant*)
Mon. 8:30 am to 5:30 pm, \$640 / \$735
NEW
- SC1072 **Statistics for Imaging and Sensor Data** (*Bajorski*)
Mon. 8:30 am to 5:30 pm, \$665 / \$760
NEW
- SC157 **MTF in Optical and Electro-Optical Systems** (*Ducharme*)
Tues. 8:30 am to 5:30 pm, \$605 / \$700
- SC720 **Cost-Conscious Tolerancing of Optical Systems** (*Youngworth*) 8:30 am to 12:30 pm, \$345 / \$395
- SC950 **Infrared Imaging Radiometry** (*Richards*) 8:30 am to 5:30 pm, \$565 / \$660
- WS609 **Basic Optics for Non-Optics Personnel** (*Harding*)
Tues. 1:30 to 4:00 pm, \$150 / \$200
- SC1071 **Understanding Diffractive Optics** (*Soskind*)
Tues. 1:30 to 5:30 pm, \$380 / \$430
NEW
- SC254 **Integrated Opto-Mechanical Analysis** (*Genberg, Doyle*)
Wed. 8:30 am to 5:30 pm, \$615 / \$710
- SC014 **Introduction to Optomechanical Design** (*Vukobratovich*)
Wed.-Thurs. 8:30 am to 5:30 pm, \$940 / \$1160
- SC206 **Polarized Light: A Practical Hands-on Introduction** (*Fisher*) 8:30 am to 5:30 pm, \$565 / \$660
- SC1000 **Introduction to Infrared and Ultraviolet Imaging Technology** (*Richards*) 1:30 to 5:30 pm, \$380 / \$430
- SC1052 **Optical Systems Engineering** (*Kasunic*)
Thurs. 8:30 am to 5:30 pm, \$565 / \$660
NEW
- SC220 **Optical Alignment Mechanisms** (*Guyer*) 1:30 to 5:30 pm, \$345 / \$395

Sensing for Industry, Environment, and Health

- SC719 **Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies** (*Gardner, Popa*)
Mon. 8:30 am to 5:30 pm, \$565 / \$660
- SC1077 **Introduction to Optical Oceanography** (*Hou*)
Mon. 1:30 to 5:30 pm, \$345 / \$395
NEW
- SC952 **Applications of Detection Theory** (*Carrano*) 8:30 am to 5:30 pm, \$565 / \$660
- SC789 **Introduction to Optical and Infrared Sensor Systems** (*Shaw*) 8:30 am to 5:30 pm, \$565 / \$660
- SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (*Erturk*) 1:30 to 5:30 pm, \$345 / \$395
NEW
- SC901 **Sensor Array Signal Processing** (*Rao*) 8:30 am to 5:30 pm, \$565 / \$660
- SC995 **Target Detection Algorithms for Hyperspectral Imagery** (*Nasrabadi*) 8:30 am to 5:30 pm, \$565 / \$660
- SC547 **Terahertz Wave Technology and Applications** (*Zhang*)
Thurs. 8:30 am to 12:30 pm, \$345 / \$395

Sensor Data and Information Exploitation

- SC160 **Precision Stabilized Pointing and Tracking Systems** (*Hilkert*) 8:30 am to 5:30 pm, \$565 / \$660
- SC1072 **Statistics for Imaging and Sensor Data** (*Bajorski*)
Mon. 8:30 am to 5:30 pm, \$665 / \$760
NEW
- SC994 **Multisensor Data Fusion for Object Detection, Classification and Identification** (*Klein*) 8:30 am to 5:30 pm, \$635 / \$730
- SC194 **Multispectral and Hyperspectral Image Sensors** (*Lomheim*) 1:30 to 5:30 pm, \$425 / \$475
- SC1076 **Analog-to-Digital Converters for Digital ROICs** (*Veeder*)
Tues. 8:30 am to 12:30 pm, \$345 / \$395
NEW
- SC158 **Fundamentals of Automatic Target Recognition** (*Sadjadi*)
Wed. 8:30 am to 5:30 pm, \$565 / \$660
- SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (*Vollmerhausen*) 8:30 am to 5:30 pm, \$620 / \$715
- SC1031 **Radar Micro-Doppler Signatures - Principles and Applications** (*Chen, Tahmoush*) 8:30 am to 12:30 pm, \$345 / \$395
- SC1035 **Military Laser Safety** (*Marshall*) 8:30 am to 5:30 pm, \$565 / \$660
- SC1070 **Radar Waveforms and Signal Processing** (*Welstead*)
Thurs. 8:30 am to 12:30 pm, \$345 / \$395
NEW
- SC901 **Sensor Array Signal Processing** (*Rao*) 8:30 am to 5:30 pm, \$565 / \$660
- SC995 **Target Detection Algorithms for Hyperspectral Imagery** (*Nasrabadi*) 8:30 am to 5:30 pm, \$565 / \$660

Signal, Image, and Neural Net Processing

- SC066 **Fundamentals of Electronic Image Processing** (*Weeks*)
 Mon. 8:30 am to 5:30 pm, \$635 / \$730
- SC1072 **Statistics for Imaging and Sensor Data** (*Bajorski*)
 Mon. 8:30 am to 5:30 pm, \$665 / \$760
NEW
- SC952 **Applications of Detection Theory** (*Carrano*) 8:30 am to
 Tues. 5:30 pm, \$565 / \$660
- SC994 **Multisensor Data Fusion for Object Detection,
 Classification and Identification** (*Klein*) 8:30 am to 5:30 pm,
 Tues. \$635 / \$730
- SC1076 **Analog-to-Digital Converters for Digital ROICs** (*Veeder*)
 Tues. 8:30 am to 12:30 pm, \$345 / \$395
NEW
- SC1070 **Radar Waveforms and Signal Processing** (*Welstead*)
 Thurs. 8:30 am to 12:30 pm, \$345 / \$395
NEW
- SC901 **Sensor Array Signal Processing** (*Rao*) 8:30 am to 5:30 pm,
 Thurs. \$565 / \$660
- SC946 **Super Resolution in Imaging Systems** (*Bagheri, Javid*)
 Thurs. 8:30 am to 5:30 pm, \$565 / \$660
- SC995 **Target Detection Algorithms for Hyperspectral Imagery**
 Thurs. (*Nasrabadi*) 8:30 am to 5:30 pm, \$565 / \$660

Unmanned, Robotic, and Layered Systems

- SC1077 **Introduction to Optical Oceanography** (*Hou*)
 Mon. 1:30 to 5:30 pm, \$345 / \$395
NEW
- SC952 **Applications of Detection Theory** (*Carrano*) 8:30 am to
 Tues. 5:30 pm, \$565 / \$660
- SC996 **Introduction to GPS Receivers** (*Zhu*) 8:30 am to 12:30 pm,
 Tues. \$345 / \$395
- SC993 **Soil Physics For Non-Soil Engineers: Moisture, Thermal,
 and Dielectric Soil Properties Affecting IED Detection**
 Wed. (*Hendrickx*) 8:30 am to 5:30 pm, \$565 / \$660
- SC1075 **Methods of Energy Harvesting for Low-Power Sensors**
 Wed. (*Erturk*) 1:30 to 5:30 pm, \$345 / \$395
NEW

INDUSTRY WORKSHOPS

Business + Professional Development

- WS609 **Basic Optics for Non-Optics Personnel** (*Harding*)
 Tues. 1:30 to 4:00 pm, \$150 / \$200
- WS951 **Leading Successful Product Innovation** (*Carrano*)
 Wed. 8:30 am to 12:30 pm, \$345 / \$395
- WS1074 **Safely Navigating the Deep Waters of International Trade:
 Legal Best Practices** (*Scarlott*) 1:30 to 5:30 pm,
 Wed. \$345 / \$395
NEW
- WS933 **Complying with the ITAR: A Case Study** (*Scarlott*)
 Thurs. 8:30 am to 12:30 pm, \$345 / \$395
- WS846 **Essential Skills for Engineering Project Leaders** (*Hinkle*)
 Thurs. 1:30 to 5:30 pm, \$345 / \$395

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Daily Course Schedule

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Defense, Homeland Security, and Law Enforcement

<p>SC719 Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies (<i>Gardner, Popa</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member</p>	<p>SC952 Applications of Detection Theory (<i>Carrano</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member</p>	<p>SC789 Introduction to Optical and Infrared Sensor Systems (<i>Shaw</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member</p>	<p>SC1068 Introduction to Night Vision (<i>Browne</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member</p>
		<p>SC993 Soil Physics For Non-Soil Engineers: Moisture, Thermal, And Dielectric Soil Properties Affecting IED Detection (<i>Hendrickx</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member</p>	<p>SC1035 Military Laser Safety (<i>Marshall</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member</p>
		<p>SC1075 Methods of Energy Harvesting for Low-Power Sensors (<i>Erturk</i>) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member</p>	<p>SC995 Target Detection Algorithms for Hyperspectral Imagery (<i>Nasrabadji</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member</p>
			<p>SC547 Terahertz Wave Technology and Applications (<i>Zhang</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member</p>

Emerging Technologies

	<p>SC1071 Understanding Diffractive Optics (<i>Soskind</i>) 1:30 to 5:30 pm, \$380 Member / \$430 Non-member</p>	<p>SC1075 Methods of Energy Harvesting for Low-Power Sensors (<i>Erturk</i>) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member</p>	<p>SC547 Terahertz Wave Technology and Applications (<i>Zhang</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member</p>
	<p>SC1076 Analog-to-Digital Converters for Digital ROICs (<i>Veeder</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member</p>		

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, \$615 Member / \$710 Non-member	SC1071 Understanding Diffractive Optics (Soskind) 1:30 to 5:30 pm, \$380 Member / \$430 Non-member	SC1075 Methods of Energy Harvesting for Low-Power Sensors (Erturk) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member	SC547 Terahertz Wave Technology and Applications (Zhang) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	SC154 Electro-Optical Imaging System Performance (Holst) 8:30 am to 5:30 pm, \$645 Member / \$740 Non-member
SC1073 Radiometry and its Practical Applications (Grant) 8:30 am to 5:30 pm, \$640 Member / \$735 Non-member	SC952 Applications of Detection Theory (Carrano) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC1069 GPU for Defense Applications (Humphrey) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	SC1070 Radar Waveforms and Signal Processing (Welstead) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	
SC1077: Introduction to Optical Oceanography (Hou) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member	SC720 Cost-Conscious Tolerancing of Optical Systems (Youngworth) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	SC789 Introduction to Optical and Infrared Sensor Systems (Shaw) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC901 Sensor Array Signal Processing (Rao) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	
	SC950 Infrared Imaging Radiometry (Richards) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC206 Polarized Light: A Practical Hands-on Introduction (Fisher) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC946 Super Resolution in Imaging Systems (Bagheri, Javid) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	
	SC157 MTF in Optical and Electro-Optical Systems (Ducharme) 8:30 am to 5:30 pm, \$605 Member / \$700 Non-member	SC1031 Radar Micro-Doppler Signatures - Principles and Applications (Chen, Tahmoush) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	SC995 Target Detection Algorithms for Hyperspectral Imagery (Nasrabadi) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	
	SC067 Testing and Evaluation of E-O Imaging Systems (Holst) 8:30 am to 5:30 pm, \$645 Member / \$740 Non-member	SC967 High Dynamic Range Imaging: Sensors and Architectures (Darmont) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member		
	SC194 Multispectral and Hyperspectral Image Sensors (Lomheim) 1:30 to 5:30 pm, \$425 Member / \$475	SC1000 Introduction to Infrared and Ultraviolet Imaging Technology (Richards) 1:30 to 5:30 pm, \$380 Member / \$430		
	SC1076 Analog-to-Digital Converters for Digital ROICs (Veeder) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member			

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Daily Course Schedule

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

SC1072 Statistics for NEW Imaging and Sensor Data (<i>Bajorski</i>) 8:30 am to 5:30 pm, \$665 Member / \$760 Non-member	SC952 Applications of Detection Theory (<i>Carrano</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member		SC901 Sensor Array Signal Processing (<i>Rao</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	
	SC994 Multisensor Data Fusion for Object Detection, Classification and Identification (<i>Klein</i>) 8:30 am to 5:30 pm, \$635 Member / \$730 Non-member			

Innovative Defense and Security Applications for Displays

	SC159 Head-Mounted Displays: Design and Applications (<i>Melzer, Browne</i>) 8:30 am to 5:30 pm, \$600 Member / \$695 Non-member	SC1069 GPU for NEW Defense Applications (<i>Humphrey</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	SC1068 Introduction NEW to Night Vision (<i>Browne</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	
		SC967 High Dynamic NEW Range Imaging: Sensors and Architectures (<i>Darmont</i>) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member		

IR Sensors and Systems

SC713 Engineering Approach to Imaging System Design (<i>Holst</i>) 8:30 am to 5:30 pm, \$615 Member / \$710 Non-member	SC720 Cost-Conscious Tolerancing of Optical Systems (<i>Youngworth</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member,	SC789 Introduction to Optical and Infrared Sensor Systems (<i>Shaw</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC892 Infrared Search and Track Systems (<i>Schwering</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC154 Electro-Optical Imaging System Performance (<i>Holst</i>) 8:30 am to 5:30 pm, \$645 Member / \$740 Non-member
SC278 Infrared Detectors (<i>Dereniak</i>) 8:30 am to 12:30 pm, \$460 Member / \$510 Non-member	SC950 Infrared Imaging Radiometry (<i>Richards</i>) 8:30 am to 5:30 pm, \$515 Member / \$610 Non-member, p. 22	SC206 Polarized Light: A Practical Hands-on Introduction (<i>Fisher</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC1068 Introduction NEW to Night Vision (<i>Browne</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	
SC835 Infrared Systems - Technology & Design (<i>Daniels</i>) 8:30 am to 5:30 pm, \$1085 Member / \$1305 Non-member		SC181 Predicting Target Acquisition Performance of Electro-Optical Imagers (<i>Vollmerhausen</i>) 8:30 am to 5:30 pm, \$620 Member / \$715 Non-member	SC1035 Military Laser Safety (<i>Marshall</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	
SC1073 Radiometry NEW and its Practical Applications (<i>Grant</i>) 8:30 am to 5:30 pm, \$640 Member / \$735 Non-member	SC067 Testing and Evaluation of E-O Imaging Systems (<i>Holst</i>) 8:30 am to 5:30 pm, \$635 Member / \$740 Non-member	SC993 Soil Physics For Non-Soil Engineers: Moisture, Thermal, And Dielectric Soil Properties Affecting IED Detection (<i>Hendrickx</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member		
SC900 Uncooled Thermal Imaging Detectors and Systems (<i>Hanson</i>) 8:30 am to 5:30 pm, \$605 Member / \$700 Non-member	SC194 Multispectral and Hyperspectral Image Sensors (<i>Lomheim</i>) 1:30 to 5:30 pm, \$425 Member / \$475 Non-member	SC1000 Introduction to Infrared and Ultraviolet Imaging Technology (<i>Richards</i>) 1:30 to 5:30 pm, \$380 Member / \$430 Non-member		
SC152 Infrared Focal Plane Arrays (<i>Dereniak, Hubbs</i>) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member	SC1071 Understand- ing Diffractive Optics (<i>Soskind</i>) 1:30 to 5:30 pm, \$380 Member / \$430 Non-member			
SC1077: Introduction NEW to Optical Oceanography (<i>Hou</i>) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member	SC1076 Analog-to- Digital Converters for Digital ROICs (<i>Veeder</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member			

Daily Course Schedule

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Laser Sensors and Systems

SC1032 Direct Detection Laser Radar Systems for Imaging Applications (<i>Richmond, Cain</i>) 8:30 am to 5:30 pm, \$610 Member / \$705 Non-member	SC720 Cost-Conscious Tolerancing of Optical Systems (<i>Youngworth</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	SC789 Introduction to Optical and Infrared Sensor Systems (<i>Shaw</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC997 High Power Laser Beam Quality (<i>Ross</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	
SC167 Introduction to Laser Radar (<i>Kammerman</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	SC1071 Understanding Diffractive Optics (<i>Soskind</i>) 1:30 to 5:30 pm, \$380 Member / \$430 Non-member	SC1031 Radar Micro-Doppler Signatures - Principles and Applications (<i>Chen, Tahmoush</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	SC1035 Military Laser Safety (<i>Marshall</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	
SC160 Precision Stabilized Pointing and Tracking Systems (<i>Hilkert</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member				

Optical and Optomechanical Engineering

SC010 Introduction to Optical Alignment Techniques (<i>Ruda</i>) 8:30 am to 5:30 pm, \$940 Member / \$1160 Non-member		SC014 Introduction to Optomechanical Design (<i>Vukobratovich</i>) 8:30 am to 5:30 pm, \$940 Member / \$1160 Non-member		
SC156 Basic Optics for Engineers (<i>Ducharme</i>) 8:30 am to 5:30 pm, \$605 Member / \$700 Non-member	SC720 Cost-Conscious Tolerancing of Optical Systems (<i>Youngworth</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	SC254 Integrated Opto-Mechanical Analysis (<i>Genberg, Doyle</i>) 8:30 am to 5:30 pm, \$615 Member / \$710 Non-member	SC1052 Optical Systems Engineering (<i>Kasunic</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	
SC1073 Radiometry and its Practical Applications (<i>Grant</i>) 8:30 am to 5:30 pm, \$640 Member / \$735 Non-member	SC950 Infrared Imaging Radiometry (<i>Richards</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC206 Polarized Light: A Practical Hands-on Introduction (<i>Fisher</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC220 Optical Alignment Mechanisms (<i>Guyer</i>) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member	
SC1072 Statistics for Imaging and Sensor Data (<i>Bajorski</i>) 8:30 am to 5:30 pm, \$665 Member / \$760 Non-member	WS609 Basic Optics for Non-Optics Personnel (<i>Harding</i>) 1:30 to 4:00 pm, \$150 Member / \$200 Non-member	SC1000 Introduction to Infrared and Ultraviolet Imaging Technology (<i>Richards</i>) 1:30 to 5:30 pm, \$380 Member / \$430 Non-member		
	SC1071 Understanding Diffractive Optics (<i>Soskind</i>) 1:30 to 5:30 pm, \$380 Member / \$430 Non-member			
	SC157 MTF in Optical and Electro-Optical Systems (<i>Ducharme</i>) 8:30 am to 5:30 pm, \$605 Member / \$700 Non-member			

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Daily Course Schedule

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Sensing for Industry, Environment, and Health

SC719 Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies (<i>Gardner, Popa</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC952 Applications of Detection Theory (<i>Carrano</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC789 Introduction to Optical and Infrared Sensor Systems (<i>Shaw</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC901 Sensor Array Signal Processing (<i>Rao</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member
SC1077: Introduction NEW to Optical Oceanography (<i>Hou</i>) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member		SC1075 Methods of NEW Energy Harvesting for Low-Power Sensors (<i>Erturk</i>) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member	SC995 Target Detection Algorithms for Hyperspectral Imagery (<i>Nasrabadi</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member
			SC547 Terahertz Wave Technology and Applications (<i>Zhang</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member

Sensor Data and Information Exploitation

SC1072 Statistics for NEW Imaging and Sensor Data (<i>Bajorski</i>) 8:30 am to 5:30 pm, \$665 Member / \$760 Non-member	SC994 Multisensor Data Fusion for Object Detection, Classification and Identification (<i>Klein</i>) 8:30 am to 5:30 pm, \$635 Member / \$730 Non-member	SC158 Fundamentals of Automatic Target Recognition (<i>Sadjadi</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC1035 Military Laser Safety (<i>Marshall</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member
SC160 Precision Stabilized Pointing and Tracking Systems (<i>Hilkert</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC194 Multispectral and Hyperspectral Image Sensors (<i>Lomheim</i>) 1:30 to 5:30 pm, \$425 Member / \$475 Non-member	SC181 Predicting Target Acquisition Performance of Electro-Optical Imagers (<i>Vollmerhausen</i>) 8:30 am to 5:30 pm, \$620 Member / \$715 Non-member	SC1070 Radar NEW Waveforms and Signal Processing (<i>Welstead</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member
	SC1076 Analog-to- NEW Digital Converters for Digital ROICs (<i>Veeder</i>) 8:30 am to 12:30 pm, \$34 Member / \$395 Non-member	SC1031 Radar Micro-Doppler Signatures - Principles and Applications (<i>Chen, Tahmoush</i>) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	SC901 Sensor Array Signal Processing (<i>Rao</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member
			SC995 Target Detection Algorithms for Hyperspectral Imagery (<i>Nasrabadi</i>) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member

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Daily Course Schedule

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Signal, Image, and Neural Net Processing

SC066 Fundamentals of Electronic Image Processing (Weeks) 8:30 am to 5:30 pm, \$635 Member / \$730 Non-member	SC952 Applications of Detection Theory (Carrano) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member		SC1070 Radar Waveforms and Signal Processing (WeIstead) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member NEW	
SC1072 Statistics for Imaging and Sensor Data (Bajorski) 8:30 am to 5:30 pm, \$665 Member / \$760 Non-member NEW	SC994 Multisensor Data Fusion for Object Detection, Classification and Identification (Klein) 8:30 am to 5:30 pm, \$635 Member / \$730 Non-member		SC901 Sensor Array Signal Processing (Rao) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	
	SC1076 Analog-to-Digital Converters for Digital ROICs (Veeder) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member NEW		SC946 Super Resolution in Imaging Systems (Bagheri, Javid) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	
			SC995 Target Detection Algorithms for Hyperspectral Imagery (Nasrabad) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	

Unmanned, Robotic, and Layered Systems

SC1077: Introduction to Optical Oceanography (Hou) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member NEW	SC952 Applications of Detection Theory (Carrano) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member	SC993 Soil Physics For Non-Soil Engineers: Moisture, Thermal, And Dielectric Soil Properties Affecting IED Detection (Hendrickx) 8:30 am to 5:30 pm, \$565 Member / \$660 Non-member		
	SC996 Introduction to GPS Receivers (Zhu) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	SC1075 Methods of Energy Harvesting for Low-Power Sensors (Erturk) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member NEW		

Business + Professional Development Workshops

	WS609 Basic Optics for Non-Optics Personnel (Harding) 1:30 to 4:00 pm, \$150 Member / \$200 Non-member	WS951 Leading Successful Product Innovation (Carrano) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	WS933 Complying with the ITAR: A Case Study (Scarlott) 8:30 am to 12:30 pm, \$345 Member / \$395 Non-member	
		WS1074 Safely Navigating the Deep Waters of International Trade: Legal Best Practices (Scarlott) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member NEW	WS846 Essential Skills for Engineering Project Leaders (Hinkle) 1:30 to 5:30 pm, \$345 Member / \$395 Non-member	

Daily Conference Schedule

Monday	Tuesday	Wednesday	Thursday	Friday
IR Sensors and Systems				
8353 Infrared Technology and Applications XXXVIII (<i>Andresen/Fulop/Norton</i>), p. 41				
	8354 Thermosense: Thermal Infrared Applications XXXIV (<i>Burleigh/Stockton</i>), p. 49			
	8355 Infrared Imaging Systems: Design, Analysis, Modeling, and Testing XXIII (<i>Holst/Krapels</i>), p. 52			
		8356 Technologies for Synthetic Environments: Hardware- in-the-Loop XVII (<i>Buford</i>), p. 55		
Defense, Homeland Security, and Law Enforcement				
8357 Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XVII (<i>Broach/Holloway</i>), p. 57				
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	8372 Ocean Sensing and Monitoring IV (<i>Hou/Arnone</i>), p. 93			

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Infrared Technology and Applications XXXVIII

Conference Chairs: **Bjørn F. Andresen**, Israel Aerospace Industries-ELTA (Israel); **Gabor F. Fulop**, Maxtech International, Inc. (USA); **Paul R. Norton**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

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

Monday 23 April

Room: Conv. Ctr. 307 Mon. 8:00 to 8:10 am

Opening Remarks

Session Chair: **Bjørn F. Andresen**, Israel Aerospace Industries-ELTA (Israel)

SESSION 1

Room: Conv. Ctr. 307 Mon. 8:10 am to 12:05 pm

NIR/SWIR FPAs and Applications

Session Chairs: **Tara J. Martin**, Sensors Unlimited, Inc., part of Goodrich Corp. (USA); **Michael H. MacDougall**, FLIR Electro-Optical Components (USA)

8:10 am: **A high-resolution SWIR camera via compressed sensing**, Lenore McMackin, Matt Herman, Bill Chatterjee, Matt S. Weldon, InView Technology Corp. (USA) [8353-01]

8:30 am: **Shortwave infrared camera with extended spectral sensitivity**, Martin Gerken, Bertram Achnert, Michael Kraus, Tanja Neumann, Mario O. Münzberg, Carl Zeiss Optronics GmbH (Germany) [8353-02]

8:50 am: **SCD's cooled and uncooled photo detectors for NIR SWIR** (*Igor Szafranek Memorial presentation*), Avraham Fraenkel, Daniel Aronov, Yael Beny, Leonid Bikov, Zipora Calahorra, Tal Fishman, Aviho Giladi, Elad Ilan, Philip Klipstein, Lidia Langof, Inna Lukomsky, Udi Mizrahi, Avi Tuito, Michael Yassen, Ami Zemel, SCD Semiconductor Devices (Israel) [8353-03]

9:15 am: **Flexible wide dynamic range VGA ROIC for InGaAs SWIR imaging**, Yang Ni, Bogdan Arion, Yiming Zhu, Pierre Potet, New Imaging Technologies SAS (France) [8353-04]

9:35 am: **High-performance 640 x 512 pixel hybrid InGaAs image sensor for night vision**, Eric De Borniol, Fabrice Guellec, Pierre Castelain, Michaël Tchagaspanian, CEA-LETI (France); Anne Rouvié, Jean-Alexandre Robo, Alcatel-Thales III-V Lab. (France); Philippe F. Bois, Thales Research & Technology (France) [8353-05]

9:55 am: **InGaAs focal plane array developments at III-V Lab.**, Anne Rouvié, Jean-Luc Reverchon, Odile Huet, Jean-Alexandre Robo, Jean-Patrick Truffer, Toufiq Bria, Jean Decobert, Philippe F. Bois, Eric M. Costard, Alcatel-Thales III-V Lab. (France) [8353-06]

Coffee Break 10:15 to 10:45 am

10:45 am: **Low dark current small pixel large format InGaAs 2D photodetector array development at Teledyne Judson Technologies**, Henry H. Yuan, Joseph Kimchi, Louis C. Kilmer, Teledyne Judson Technologies (USA) [8353-07]

11:05 am: **Large-format InGaAs focal plane arrays for SWIR imaging**, Michael H. MacDougall, Andrew D. Hood, Juan Manzo, Jonathan C. Geske, David Follman, FLIR Electro-Optical Components (USA) [8353-08]

11:25 am: **A low-power, TEC-less, 1280x1024, compact SWIR camera with temperature-dependent, non-uniformity corrections**, Jonathan Nazemi, Michael Delamere, Jesse Battaglia, Christopher Martin, Goodrich ISR Systems (USA) [8353-09]

11:45 am: **Ultralow flux SWIR detection issues using HgCdTe planar p-on-n photodiode arrays**, Olivier Gravrand, CEA-LETI-Minatec (France); Olivier Boulade, Vincent Moreau, Commissariat à l'Énergie Atomique (France); Eric Sanson, SOFRADIR (France); Gérard L. Destefanis, CEA-LETI-Minatec (France) [8353-10]

Standby Oral/Poster Presentation
 This poster may also be given as an oral presentation in this session.
MT6425CA: a 640 X 512-25 µm CTIA ROIC for SWIR InGaAs detector arrays, Selim Eminoglu, Yigit Uygur Mahsereci, Caglar Altiner, Tayfun Akin, Mikro-Tasarim Ltd. (Turkey) [8353 147]

Lunch Break 12:05 to 1:05 pm

SESSION 2

Room: Conv. Ctr. 307 Mon. 1:05 to 4:35 pm

Air Force Infrared Research and Development

Session Chairs: **Paul D. LeVan**, Air Force Research Lab. (USA); **R. Kennedy McEwen**, SELEX Galileo (United Kingdom)

1:05 pm: **Multispectral imaging with Type II superlattice detectors** (*Invited Paper*), Gamini Ariyawansa, Joshua M. Duran, Matthew Grupen, John E. Scheihing, Thomas R. Nelson, Jr., Michael T. Eismann, Air Force Research Lab. (USA) [8353-11]

1:25 pm: **Radiation tolerance of a dual-band IR detector based on a pBp architecture** (*Invited Paper*), Vincent M. Cowan, Christian P. Morath, Air Force Research Lab. (USA); Stephen A. Myers, Elena Plis, Sanjay Krishna, Ctr. for High Technology Materials, Univ. of New Mexico (USA) [8353-141]

1:45 pm: **Space-based hyperspectral technologies for the thermal infrared** (*Invited Paper*), Paul D. LeVan, Air Force Research Lab. (USA) [8353-13]

2:05 pm: **Hybrid dual-color MWIR detector for airborne missile warning systems** (*Invited Paper*), Itay Hirsh, Lior Shkedy, Dan Chen, Nir Fishler, Yonatan Hagbi, Alina Koifman, Yaki Openhaim, Ilan Vaserman, Michael T. Singer, SCD Semiconductor Devices (Israel) [8353-14]

2:25 pm: **Detection in urban scenario using combined airborne imaging sensors** (*Invited Paper*), Ingmar G. Renhorn, Swedish Defence Research Agency (Sweden); Michal Shimoni, Royal Belgian Military Academy (Belgium); Xavier Briottet, Yannic Boucher, ONERA (France); Alwin Dimmeler, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Sergio U. de Ceglie, CISAM (Italy); Salvatore Resta, Univ. degli Studi di Pisa (Italy); Piet B. W. Scherwing, Koen W. Benoist, Rob J. Dekker, TNO Defence, Security and Safety (Netherlands); Remco Dost, Mark van Persie, National Aerospace Lab. NLR (Netherlands); Ingebjörg Kåsen, Trym V. Haavardsholm, Norwegian Defence Research Establishment (Norway); Ola Friman, Swedish Defence Research Agency (Sweden) [8353-15]

2:45 pm: **IR-CENTRIC®: a force multiplier for fixed and rotary wing aircraft** (*Invited Paper*), Tsvi Rozen, Shavit Nadav, Meir Danino, Elbit Systems EW & SIGINT - ELISRA Ltd. (Israel) [8353-16]

Coffee Break 3:05 to 3:35 pm

3:35 pm: **Half TV format MWIR sensor incorporating proximity electronics** (*Invited Paper*), Andrew P. Ashcroft, SELEX Galileo Infrared Ltd. (United Kingdom) [8353-17]

3:55 pm: **Comparison of the strapdown and gimballed seekers** (*Invited Paper*), Bülent Özkan, Altug Uçar, TÜBITAK SAGE (Turkey) [8353-18]

4:15 pm: **Anti-dazzling protection for Air Force pilots** (*Invited Paper*), Ariela Donval, Tali Fisher, Ofir Lipman, Moshe Oron, KiloLambda Technologies, Ltd. (Israel) [8353-19]

Symposium-Wide Plenary Session
 Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II
Bruce Carlson, Director, National Reconnaissance Office
 See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 3

Room: Conv. Ctr. 307 Tues. 8:00 to 10:00 am

Threat Acquisition

Session Chairs: **Mario O. Münzberg**, Carl Zeiss Optronics GmbH (Germany); **Gil A. Tidhar**, IAI-Elta Systems Ltd. (Israel)

8:00 am: **Stereoscopic uncooled thermal imaging with autostereoscopic 3D-flat screen display in military driving enhancement systems**, Hubertus A. Haan, Mario O. Münzberg, Uwe Schwarzkopf, Carl Zeiss Optronics GmbH (Germany); Rene De la Barre, Silvio Jurk, Bernd Duckstein, Fraunhofer-Institut für Nachrichtentechnik Heinrich-Hertz-Institut (Germany) [8353-20]

8:20 am: **Infrared stereo camera for human machine interface**, Richard Edmondson, David B. Chenault, Justin P. Vaden, Polaris Sensor Technologies, Inc. (USA) [8353-21]

8:40 am: **A compact deployable mid-wave infrared imaging system for wide-area persistence surveillance in maritime environments**, K. Peter Judd, U.S. Naval Research Lab. (USA); Costa Colbert, Russ Smith, Smart Logic, Inc. (USA); Kenneth M. Vilardebo, V Systems, Inc. (USA); James R. Waterman, U.S. Naval Research Lab. (USA); Gregory J. Petty, Joel Kilzer, Naval Surface Warfare Ctr. Crane Div. (USA) [8353-23]

9:00 am: **OTHELLO: a novel SWIR dual-band detection system and its applications**, Gil A. Tidhar, Ori Aphek, Israel Aerospace Industries Ltd., Elta Group (Israel) [8353-24]

9:20 am: **Quantification of nitromethane with complementary super clip apodization and an iterative spectral comparison routine**, Kathryn J. Conroy, The Univ. of New South Wales (Australia); K. Paul Kirkbride, Australian Federal Police (Australia); Charles C. Harb, The Univ. of New South Wales (Australia) [8353-25]

9:40 am: **On designing a SWIR multiwavelength facial-based acquisition system**, Thirimachos Bourlai, Neeru Narang, Bojan Cukic, Lawrence A. Hornak, West Virginia Univ. (USA) [8353-26]

Coffee Break 10:00 to 10:30 am

SESSION 4

Room: Conv. Ctr. 307 Tues. 10:30 to 11:30 am

Type II Superlattice FPAs I

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

10:30 am: **Recent developments in type-II superlattice detectors at IRnova AB**, Hedda Malm, Rickard Marcks von Würtemberg, Carl Asplund, Dan Haga, Henk H. Martijn, IRnova AB (Sweden); Amir Karim, Acreo AB (Sweden); Elena Plis, Sanjay Krishna, Ctr. for High Technology Materials, Univ. of New Mexico (USA) [8353-27]

10:50 am: **Long-wavelength infrared superlattice detectors and FPA based on CBIRD design**, Alexander Soibel, Sir B. Rafol, Jean Nguyen, Arezou Khoshaklagh, Linda Höglund, Sam A. Keo, Jason M. Mumolo, John K. Liu, Anna Liao, David Z. Y. Ting, Sarath D. Gunapala, Jet Propulsion Lab. (USA) [8353-28]

11:10 am: **Development of type II superlattice detector for future space applications at JAXA**, Haruyoshi Katayama, Jyunpei Murooka, Masataka Naitoh, Tadashi Imai, Ryota Sato, Eichi Tomita, Munetaka Ueno, Hiroshi Murakami, Japan Aerospace Exploration Agency (Japan); Kunihiko Bito, Satoshi Kawasaki, Masafumi Kimata, Ritsumeikan Univ. (Japan); Takahiro Kitada, Toshiro Isu, Univ. of Tokushima (Japan); Mikhail A. Patrashin, Iwao Hosako, National Institute of Information and Communications Technology (Japan) [8353-32]

Standby Oral/Poster Presentation
 This poster may also be given as an oral presentation in this session.
MWIR and LWIR photodetectors made of InAs/InAsSb Type-II superlattices, Oray O. Cellek, Ha Sul Kim, Elizabeth H. Steenberg, Hua Li, Zhiyuan Lin, Shi Liu, Yong-Hang Zhang, Arizona State Univ. (USA) [8353-143]

SESSION 5

Room: Conv. Ctr. 307 Tues. 11:30 am to 12:00 pm

Keynote Session

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

11:30 am: **Advanced imaging R&D at DARPA-MTO** (*Keynote Presentation*), Nibir K. Dhar, Defense Advanced Research Projects Agency (USA) . [8353-29]

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

SESSION 6

Room: Conv. Ctr. 307 Tues. 1:30 to 6:20 pm

Type II Superlattice FPAs II

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

1:30 pm: **Performance enhancement of III-V superlattice infrared detectors by solving material and fabrication issues** (*Invited Paper*), Meimei Z. Tidrow, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Lucy Zheng, Institute for Defense Analyses (USA) [8353-30]

2:00 pm: **1024 x 1024 LWIR SLS FPAs: status and characterization**, Mani Sundaram, Axel Reisinger, Richard Dennis, Kelly Patnaude, Douglas Burrows, Jason Bundas, Kim E. Beech, Ross Faska, Daniel Manidakos, QmagiQ, LLC (USA) [8353-35]

2:20 pm: **Temperature-dependent absorption derivative on InAs/GaSb Type II superlattices**, Brianna Klein, Nutan Gautam, Stephen A. Myers, Sanjay Krishna, Ctr. for High Technology Materials, Univ. of New Mexico (USA) [8353-33]

2:40 pm: **Electronic transport in InAs/GaSb type-II superlattices for infrared detector applications**, Gilberto A. Umana-Membreno, Hemendra Kala, Jarek Antoszewski, Lorenzo Faraone, The Univ. of Western Australia (Australia); Brianna Klein, Nutan Gautam, Maya Narayanan Kutty, Elena Plis, Sanjay Krishna, The Univ. of New Mexico (USA) [8353-34]

Coffee Break 3:00 to 3:30 pm

3:30 pm: **Passivation of type II InAs/GaSb superlattice photodetectors with atomic layer deposited Al₂O₃**, Omer Salihoglu, Abdullah Muti, Bilkent Univ. (Turkey); Kutlu Kutluer, Tunay Tansel, Rasit Turan, Middle East Technical Univ. (Turkey); Atilla Aydinli, Bilkent Univ. (Turkey) [8353-36]

3:50 pm: **Recent advances in 2 colors FPAs based on T2SL; InAs/GaSb** (*Invited Paper*), Manijeh Razeghi, Northwestern Univ. (USA) [8353-31]

4:20 pm: **Analysis surface oxides on narrow band III-V semiconductors toward surface-leakage-free IR photodetectors**, Qin Wang, Acreo AB (Sweden); Mats Göthelid, Kista Photonics Research Ctr. (Sweden); Emmanuelle Göthelid, Uppsala Univ. (Sweden); Susanne Almqvist, Amir Karim, Acreo AB (Sweden); Oscar Gustafsson, Mattias Hammar, Kista Photonics Research Ctr. (Sweden); Jan Y. Andersson, Acreo AB (Sweden) [8353-37]

4:40 pm: **Unrelaxed InAsSb with novel absorption, carrier transport, and recombination properties for MWIR and LWIR photodetectors**, Dmitry Donetsky, Gregory Belenky, Ding Wang, Youxi Lin, Leon Shterengas, Gela Kipshidze, Stony Brook Univ. (USA); Wendy L. Sarney, Stefan P. Svensson, Harry Hier, U.S. Army Research Lab. (USA) [8353-38]

5:00 pm: **100mm GaSb substrate manufacturing for IRFPA epi growth**, Lisa P. Allen, J. Patrick Flint, Gregory Meshew, Gordon Dallas, John Trevehan, Galaxy Compound Semiconductors, Inc. (USA); Dmitri Lubyshev, Yueming Qiu, Amy W. Liu, Joel M. Fastenau, IQE Inc. (USA) [8353-39]

5:20 pm: **Large diameter ultra-flat epitaxy ready GaSb substrates: requirements for MBE grown advanced infrared detectors**, Mark J. Furlong, Rebecca J. Martinez, Sasson Amirhaghi, Brian Smith, Andrew Mowbray, Wafer Technology Ltd. (United Kingdom) [8353-40]

5:40 pm: **Competing technology for high-speed HOT-IR-FPAs** (*Invited Paper*), Manijeh Razeghi, Northwestern Univ. (USA) [8353-91]

6:00 pm: **Dark current modeling of Type II superlattice diodes**, Antoni Rogalski, Military Univ. of Technology (Poland) [8353-41]

Standby Oral/Poster Presentation
 This poster may also be given as an oral presentation in this session.
MWIR and LWIR photodetectors made of InAs/InAsSb Type-II superlattices, Oray O. Celtek, Ha Sul Kim, Elizabeth H. Steenbergen, Hua Li, Zhiyuan Lin, Shi Liu, Yong-Hang Zhang, Arizona State Univ. (USA) [8353-143]

Wednesday 25 April

Sessions 7, 8, 9 run concurrently with sessions 10,11,12.

SESSION 7

Room: Conv. Ctr. 307Wed. 8:00 to 9:40 am

Emerging Uncooled Technologies

Session Chairs: **Colin E. Reese**, U.S. Army Night Vision & Electronic Sensors Directorate (USA);

Charles M. Hanson, Consultant in Infrared (USA)

8:00 am: **Uncooled silicon germanium oxide (Si_xGe_{1-x}O_y) thin films for infrared detection**, Muhammad L. Hai, Muhammad Hesani, Qi Cheng, Univ. of Missouri-Columbia (USA); Athanasios J. Syllaios, Sameer K. Ajmera, L-3 Electro-Optical Systems (USA); Mahmoud F. Almasri, Univ. of Missouri-Columbia (USA) [8353-105]

8:20 am: **Formation of GaN film on Si for microbolometer**, Yong Soo Lee, Dong-Seok Kim, Jong-Hoon Kim, Kyungpook National Univ. (Korea, Republic of); Young-Chul Jung, Kyungju Univ. (Korea, Republic of); Jung-Hee Lee, Kyungpook National Univ. (Korea, Republic of) [8353-43]

8:40 am: **Novel uncooled detector based on gallium nitride micromechanical resonators**, Mina Rais-Zadeh, Vikrant J. Gokhale, Sui Yu, Univ. of Michigan (USA) [8353-44]

9:00 am: **Silicon-based nanobolometer for multispectral room temperature IR detection**, Hyesog Lee, Tanner Research, Inc. (USA) [8353-45]

9:20 am: **Development of microbolometer with high fill factor and high mechanical stability by shared-anchor structure**, Taehyun Kim, Kimyung Kyung, Jae Hong Park, Young Su Kim, Sung Kyu Lim, Kyungmin Kim, Taejoong Lee, Kwyro Lee, National Nanofab Ctr. (Korea, Republic of); Christopher Welham, COVENTOR Europe (France); Hee Yeoun Kim, National Nanofab Ctr. (Korea, Republic of) [8353-46]

SESSION 10

Room: Conv. Ctr. 316Wed. 8:00 to 10:00 am

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 (USA)

8:00 am: **Thales cryogenics rotary cryocoolers for HOT applications**, Jean-Yves Martin, Jean-Marc Cauquill, Thales Cryogénie S.A. (France); Tony Benschop, Thales Cryogenics B.V. (Netherlands); René J. Griot, Sébastien Freche, Thales Cryogénie S.A. (France) [8353-56]

8:20 am: **Update on MTF figures for linear and rotary coolers of Thales cryogenics**, Willem van de Groep, Thales Cryogenics B.V. (Netherlands)[8353-57]

8:40 am: **Compact high-efficiency linear cryocooler in single-piston moving magnet design for HOT detectors**, Ingo Rühlich, Markus Mai, Carsten Rosenhagen, AIM INFRAROT-MODULE GmbH (Germany) [8353-58]

9:00 am: **RICOR's rotary cryocoolers development and optimization for HOT IR detectors**, Avishai Filis, Zvi Bar-Haim, Tomer Havatzelet, Moshe Barak, RICOR-Cryogenic & Vacuum Systems (Israel) [8353-59]

9:20 am: **Linear cryogenic coolers for HOT infrared detectors**, Alexander Veprik, Sergey V. Riabzev, RICOR-Cryogenic & Vacuum Systems (Israel) [8353-60]

9:40 am: **Experimental demonstration of cryocooler electronics with multiple mechanical cryocooler types**, Jeremy J. Freeman, Carl S. Kirkconnell, J. Brian Murphy, Robert K. Ito, Iris Technology Corp. (USA) [8353-61]

Coffee Break 10:00 to 10:30 am

SESSION 8

Room: Conv. Ctr. 307Wed. 9:40 to 11:50 am

Uncooled FPAs and Applications

Session Chairs: Jean-Luc M. Tissot, ULIS (France);

Masafumi Kimata, Ritsumeikan Univ. (Japan);

Avraham Fraenkel, SCD Semiconductor Devices (Israel)

9:40 am: **Uncooled detector development at Raytheon**, Stephen H. Black, Raytheon Co. (USA) [8353-47]

Coffee Break 10:00 to 10:30 am

10:30 am: **Easy to use uncooled ¼ VGA 17 µm FPA development for compact and low-power systems**, Jean-Luc M. Tissot, Patrick Robert, ULIS (France) [8353-49]

10:50 am: **2-million-pixel SOI diode uncooled IRFPA with 15µm pixel pitch**, Daisuke Takamuro, Tomohiro Maegawa, Yasuaki Ohta, Takaki Sugino, Yasuhiro Kosasayama, Takahiro Ohnakado, Hisatoshi Hata, Masashi Ueno, Hiroshi Ohji, Mitsubishi Electric Corp. (Japan); Ryota Sato, Haruyoshi Katayama, Tadashi Imai, Munetaka Ueno, Japan Aerospace Exploration Agency (Japan) [8353-50]

11:10 am: **SCD µ-Bolometer VOx infrared high-end detector development**, Udi Mizrahi, Fabian Schapiro, Leonid Bikov, Aviho Giladi, Niv Shiloah, Igor Pivnik, Shimon Elkind, Shay Maayani, Emanuel Mordechai, Asaf Amsterdam, Ilan Vaserman, Oran Farbman, Yoav Hirsh, SCD Semiconductor Devices (Israel); Avi Tuito, Israel Ministry of Defense (Israel); Michael Ben-Ezra, SCD Semiconductor Devices (Israel) [8353-51]

11:30 am: **Current progress on pixel level packaging for uncooled IRFPA**, Geoffroy Dumont, Wilfried Rabaud, Jean-Jacques Yon, Laurent Carle, Valérie Goudon, Claire Vialle, Agnès Arnaud, CEA-LETI-Minatec (France) [8353-52]

Oral Standby Presentation

This presentation may be given in this session, and will also be given in Session 18 on Friday.

An uncooled microbolometer focal plane array using bias heating for resistance nonuniformity compensation, Murat Tepegoz, Alperen Toprak, Alp Oguz, Sukru Senveli, Eren Canga, Yusuf Tanrikulu, Tayfun Akin, Middle East Technical Univ. (Turkey) [8353-146]

Lunch/Exhibition Break 11:50 am to 1:30 pm

SESSION 11

Room: Conv. Ctr. 316Wed. 10:30 to 11:50 am

IR Optics I

Session Chairs: Jay N. Vizgaitis,

U.S. Army Night Vision & Electronic Sensors Directorate (USA);

Christopher C. Alexay, StingRay Optics, LLC (USA)

10:30 am: **Common aperture multispectral optics for military applications**, Nicholas A. Thompson, Qioptiq Ltd. (United Kingdom) [8353-62]

10:50 am: **Multi-field of view see-spot optics**, Scott Lilley, Jay N. Vizgaitis, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Jonathan E. Everett, Robert Spinazzola, General Dynamics-Global Imaging Technologies (USA) [8353-66]

11:10 am: **Tailored thermal emission from sub-wavelength diffractive optical elements**, Adam M. Jones, College of Optical Sciences, The Univ. of Arizona (USA) and Sandia National Labs. (USA); Shanalyn A. Kemme, David A. Scrymgeour, Michael J. Cich, Sally Samora, Sandia National Labs. (USA); Robert A. Norwood, College of Optical Sciences, The Univ. of Arizona (USA) [8353-64]

11:30 am: **Low-reflecting DLC coating on IR substrates**, Mordechai Gilo, Ophir Optronics Ltd. (Israel) [8353-65]

Lunch/Exhibition Break 11:50 am to 1:30 pm

Defense, Security, and Sensing Facility Maps:

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Hilton Baltimore p. 5

SESSION 9

Room: Conv. Ctr. 307 Wed. 1:30 to 5:40 pm

Smart Processing

Joint Session with Conference 8355

Session Chairs: **Richard L. Espinola**, U.S. Army Night Vision & Electronic Sensors Directorate (USA);
Andre Repasi, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany);
Paul L. McCarley, Air Force Research Lab. (USA);
John T. Caulfield, Cyan Systems (USA)

1:30 pm: **Infrared detector size: how low should you go?**, Ronald G. Driggers, U.S. Naval Research Lab. (USA); Richard H. Vollmerhausen, Univ. of Delaware (USA); Joseph Reynolds, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA); Gerald C. Holst, Consultant (USA) [8355-23]

1:50 pm: **An information-theoretic perspective on the challenges and advances in the race toward 12µm pixel pitch for megapixel uncooled infrared imaging**, Christel-Loic Tisse, MTech Imaging Pte. Ltd. (Singapore); Arnaud A. Crastes, Jean-Luc M. Tissot, ULIS (France)..... [8353-53]

2:10 pm: **Implementation of intensity ratio change and LOS rate change algorithms for imaging infrared trackers**, Claude R. Viau, Tactical Technologies Inc. (Canada) [8355-25]

2:30 pm: **Flexible readout and integration sensor (FRIS): a bio-inspired, system-on-chip, event-based readout architecture**, Joseph H. Lin, Philippe O. Pouliquen, Andreas G. Andreou, The Johns Hopkins Univ. (USA); Charbel G. Rizk, Arnold C. Goldberg, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8353-54]

Coffee/Exhibition Break. 2:50 to 4:00 pm

4:00 pm: **ADMIRE: a locally adaptive single-image, non-uniformity correction and denoising algorithm: application to uncooled IR camera**, Yohann Tendero, École Normale Supérieure de Cachan (France); Jerome Gilles, Univ. of California, Los Angeles (USA) [8353-55]

4:20 pm: **Turbulence compensation: an overview**, Adam W. M. van Eekeren, Klammer Schutte, Judith Dijk, Piet B. W. Schwering, Miranda van Iersel, TNO Defence, Security and Safety (Netherlands) [8355-26]

4:40 pm: **A real-time atmospheric turbulence mitigation and superresolution solution for infrared imaging systems**, Douglas R. Droege, L-3 Communications Cincinnati Electronics (USA); Russell C. Hardie, L-3 Communications Cincinnati Electronics (USA) and Univ. of Dayton (USA); Brian S. Allen, Alexander J. Dapore, Jon C. Blevins, L-3 Communications Cincinnati Electronics (USA) [8355-27]

5:00 pm: **Turbulence degradation and mitigation performance for handheld weapon ID**, Richard L. Espinola, Sameer Aghera, Jason Miller, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA) [8355-28]

5:20 pm: **Patch-based local turbulence compensation in anisoplanatic conditions**, Adam W. M. van Eekeren, Maarten Kruihof, Klammer Schutte, Judith Dijk, Miranda van Iersel, Piet B. W. Schwering, TNO Defence, Security and Safety (Netherlands) [8355-29]

SESSION 12

Room: Conv. Ctr. 316 Wed. 1:30 to 5:50 pm

IR Optics II

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

1:30 pm: **Planar integrated plasmonic mid-IR spectrometer**, Christopher J. Fredricksen, LRC Engineering, Inc. (USA); Justin W. Cleary, Air Force Research Lab. (USA); Walter R. Buchwald, Solid State Scientific Corp. (USA); Pedro Figueiredo, Janardan Nath, Gautam Medhi, Imen Rezadad, Javaneh Boroumand, Robert E. Peale, Univ. of Central Florida (USA) [8353-63]

1:50 pm: **Integration of wide field-of-view imagery functions in a detector dewar cooler assembly**, Guillaume Druart, Florence de la Barrière, Nicolas Guérineau, ONERA (France); Gilles Lafargues, Manuel Fendler, Nicolas Lhermet, CEA-LETI (France); Jean Taboury, Institut d'Optique Graduate School (France); Yann Reibel, SOFRADIR (France); Jean-Baptiste Moullec, Direction Générale de L'armement (France) [8353-67]

2:10 pm: **Infrared focal plane array with a built-in stationary Fourier-transform spectrometer: recent technological advances**, Nicolas Guérineau, Yann Ferrec, Sylvain Rommeluère, Frédéric Gillard, Florence de la Barrière, Sidonie Lefebvre, ONERA (France); Gilles Lafargues, Manuel Fendler, Commissariat à l'Énergie Atomique (France) [8353-68]

2:30 pm: **Laser designator protection filter for see-spot thermal imaging systems**, Ariela Donval, Tali Fisher, Ofir Lipman, Moshe Oron, KiloLambda Technologies, Ltd. (Israel) [8353-70]

Coffee/Exhibition Break. 2:50 to 3:50 pm

3:50 pm: **Passive athermalization of two-lens designs in 8-12micron waveband**, Norbert Schuster, Umicore Electro-Optic Materials (Belgium); John Franks, Umicore Coating Services (United Kingdom) [8353-71]

4:10 pm: **Advantages of using engineered chalcogenide glass for color corrected, passively athermalized LWIR imaging systems**, Scott W. Sparrold, Katie Schwertz, Adam Bublitz, Edmund Optics Inc. (USA) [8353-72]

4:30 pm: **Qualification and metrology for US-produced chalcogenides**, Nathan Carlie, SCHOTT North America, Inc. (USA) [8353-73]

4:50 pm: **Material trades between Be, SiC, and VQ aluminum for tactical systems: update referencing the current state-of-the-art**, Christopher J. Duston, Tony Hull, L-3 Integrated Optical Systems Division (USA) [8353-74]

5:10 pm: **Mid-spatial frequency matters: examples of the control of the power spectral density and what that means to the performance of imaging systems**, Tony Hull, L-3 Integrated Optical Systems Division (USA) and The Univ. of New Mexico (USA); Michael J. Riso, John M. Barentine, L-3 Integrated Optical Systems Division (USA) [8353-75]

5:30 pm: **Advanced in shutter drive technology to enhance man-portable IR cameras**, David W. Durfee, CVI Melles Griot (USA) [8353-142]

Thursday 26 April

SESSION 13

Room: Conv. Ctr. 307 Thurs. 8:00 to 9:20 am

Active Imaging

Session Chairs: **Stefan T. Baur**, Raytheon Co. (USA);

Ingmar G. Renhorn, Swedish Defence Research Agency (Sweden)

8:00 am: **Low-noise GHz bandwidth 16-channel photoreceivers for lidar imaging applications**, Xiaogang Bai, Ping Yuan, Paul A. McDonald, Joseph C. Boisvert, James J. Chang, Robyn L. Woo, Eduardo L. Labios, Rengarajan Sudharsanan, Spectrolab, Inc., A Boeing Co. (USA); Michael A. Krainak, Guangning Yang, Xiaoli Sun, Wei Lu, NASA Goddard Space Flight Ctr. (USA) [8353-76]

8:20 am: **Advances in lidar components and subsystems at Raytheon**, Michael D. Jack, Raytheon Co. (USA) [8353-77]

8:40 am: **Small pixel pitch APD solutions for active and passive imaging**, Yann Reibel, Alexandre Kerlain, Gwladys Bonnouvrier, David Billon-Lanfrey, SOFRADIR (France); Johan Rothman, Laurent R. Mollard, Eric De Borniol, Gérard L. Destefanis, CEA-LETI (France) [8353-78]

9:00 am: **Development of low-excess noise SWIR APDs**, Xiaogang Bai, Ping Yuan, Paul A. McDonald, Joseph C. Boisvert, James J. Chang, Rengarajan Sudharsanan, Spectrolab, Inc., A Boeing Co. (USA) [8353-79]

SESSION 14

Room: Conv. Ctr. 307 Thurs. 9:20 am to 12:05 pm

HgCdTe I

Session Chairs: **Joseph G. Pellegrino**,

U.S. Army Night Vision & Electronic Sensors Directorate (USA);

Michel Vuillermet, SOFRADIR (France)

9:20 am: **Mercury cadmium telluride (HgCdTe) passivation by advanced thin conformal Al₂O₃ films**, Richard Fu, James Pattison, Andrew Chen, Osama Nayfeh, U.S. Army Research Lab. (USA) [8353-80]

9:40 am: **12µm pixel pitch development for 3-side buttable megapixel MW FPAs**, Peter Thorne, Harald J. Weller, Les G. Hipwood, SELEX Galileo Infrared Ltd. (United Kingdom) [8353-81]

Coffee Break 10:00 to 10:30 am

10:30 am: **Status of MCT focal plane arrays in France**, Michel Vuillermet, David Billon-Lanfrey, SOFRADIR (France); Gérard L. Destefanis, CEA-LETI (France) [8353-82]

10:50 am: **State-of-the-art MCT IR-modules with enhanced long-term and cycle stability**, Rainer Breiter, Joachim C. Wendler, Holger Lutz, Stefan Rutzinger, Timo Schallenberg, Johann Ziegler, AIM INFRAROT-MODULE GmbH (Germany) [8353-83]

11:10 am: **SWIR and NIR MCT arrays grown by MOVPE for astronomy applications**, Les G. Hipwood, Ian M. Baker, Paul Abbott, Nick Shorrocks, Chris D. Maxey, SELEX Galileo Infrared Ltd. (United Kingdom); Naidu Bezawada, David C. Atkinson, UK Astronomy Technology Ctr. (United Kingdom) [8353-84]

11:30 am: **Very long wavelength infrared detection with p-on-n LPE HgCdTe**, Nicolas Baier, Laurent R. Mollard, Olivier Gravrand, Gérard L. Destefanis, Guillaume Bourgeois, Jean-Paul Zanatta, Commissariat à l'Énergie Atomique (France); Patricia Pidancier, SOFRADIR (France); Laurie Tauziède, Centre National d'Études Spatiales (France) [8353-85]

11:50 am: **LWIR and VLWIR MCT technologies and detectors development at Sofradir for space applications**, Cedric Leroy, Patricia Pidancier, Philippe Chorier, SOFRADIR (France); Gérard L. Destefanis, CEA-LETI (France) [8353-115]

Lunch/Exhibition Break 12:05 to 1:30 pm

SESSION 15

Room: Conv. Ctr. 307 Thurs. 1:30 to 2:30 pm

HgCdTe II

Session Chairs: **Michel Vuillermet**, SOFRADIR (France);

Joseph G. Pellegrino, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

1:30 pm: **Electrical characteristics of a MOVPE grown MWIR N+p(As)HgCdTe heterostructure photodiode build on a GaAs substrate**, Roger E. DeWames, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8353-86]

1:50 pm: **State of MBE technology at AIM**, Johann Ziegler, Jan Wenisch, Detlef Eich, Holger Lutz, Timo Schallenberg, Richard Wollrab, AIM INFRAROT-MODULE GmbH (Germany) [8353-87]

2:10 pm: **HgCdTe photon trapping detectors for mid-wavelength infrared (MWIR) high operating temperature (HOT) focal plane arrays**, Kasey D. Smith, Justin G. A. Wehner, Aaron M. Ramirez, Edward P. Smith, Raytheon Co. (USA) [8353-88]

Standby Oral/Poster Presentation

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

Laser power and temperature dependence on laser beam induced current signal in As-doped p-type HgCdTe, Y. Chen, W. Hu, X. Chen, Z. Ye, Shanghai Institute of Technical Physics (China); J. Wang, Univ. of Science and Technology of China (China); C. Lin, X. Hu, W. Lu, Shanghai Institute of Technical Physics (China) [8353-137]

SESSION 16

Room: Conv. Ctr. 307 Thurs. 2:30 to 6:00 pm

HOT: High-Operating Temperature FPAs

Session Chairs: **Michael T. Eismann**,

Air Force Research Lab. (USA); **Stuart B. Horn**,

U.S. Army Night Vision & Electronic Sensors Directorate (USA)

2:30 pm: **MWIR mercury cadmium telluride detectors for high operating temperatures (Invited Paper)**, Les G. Hipwood, Peter Knowles, Luke Pillans, Richard Ash, Nick Shorrocks, Darren Vincent, SELEX Galileo Infrared Ltd. (United Kingdom) [8353-89]

2:50 pm: **HOT MWIR HgCdTe performance on CZT and alternative substrates (Invited Paper)**, Joseph G. Pellegrino, Roger E. DeWames, Patrick G. Maloney, Curtis Billman, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8353-90]

3:10 pm: **High operating temperature InAs_{1-x}Sb_x diode and bariode photodetectors (Invited Paper)**, Philip Klipstein, Daniel Aronov, Eyal Berkowicz, Maya Brumer, Avraham Fraenkel, Alexander Glozman, Steve Grossman, Olga Klin, Inna Lukomsky, Osnat Magen, Itay Shtrichman, Noam Snapi, Michael Yassen, Eliezer Weiss, SCD Semiconductor Devices (Israel) [8353-92]

Coffee Break 3:30 to 4:00 pm

4:00 pm: **Photoconductive gain in barrier heterostructure infrared detectors**, Stephen A. Myers, Nutan Gautam, Elena Plis, Ctr. for High Technology Materials, Univ. of New Mexico (USA); Christian P. Morath, Vincent M. Cowan, Air Force Research Lab. (USA); Sanjay Krishna, Ctr. for High Technology Materials, Univ. of New Mexico (USA) [8353-93]

4:20 pm: **Numerical simulation of InAsSb/AlAsSb nBn detector arrays**, Jonathan Schuster, Craig A. Keasler, Boston Univ. (USA); Marion B. Reine, Consultant in Infrared Detectors (USA); Enrico Bellotti, Boston Univ. (USA) [8353-94]

4:40 pm: **320 x 256 complementary barrier infrared detector focal plane array for longwave infrared imaging**, Jean Nguyen, Sir B. Rafol, Alexander Soibel, Arezou Khoshakhlagh, David Z. Y. Ting, John K. Liu, Jason M. Mumolo, Sarath D. Gunapala, Jet Propulsion Lab. (USA) [8353-95]

5:00 pm: **High operating temperature midwave quantum dot barrier infrared detector (QD-BIRD)**, David Z. Y. Ting, Alexander Soibel, Cory J. Hill, Sam A. Keo, Jason M. Mumolo, Sarath D. Gunapala, Jet Propulsion Lab. (USA) [8353-96]

5:20 pm: **MWIR InAs_{1-x}Sb_x nCBn detectors data and analysis**, Arvind I. D'Souza, Ernest W. Robinson, Adrian C. Ionescu, Daniel Okerlund, DRS Sensors & Targeting Systems, Inc. (USA); Terrence J. deLyon, Rajesh D. Rajavel, Hasan Sharifi, Daniel Yap, HRL Labs., LLC (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA); Priyalal S. Wijewarnasuriya, U.S. Army Research Lab. (USA); Christoph H. Grein, Univ. of Illinois at Chicago (USA) [8353-97]

5:40 pm: **Improved IR detectors to swap heavy systems for SWaP**, Alain Manissadjian, Yann Reibel, Laurent Rubaldo, SOFRADIR (France); Laurent R. Mollard, Delphine Brelrier, CEA-LETI (France) [8353-98]

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Multispectral detection of small vessels in infrared, Rafal Dulski, Military Univ. of Technology (Poland); Stanislaw Milewski, Polish Naval Academy (Poland); Mariusz Kasteck, Piotr Trzaskawka, Marek Zyczkowski, Military Univ. of Technology (Poland) [8353-22]

Thermoelectric sensors for analytical measurement applications, Frank Hänschke, Ernst Kessler, Ulrich Dillner, Uwe Schinkel, Andreas Ihring, Hans-Georg Meyer, Institut für Photonische Technologien e.V. (Germany) . . . [8353-110]

Passivation effect on the noise characteristics of midwave infrared InAs/GaSb superlattice photodiodes, Tunay Tansel, Kutlu Kutluer, Rasit Turan, Middle East Technical Univ. (Turkey) [8353-117]

Studies on a novel mask technique to depress side-wall processing damage of ICP-etched HgCdTe trenches, Zhenhua Ye, Weida Hu, Wenting Yin, Jingguo Huang, Chun Lin, Xiaoning Hu, Xiaoshuang Chen, Wei Lu, Li He, Shanghai Institute of Technical Physics (China) [8353-119]

Study on optimizing the thickness of silicon window of WLP for IR sensor, Myeongho Song, National Nanofab Ctr. (Korea, Republic of) [8353-121]

SWIR imaging for facial image capture through tinted materials, Jason Ice, Neeru Narang, Cameron Whitelam, Nathan D. Kalka, Lawrence A. Hornak, Jeremy M. Dawson, Thirimachos Bourlai, West Virginia Univ. (USA) [8353-122]

Electrical characterization of (GaIn)Sb/InAs T2SLS detector materials using CV, hall effect, and capacitance transient measurements, Frederick J. Townner, Richard P. Leavitt, John T. Pham, John D. Bruno, Maxion Technologies, Inc. (USA); John W. Little, U.S. Army Research Lab. (USA) [8353-123]

Infrared detection module for optoelectronic sensors, Waldemar Gawron, Zbigniew Bielecki, Jacek Wojtas, Military Univ. of Technology (Poland); Dariusz Szanaszek, Jerzy Lach, Maciej Fimiarez, VIGO Systems S.A. (Poland) . . [8353-125]

Initial testing of a Si:As blocked-impurity-band (BIB) trap detector, Solomon I. Woods, Simon G. Kaplan, National Institute of Standards and Technology (USA); Timothy M. Jung, Jung Research and Development Corp. (USA); Adriaan C. Carter, Booz Allen Hamilton Inc. (USA); James E. Proctor, Joptech Inc. (USA) [8353-126]

Commercially developed, mixed-signal CMOS process features for advanced ROICs and image sensor products in 0.18µm technology node, Arjun Kar-Roy, Paul Hurwitz, Richard Mann, Yasir Qamar, Li Dong, Samir Chaudhry, Robert Zwingman, David Howard, Marco Racanelli, TowerJazz (USA) [8353-127]

The estimation of thermal conductance values of µ-bolometers in a FPA with some selected structures and pitches, Seung-Man Park, Seungoh Han, Chang Suk Han, Hoseo Univ. (Korea, Republic of); Hee Chul Lee, KAIST (Korea, Republic of) [8353-128]

Design and realization of 144 x 7 TDI ROIC with hybrid integrated test structure, Huseyin Kayahan, Omer Ceylan, Melik Yazici, Muhammet B. Baran, Yasar Gurbuz, Sabanci Univ. (Turkey) [8353-129]

Adaptive bias voltage technique of IRFPA, Xiubao Sui, Qian Chen, Guohua Gu, Nanjing Univ. of Science & Technology (China) [8353-130]

Parylene supported 20µm*20µm uncooled thermoelectric infrared detector with high fill factor, Mohammad J. Modares-Zadeh, Zachary Carpenter, Mark G. Rockley, Reza Abdolvand, Oklahoma State Univ. (USA) [8353-131]

Update on Tinsley Visible Quality (VQ) aluminum optics, Ankit Patel, L-3 Communications Tinsley Labs. Inc. (USA); Keith G. Carrigan, L-3 Integrated Optical Systems (USA) [8353-132]

Manufacturing status of Tinsley Visible Quality (VQ) bare aluminum, and an example of snap together assembly, Keith G. Carrigan, L-3 Integrated Optical Systems (USA) [8353-133]

Precise optomechanical characterization of assembled IR optics, Patrik Langehanenberg, Bernd Lueerss, Josef Heinisch, TRIOPTICS GmbH (Germany) [8353-134]

Evaluation of the effect of optical manufacturing tolerances on the performance of an infrared imager, Altug Uçar, Göktug G. Artan, Turgay Karakas, TÜBITAK SAGE (Turkey) [8353-135]

Modeling of dark current suppression in unipolar barrier infrared detectors, Jun Wang, Univ. of Science and Technology of China (China); Xiaoshuang Chen, Weida Hu, Yongguo Chen, Lin Wang, Wei Lu, Shanghai Institute of Technical Physics (China); Faqiang Xu, Univ. of Science and Technology of China (China) [8353-138]

The first fabricated dual-band uncooled infrared microbolometer detector with a tunable micro-mirror structure, Selcuk Keskin, Tayfun Akin, Middle East Technical Univ. (Turkey) [8353-144]

An analysis for the absorption enhancement using plasmonic structures on uncooled infrared detector pixels, Sevil Zeynep Lulec, Seniz E. Kucuk, Middle East Technical Univ. (Turkey); Enes Battal, Ali K. Okyay, Bilkent Univ. (Turkey); Yusuf Tanrikulu, Tayfun Akin, Middle East Technical Univ. (Turkey) . . . [8353-145]

Standby Oral/Poster Presentations

Room: Conv. Ctr. Hall A Thurs. 6:00 to 7:30 pm

Laser power and temperature dependence on laser beam induced current signal in As-doped p-type HgCdTe, Yongguo Chen, Weida Hu, Xiaoshuang Chen, Zhenhua Ye, Shanghai Institute of Technical Physics (China); Jun Wang, Univ. of Science and Technology of China (China); Chun Lin, Xiaoning Hu, Wei Lu, Shanghai Institute of Technical Physics (China) [8353-143]

MWIR and LWIR photodetectors made of InAs/InAsSb Type-II superlattices, Oray O. Celtek, Ha Sul Kim, Elizabeth H. Steenbergen, Hua Li, Zhiyuan Lin, Shi Liu, Yong-Hang Zhang, Arizona State Univ. (USA) [8353-143]

MT6425CA: a 640 X 512-25 µm CTIA ROIC for SWIR InGaAs detector arrays, Selim Eminoglu, Yigit Uygar Mahsereci, Caglar Altiner, Tayfun Akin, Mikro-Tasarim Ltd. (Turkey) [8353-147]

Friday 27 April

SESSION 17

Room: Conv. Ctr. 307 Fri. 8:00 to 9:20 am

QWIP and Q-DOT

Session Chair: Eric M. Costard, Alcatel-Thales III-V Lab. (France)

8:00 am: **Sub-monolayer InAs/InGaAs quantum dot infrared photodetectors**, Jun Oh Kim, Saumya Sengupta, Yagya D. Sharma, Ajit V. Barve, Ctr. for High Technology Materials, Univ. of New Mexico (USA); Sang Jun Lee, Sam Kyu Noh, Korea Research Institute of Standards and Science (Korea, Republic of); Sanjay Krishna, Ctr. for High Technology Materials, Univ. of New Mexico (USA) [8353-99]

8:20 am: **Solution-processed colloidal quantum dot photodiodes for low-cost SWIR imaging**, Ethan J. Klem, Jay S. Lewis, Chris Gregory, Garry Cunningham, Dorota Temple, RTI International (USA) [8353-100]

8:40 am: **Demonstration of high responsivity (~2.2 A/W) and detectivity (~10¹¹ Jones) in the long wavelength (~10.2µm) from InGaAs/GaAs quantum dot infrared photodetector with quaternary In_{0.21}Al_{0.21}Ga_{0.58}As capping**, Subhananda Chakrabarti, Sourav Adhikary, Indian Institute of Technology Bombay (India); Yigit Aytac, A. G. Unil Perera, Georgia State Univ. (USA) [8353-101]

9:00 am: **QWIP infrared detector production line results**, Michel Runtz, Yann Reibel, SOFRADIR (France); Nadia Brière de l'Isle, Alexandru Nedelcu, Hugues Facoetti, Eric M. Costard, Alcatel-Thales III-V Lab. (France); Vincent Guériaux, Véronique Besnard, Arnaud Mouette, Thales Optronique S.A. (France); William Johnston, Robert Craig, Thales Optronics Ltd. (United Kingdom) [8353-102]

SESSION 18

Room: Conv. Ctr. 307 Fri. 9:20 to 12:10 am

Selected Detector Technologies

Session Chair: John W. Devitt, Georgia Tech Research Institute (USA)

9:20 am: **Design and development of carbon nanotube-based microbolometer for IR imaging applications**, Ashok K. Sood, Magnolia Optical Technologies, Inc. (USA); Jimmy Xu, Gustavo E. Fernandes, Brown Univ. (USA); Neil Goldsman, Univ. of Maryland, College Park (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA); Priyalal S. Wijewarnasuriya, U.S. Army Research Lab. (USA) [8353-103]

9:40 am: **Nano-antenna-enabled MWIR FPAs**, David W. Peters, Paul Davids, John F. Klem, Sandia National Labs. (USA) [8353-104]

10:00 am: **Lifetime prediction in vacuum packaged MEMS provided with integrated getter film**, Fabrizio Siviero, Antonio Bonucci, Andrea Conte, Marco Moraja, SAES Getters S.p.A. (Italy); Olivier Gigan, TRONICS Microsystems (France); Isabelle Thomas, Thales Avionics S.A. (France) [8353-106]

Coffee Break 10:20 to 10:50 am

10:50 am: **High-speed, large-area, p-i-n InGaAs photodiode linear array at 2-micron wavelength**, Abhay Joshi, Shubhashish Datta, Discovery Semiconductors, Inc. (USA) [8353-107]

11:10 am: **NIR/LWIR dual-band infrared photodetector with optical addressing**, Oray O. Cellek, Ha Sul Kim, Arizona State Univ. (USA); John L. Reno, Sandia National Labs. (USA); Yong-Hang Zhang, Arizona State Univ. (USA) [8353-109]

11:30 am: **InAs/InAsSb Type-II superlattice: a promising material for middle-wavelength and long-wavelength infrared applications**, Elizabeth H. Steenbergen, Oray O. Cellek, Hua Li, Xiaomeng Shen, Zhiyuan Lin, Ding Ding, Shi Liu, Qiang Zhang, Ha Sul Kim, Lu Ouyang, Jin Fan, Zhaoyu He, Preston Webster, Shane R. Johnson, David J. Smith, Yong-Hang Zhang, Arizona State Univ. (USA) [8353-136]

11:50 am: **An uncooled microbolometer focal plane array using bias heating for resistance nonuniformity compensation**, Murat Tepegoz, Alperen Toprak, Alp Oguz, Sukru Senveli, Eren Canga, Yusuf Tanrikulu, Tayfun Akin, Middle East Technical Univ. (Turkey) [8353-146]

Lunch Break 12:10 am to 1:10 pm

SESSION 19

Room: Conv. Ctr. 307 Fri. 1:10 to 2:50 pm

Various Applications of Selected Detector Technologies

Session Chairs: Bjørn F. Andresen, Israel Aerospace Industries-ELTA (Israel); Paul R. Norton, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

1:10 pm: **IR CMOS: infrared enhanced silicon imager**, Martin U. Pralle, James E. Carey, Homayoon Haddad, SiOnyx Inc. (USA) [8353-111]

1:30 pm: **Development of low-flux SWIR radio-imaging systems to study nightglow emission**, Sophie Derelle, Pierre Simoneau, Joël R. Deschamps, Sylvain Rommeluère, ONERA (France); Michel Hersé, Guy Moreels, Observatoire de Besançon (France); Eric De Borniol, CEA-LETI (France); Olivier Pacaud, SOFRADIR (France) [8353-112]

1:50 pm: **Location precision analysis of stereo thermal anti-sniper detection system**, Yuqing He, Ya Lu, Yushi Hou, Weiqi Jin, Xiaoyan Zhang, Beijing Institute of Technology (China) [8353-140]

2:10 pm: **Development of the Compact InfraRed Camera (CIRC) for earth observation**, Eri Kato, Haruyoshi Katayama, Masataka Naitoh, Masatomo Harada, Ryoko Nakamura, Ryota Sato, Japan Aerospace Exploration Agency (Japan) [8353-114]

2:30 pm: **Application of advanced IR-FPA in high-sensitivity pushbroom SWIR hyperspectral imager**, Yueming Wang, Jian-yu Wang, Xiao-qiong Zhuang, Sheng-wei Wang, Shanghai Institute of Technical Physics (China) [8353-139]

Courses of Related Interest

- SC1076 **Analog-to-Digital Converters for Digital ROICs** (Veeder) Tuesday, 8:30 am to 12:30 pm
- 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, 8:30 am to 5:30 pm
- SC892 **Infrared Search and Track Systems** (Schwering) Thursday, 8:30 am to 5:30 pm
- SC900 **Uncooled Thermal Imaging Detectors and Systems** (Hanson) Monday, 8:30 am to 5:30 pm
- SC067 **Testing and Evaluation of E-O Imaging Systems** (Holst) Tuesday, 8:30 am to 5:30 pm
- SC1000 **Introduction to Infrared and Ultraviolet Imaging Technology** (Richards) Wednesday, 1:30 to 5:30 pm
- SC789 **Introduction to Optical and Infrared Sensor Systems** (Shaw) Wednesday, 8:30 am to 5:30 pm
- SC154 **Electro-Optical Imaging System Performance** (Holst) Friday, 8:30 am to 5:30 pm
- SC713 **Engineering Approach to Imaging System Design** (Holst) Monday, 8:30 am to 5:30 pm
- SC950 **Infrared Imaging Radiometry** (Richards) Tuesday, 8:30 am to 5:30 pm
- SC1073 **Radiometry and its Practical Applications** (Grant) Monday, 8:30 am to 5:30 pm
- SC720 **Cost-Conscious Tolerancing of Optical Systems** (Youngworth) Tuesday, 8:30 am to 12:30 pm
- SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Wednesday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

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Thermosense: Thermal Infrared Applications XXXIV

Conference Chairs: **Douglas Burleigh**, La Jolla Cove Consulting (USA); **Gregory R. Stockton**, Stockton Infrared Thermographic Services, Inc. (USA)

Program Committee: **Andrea Acosta**, Colbert Infrared Services (USA); **Nicolas P. Avdelidis**, National Technical Univ. of Athens (Greece); **Jeff R. Brown**, Hope College (USA); **Fred P. Colbert**, Colbert Infrared Services (USA); **K. Elliott Cramer**, NASA Langley Research Ctr. (USA); **Ralph B. Dinwiddie**, Oak Ridge National Lab. (USA); **Ermanno G. Grinzato**, Consiglio Nazionale delle Ricerche (Italy); **Sheng-Jen Hsieh**, Texas A&M Univ. (USA); **Herbert Kaplan**, Honeyhill Technical Co. (USA); **Timo T. Kauppinen**, VTT Technical Research Ctr. of Finland (Finland); **Dennis H. LeMieux**, Siemens Power Generation, Inc. (USA); **Monica Lopez Saenz**, IRCAM GmbH (Germany); **Xavier P. V. Maldague**, Univ. Laval (Canada); **Gary L. Orlove**, FLIR Systems, Inc. (USA); **G. Raymond Peacock**, Temperatures.com, Inc. (USA); **Piotr Pregowski**, Pregowski Infrared Services (Poland); **Ralph A. Rotolante**, Vicon Infrared (USA); **Andrés E. Rozlosnik**, SI Termografia Infrarroja (Argentina); **Morteza Safai**, The Boeing Co. (USA); **Takahide Sakagami**, Kobe Univ. (Japan); **Steven M. Shepard**, Thermal Wave Imaging, Inc. (USA); **Sami Siikanen**, VTT Technical Research Ctr. of Finland (Finland); **Vladimir P. Vavilov**, Tomsk Polytechnic Univ. (Russian Federation); **Xiong Yu**, Case Western Reserve Univ. (USA)

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 23 April

Vendor Presentations and Reception

Room: Conv. Ctr. 309 Mon. 1:00 to 4:40 pm

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

The Vendors Session was started eight 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 10-15 minute presentations and is followed by a reception and mixer with snacks and soft drinks.

CONFIRMED PRESENTATIONS

CI Systems, Inc. (Booth 2211)
New remote sensing products from CI Systems
Presenter: Garrick Matheson

AIM Infrarot Module GmbH (Booth 1725)
Latest products from AIM
Presenter: Rolf Mütter

Thermoteknix Systems LTD. (Booth 2511)
Thermoteknix greatest hits
Presenter: Alistair Brown, Imaging Products Manager

IRCAMERAS LLC (Booth 1902)
The benefits of warm midwave digital focal planes in today's infrared cameras
Presenter: Arn Adams, Technical Director

Lambda Research Corp. (Booth 2228)
Techniques to find stray light and ghosts problems in infrared systems and how to eliminate them
Presenter: Michael Gauvin, VP, Sales and Marketing

New Infrared Technologies, LTD. (Booth 2429)
Solution for high-speed MWIR spectroscopy based on uncooled IR detectors manufactured by NIT
Presenter: Rodrigo Linares, Business Development Manager

TELOPS (Booth 1529)
Applications in infrared imaging using the TELPOS Hypervision Systems
Presenter: Paul Chabot, VP, Sales and Marketing

StingRay Optics, LLC (Booth 1634)
StingRay MWIR Standard Products; Lens Assemblies & Accessories
Overview of StingRay standard lens assemblies compatible with commercially available thermal imaging cameras and cores. Waveband ranges include VNIR, SWIR, MWIR, LWIR cooled and uncooled along with accessories such as filters holders and adapters.
Presenters: Jennifer Myers, Sales and Marketing Manager; Sam Wyman, Sales Manager

Xenics Infrared Solutions (Booth 1013)
New Xenics developments
Presenter: Jan Vermeiren

JENOPTIK Optical Systems GmbH (Booth 539)
The new VarioTHERM InSb and other new JENOPTIK products
Presenter: Heiko Richter

SCD.USA, LLC (Booth 1927)
Detector developments at semiconductor devices. We present our newest detector products including digital readouts, HD formats, wide-band (MWIR + LWIR) and high-sensitivity uncooled, and multifunction FPAs that combine infrared imaging with lidar functionality.
Presenter: Robert McDaniel, President and CEO

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

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 1

Room: Conv. Ctr. 302 Tues. 8:00 am to 12:00 pm

Nondestructive Testing (NDT) I

Session Chairs: **Douglas Burleigh**, La Jolla Cove Consulting (USA);
K. Elliott Cramer, NASA Langley Research Ctr. (USA);

Vladimir P. Vavilov, Tomsk Polytechnic Univ. (Russian Federation)

8:00 am: **Excitation source considerations for thermographic NDT**, Steven M. Shepard, Marie Lhota, Adam Jones, Thermal Wave Imaging, Inc. (USA). [8354-01]

8:30 am: **Thermography inspection for early detection of composite damage in structures during fatigue loading**, Joseph N. Zalameda, Eric R. Burke, NASA Langley Research Ctr. (USA); Jeff Seebo, Lockheed Martin Corp. (USA); Patrick Johnston, Christopher Wright, NASA Langley Research Ctr. (USA); James Bly, Lockheed Martin Corp. (USA) [8354-02]

8:50 am: **Characterisation of composites by noninvasive IR imaging techniques**, Nicolas P. Avdelidis, National Technical Univ. of Athens (Greece) and Univ. Laval (Canada); Clemente Ibarra-Castanedo, Hakim Bendada, Xavier P. V. Maldague, Univ. Laval (Canada) [8354-03]

9:10 am: **Water ingress detection on honeycomb sandwich panels by passive infrared thermography using a high-resolution imaging camera**, Clemente Ibarra-Castanedo, Univ. Laval (Canada); Louis Brault, Telops (Canada); Marc Genest, National Research Council Canada (Canada); Vincent Farley, Telops (Canada); Xavier P. V. Maldague, Univ. Laval (Canada) [8354-04]

9:30 am: **Inspection of composite structures using line scanning thermograph**, Obdulia Ley, Physical Acoustics Corp. (USA) [8354-05]

9:50 am: **Automated quality assurance based on thermographic signal reconstruction**, Steven M. Shepard, Thermal Wave Imaging, Inc. (USA) [8354-06]

Coffee Break 10:10 to 10:40 am

10:40 am: **Matched excitation for thermal nondestructive testing of carbon fiber reinforced plastic materials**, Ravibabu Mulaveesala, Ghali V. Subbarao, Muniyappa Amarnath, PDPM IITDM Jabalpur (India) [8354-07]

11:00 am: **Detecting corrosion in thick metals by active thermal nondestructive testing**, Vladimir P. Vavilov, Arseny O. Chulkov, Tomsk Polytechnic Univ. (Russian Federation) [8354-08]

11:20 am: **Development of nondestructive crack inspection technique for conveyance roll using vibro-thermography**, Daisuke Imanishi, Yoshiaki Nishina, Youichi Yoshinaga, JFE Steel Corp. (Japan) [8354-09]

11:40 am: **Nondestructive evaluation of concrete structures by nonstationary thermal wave imaging**, Ravibabu Mulaveesala, Amarnath Muniyappa, Soma Sekhara Balaji Panda, Rupla Naik Mude, PDPM IITDM Jabalpur (India) . [8354-10]

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

SESSION 2

Room: Conv. Ctr. 302 Tues. 1:00 to 2:00 pm

Nondestructive Testing (NDT) II

Session Chairs: **Douglas Burleigh**, La Jolla Cove Consulting (USA);
K. Elliott Cramer, NASA Langley Research Ctr. (USA);

Vladimir P. Vavilov, Tomsk Polytechnic Univ. (Russian Federation)

1:00 pm: **Nonstationary thermal wave imaging techniques for inspection of wooden materials**, Ravibabu Mulaveesala, Venkata Nagarjuna P., Dadda Ravi, Muniyappa Amarnath, PDPM IITDM Jabalpur (India) [8354-11]

1:20 pm: **C/C composite brake disk nondestructive evaluation by IR thermography**, Tsuchin P. Chu, Anish Poudel, Peter Filip, Southern Illinois Univ. Carbondale (USA) [8354-12]

1:40 pm: **Thermal measurement of brake pad lining surfaces during the braking process**, Tadeusz Piatkowski, Henryk Polakowski, Mariusz Kastek, Pawel Baranowski, Krzysztof Damaziak, Jerzy Malachowski, Military Univ. of Technology (Poland) [8354-13]

SESSION 3

Room: Conv. Ctr. 302 Tues. 2:00 to 3:00 pm

Aerospace

Session Chairs: **Morteza Safai**, The Boeing Co. (USA);
Sheng-Jen Hsieh, Texas A&M Univ. (USA)

2:00 pm: **Thermographic imaging of the space shuttle during re-entry using a near-infrared sensor**, Joseph N. Zalameda, Thomas J. Horvath, Robert V. Kerns, NASA Langley Research Ctr. (USA); Jeff C. Taylor, Thomas S. Spisz, David M. Gibson, The Johns Hopkins Univ. Applied Physics Lab. (USA); Edward J. Shea, Futron Corp. (USA); David Mercer, Stinger Graffarian Technologies, Inc. (USA); Richard J. Schwartz, Analytical Mechanics Associates, Inc. (USA); Steve Tack, Naval Air Warfare Ctr. Weapons Div. (USA); Brett C. Bush, Photon Research Associates Inc. (USA); Ronald F. Dantowitz, Celestial Computing, Inc. (USA) [8354-14]

2:20 pm: **Processing ground-based, near-infrared imagery of space shuttle reentries**, Thomas S. Spisz, Jeff C. Taylor, David M. Gibson, Stephen W. Kennerly, Kwame Osei-Wusu, The Johns Hopkins Univ. Applied Physics Lab. (USA); Thomas J. Horvath, Joseph N. Zalameda, Robert V. Kerns, NASA Langley Research Ctr. (USA); Edward J. Shea, Futron Corp. (USA); David Mercer, Raytheon Technical Services Co. (USA); Richard J. Schwartz, Analytical Mechanics Associates, Inc. (USA); Ronald F. Dantowitz, Marek J. Kozubal, Celestial Computing, Inc. (USA) [8354-15]

2:40 pm: **Spatially resolved infrared spectra of jet exhaust from an F109 turbofan engine**, Jacob L. Harley, Kevin C. Gross, Air Force Institute of Technology (USA); Charles F. Wisniewski, August J. Rolling, U.S. Air Force Academy (USA) [8354-16]

Coffee Break 3:00 to 3:30 pm

SESSION 4

Room: Conv. Ctr. 302 Tues. 3:30 to 4:30 pm

Buildings

Session Chair: **Douglas Burleigh**, La Jolla Cove Consulting (USA)

3:30 pm: **High-resolution texturing of building facades with thermal images**, Marco Scaioni, Elisabetta Rosina, Luigi Barazzetti, Mattia Previtali, Politecnico di Milano (Italy) [8354-17]

3:50 pm: **An evaluation of the impact of an example of thermal bridging in buildings and a design alternative**, Jack M. Kleinfeld, Kleinfeld Technical Services, Inc. (USA) [8354-18]

4:10 pm: **Building thermography and energy performance directive of buildings**, Timo T. Kauppinen, Sami Siikanen, VTT Technical Research Ctr. of Finland (Finland) [8354-19]

Wednesday 25 April

SESSION 5

Room: Conv. Ctr. 302 Wed. 8:00 to 10:10 pm

Industrial Applications

Session Chairs: **Gregory R. Stockton**,
Stockton Infrared Thermographic Services, Inc. (USA);

Nicolas P. Avdelidis, National Technical Univ. of Athens (Greece);
Ermanno G. Grinzato, Consiglio Nazionale delle Ricerche (Italy)

8:00 pm: **Monitoring and thermal effects of relubrication of greased bearings**, Richard N. Wurzbach, Maintenance Reliability Group, LLC (USA) [8354-20]

8:30 pm: **In-line particle measurement in a recovery boiler using high-speed infrared imaging**, Sami Siikanen, VTT Technical Research Ctr. of Finland (Finland); Pasi Miikkulainen, Andritz Oy (Finland); Marko Kaarre, Mikko Juuti, VTT Technical Research Ctr. of Finland (Finland) [8354-21]

8:50 pm: **Thermographic evaluation of hydrogenerator losses**, Roberto P. Siniscalchi, Furnas Centrais Elétricas (Brazil); Edson C. Bortoni, Univ. Federal de Itajubá (Brazil) [8354-22]

9:10 pm: **Opportunities and challenges of the application of a dynamic, multispectral thermography as a means to improve the effectiveness of furnace processes in the petrochemical industry**, Piotr Pregowski, Pregowski Infrared Services (Poland); Grzegorz Goleniewski, Wojciech Komosa, Waldemar Korytkowski, PKN ORLEN S.A. (Poland) [8354-23]

9:30 pm: **Infrared evaluation of insulated pipelines to detect water that could cause corrosion under insulation (CUI)**, Douglas Burleigh, La Jolla Cove Consulting (USA); H. Allen Sanders, Kakivik Asset Management, LLC (USA) [8354-24]

9:50 pm: **Sportswear textiles emissivity measurement: comparison of IR thermography and emissometry techniques**, Paolo Bison, Ermanno G. Grinzato, Consiglio Nazionale delle Ricerche (Italy); Antonio Libbra, Alberto Muscio, Univ. degli Studi di Modena e Reggio Emilia (Italy) [8354-25]
Coffee Break 10:10 to 11:00 am

SESSION 6

Room: Conv. Ctr. 302 Wed. 11:00 am to 12:00 pm

Security and Surveillance

Session Chairs: Gregory R. Stockton, Stockton Infrared Thermographic Services, Inc. (USA); Andrés E. Rozlosnik, SI Termografía Infrarroja (Argentina)
11:00 am: **Real-time object detection and tracking for night vision systems based on information fusion**, Nikos Fragoulis, Christos Theoharatos, Vassilis Tsagaris, IRIDA Labs. (Greece) [8354-27]
11:20 am: **Achieving thermography with a thermal security camera using uncooled amorphous silicon microbolometer image sensors**, Yu-Wei Wang, Curtis Tesdahl, James Owens, David Dorn, Pelco by Schneider Electric (USA) [8354-28]
11:40 am: **Using aerial infrared thermography to detect utility theft of service**, Gregory R. Stockton, RecoverIR, Inc. (USA) and United Infrared, Inc. (USA) and Stockton Infrared Thermographic Services, Inc. (USA); R. Gillem Lucas, RecoverIR, Inc. (USA) [8354-29]
Lunch/Exhibition Break 12:00 to 1:00 am

SESSION 7

Room: Conv. Ctr. 302 Wed. 1:00 to 2:50 pm

Biological Applications

Session Chairs: Morteza Safai, The Boeing Co. (USA); Piotr Pregowski, Pregowski Infrared Services (Poland)
1:00 pm: **Development and validation of experimental models for hyperemic thermal response using IR imaging**, Eulalia Moreno, Boston Univ. (USA); Jose Benjamin Giron Palomares, Sheng-Jen Hsieh, Texas A&M Univ. (USA) . [8354-30]
1:20 pm: **Breast cancer in tough economic times, new paradigms emerging (Invited Paper)**, Phillip Bretz, Desert Breast and Osteoporosis Institute (USA) and Desert Breast Foundation (USA); Richard Lynch, Desert Breast and Osteoporosis Institute (USA) [8354-31]
1:50 pm: **Investigation of thermal effects caused by interaction of laser radiation with soft tissues**, Mariusz Kasteck, Andrzej Zajac, Henryk Polakowski, Tadeusz Piatkowski, Jan Kasprzak, Military Univ. of Technology (Poland)[8354-33]
2:10 pm: **Human ear detection in the thermal infrared spectrum**, Ayman A. Abaza, West Virginia High Technology Consortium Foundation (USA); Thirimachos Bourlai, West Virginia Univ . (USA) [8354-34]
2:30 pm: **Infrared imaging for prediction of chicken embryo developmental stages**, Rebecca A. Frederick, Tulane Univ. (USA); Sheng-Jen Hsieh, Jose Benjamin Giron Palomares, Texas A&M Univ. (USA) [8354-35]

SESSION 8

Room: Conv. Ctr. 302 Wed. 2:50 to 3:30 pm

Research and Development Topics I

Session Chairs: Ralph B. Dinwiddie, Oak Ridge National Lab. (USA); Gary L. Orlove, FLIR Systems, Inc. (USA)
2:50 pm: **Accurate thermal imaging of low-emissivity surfaces using approximate blackbody cavities**, Fiona Turner, Stuart Metcalfe, Jon Willmott, Peter Drögmöller, Land Instruments International (United Kingdom) [8354-37]
3:10 pm: **Microscale thermal analysis with cooled and uncooled infrared cameras**, Junko Morikawa, Tokyo Institute of Technology (Japan); Eita Hayakawa, ai-Phase Co., Ltd. (Japan); Toshimasa Hashimoto, Tokyo Institute of Technology (Japan) [8354-38]

Thursday 26 April

SESSION 9

Room: Conv. Ctr. 302 Thurs. 8:00 to 9:50 am

Research and Development Topics II

Session Chairs: Ralph B. Dinwiddie, Oak Ridge National Lab. (USA); Gary L. Orlove, FLIR Systems, Inc. (USA)
8:00 am: **On the thermal-offset in NIR hyperspectral cameras**, Francisca I. Parra, Jorge E. Pezoa, Pablo F. Meza, Sergio N. Torres, Univ. de Concepción (Chile) [8354-39]
8:30 am: **Variable filter array spectrometer of VPD PbSe**, Rodrigo Linares-Herrero, German Vergara, Teresa Montojo, Raul Gutierrez, Carlos Fernandez-Montojo, Arturo Baldasano, New Infrared Technologies, Ltd. (Spain) . . . [8354-40]
8:50 am: **Radiance and atmosphere propagation-based method for the target range estimation**, Hoonkyung Cho, Joochwan Chun, KAIST (Korea, Republic of) [8354-42]
9:10 am: **Spatial concentration distribution model for short-range continuous gas leakage of small amount**, Meirong Wang, Lingxue Wang, Jiakun Li, Yunting Long, Yue Gao, Beijing Institute of Technology (China) [8354-43]
9:30 am: **Gas imaging detectivity model combining leakage spot size and range**, Jiakun Li, Lingxue Wang, Meirong Wang, Yue Gao, Tingfa Xu, Beijing Institute of Technology (China) [8354-44]

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

A method for infrared video mosaic based on SURF, Yunjin Chen, National Univ. of Defense Technology (China) and Graz Univ. of Technology (Austria); Ying Feng, Yu Cao, National Univ. of Defense Technology (China) [8354-41]

Courses of Related Interest

- SC1068 **Introduction to Night Vision** (Browne) Thursday, 8:30 am to 12:30 pm
 - 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, 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 Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

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

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

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

Tuesday 24 April

SESSION 1

Room: Conv. Ctr. 301 Tues. 1:00 to 3:00 pm

Testing I

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

1:00 pm: **Deriving field-performance metrics from laboratory test measurements in real time**, Alan Irwin, Santa Barbara Infrared, Inc. (USA); Stephen D. Burks, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA) [8355-01]

1:20 pm: **Spectral responsivity calibrations of two pyroelectric radiometers using three different methods**, Jinan Zeng, George P. Eppeldauer, Leonard M. Hanssen, Simon G. Kaplan, Boris H. Wilthan, Vyacheslav B. Podobedov, National Institute of Standards and Technology (USA) [8355-02]

1:40 pm: **Using GStreamer to perform real-time MRTD measurements on thermal imaging systems**, Stephen D. Burks, Joshua M. Doe, Jonathan D. Fanning, Joseph P. Reynolds, Kenneth Garner, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA) [8355-03]

2:00 pm: **PV-MCT working standard radiometer**, George P. Eppeldauer, Jinan Zeng, Vyacheslav B. Podobedov, National Institute of Standards and Technology (USA) [8355-04]

2:20 pm: **Advanced techniques for noise suppression in MTF measurements**, David P. Haefner, Stephen D. Burks, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA) [8355-05]

2:40 pm: **Laser speckle MTF processing and test development for VIS and IR sensors**, Paul P. K. Lee, ITT Corp. Geospatial Systems (USA); Craig W. McMurtry, Edwin J. Tan, Judith L. Pipher, Mark F. Bocko, Univ. of Rochester (USA); J. Daniel Newman, ITT Corp. Geospatial Systems (USA) [8355-06]

Coffee Break 3:00 to 3:30 pm

SESSION 2

Room: Conv. Ctr. 30 Tues. 3:30 to 5:10 pm

Testing II

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

3:30 pm: **Precise economical lens calibration and measurement techniques for VIS, NIR, and LWIR optical systems**, Stephen D. Fantone, Daniel Orband, Optikos Corp. (USA) [8355-07]

3:50 pm: **Advanced trend removal in 3D noise calculation**, Stephen D. Burks, Hong-Quang Nguyen, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA) [8355-08]

4:10 pm: **Modulation transfer function measurement of a 640x480 microbolometer focal plane array with a pixel pitch of 17 µm**, Guillaume Druart, Florence de la Barrière, ONERA (France); Jean Taboury, Institut d'Optique Graduate School (France); Nicolas Guérineau, ONERA (France); Hervé Sauer, Institut d'Optique Graduate School (France); Arnaud A. Crastes, ULIS (France) [8355-09]

4:30 pm: **On-axis and off-axis characterization of MWIR and LWIR imaging systems using quadri-wave interferometry**, Sabrina Velghe, Djamel Brahmi, William Boucher, Benoit Wattellier, PHASICS S.A. (France) [8355-10]

4:50 pm: **Rapid electro-optical (EO) TPS development in a military environment**, James McKechnie, Brian Nehring, Alan Irwin, Barry Lunt, Steve W. McHugh, Santa Barbara Infrared, Inc. (USA) [8355-44]

Wednesday 25 April

SESSION 3

Room: Conv. Ctr. 301 Wed. 8:00 to 10:00 am

Targets, Background, and Atmospheric I

Session Chairs: **Richard L. Espinola**, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA); **Teresa L. Pace**, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA)

8:00 am: **Atmospheric effects on target acquisition**, Natan S. Kopeika, Arkadi Zilberman, Yitzhak Yitzhaky, Ephim Golbraikh, Ben-Gurion Univ. of the Negev (Israel) [8355-12]

8:20 am: **Improved motion estimation for restoring turbulence-distorted video**, Christine M. Zwart, Arizona State Univ. (USA); Richard J. Pracht, David H. Frakes, 4-D Imaging, Inc. (USA) [8355-13]

8:40 am: **Impact of atmospheric aerosols on long-range infrared image quality**, Daniel A. LeMaster, Michael T. Eismann, Air Force Research Lab. (USA) [8355-14]

9:00 am: **Fried deconvolution**, Jerome Gilles, Stanley Osher, Univ. of California, Los Angeles (USA) [8355-15]

9:20 am: **Turbulence stabilization**, Yu Mao, Univ. of Minnesota (USA); Jerome Gilles, Univ. of California, Los Angeles (USA) [8355-16]

9:40 am: **Turbulence mitigation of short exposure image data using motion detection and background segmentation**, Claudia S. Huebner, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [8355-17]

Coffee Break 10:00 to 10:30 am

SESSION 4

Room: Conv. Ctr. 301 Wed. 10:30 am to 12:10 pm

Targets, Background, and Atmospheric II

Session Chairs: **Andre Repasi**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Bernard M. Rosier**, ONERA (France)

10:30 am: **Short-exposure passive imaging through path-varying convective boundary layer turbulence**, David H. Tofsted, U.S. Army Research Lab. (USA) [8355-18]

10:50 am: **An efficient turbulence simulation algorithm**, Aaron L. Robinson, Joshua Smith, Alex Sanders, The Univ. of Memphis (USA) [8355-19]

11:10 am: **Energy conservation: a forgotten feature property of the turbulent point spread function**, Mikhail I. Charnotskii, National Oceanic and Atmospheric Administration (USA) [8355-20]

11:30 am: **Long-term measurements of atmospheric point-spread functions over littoral waters as determined by atmospheric turbulence**, Arie N. de Jong, TNO Defence, Security and Safety (Netherlands) [8355-21]

11:50 am: **Hyperspectral image turbulence measurements of the atmosphere**, Sarah E. Lane, Leanne West, Gary G. Gimmetstad, Edward M. Burdette, Georgia Tech Research Institute (USA); William Smith, Sr., Hampton Univ. (USA) [8355-22]

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

SESSION 5

Room: Conv. Ctr. 307 Wed. 1:30 to 2:50 pm

Smart Processing I

Note room change.

Joint Session with Conference 8353

Session Chairs: **Richard L. Espinola**, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA);
Andre Repasi, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany);
Paul L. McCarley, Air Force Research Lab. (USA);
John T. Caulfield, Cyan Systems (USA)

1:30 pm: **Infrared detector size: how low should you go?**, Ronald G. Driggers, U.S. Naval Research Lab. (USA); Richard H. Vollmerhausen, Univ. of Delaware (USA); Joseph Reynolds, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA); Gerald C. Holst, Consultant (USA) [8355-23]

1:50 pm: **An information-theoretic perspective on the challenges and advances in the race toward 12µm pixel pitch for megapixel uncooled infrared imaging**, Christel-Loïc Tisse, MTEch Imaging Pte. Ltd. (Singapore); Arnaud A. Crastes, Jean-Luc M. Tissot, ULIS (France) [8353-53]

2:10 pm: **Implementation of intensity ratio change and LOS rate change algorithms for imaging infrared trackers**, Claude R. Viau, Tactical Technologies Inc. (Canada) [8355-25]

2:30 pm: **Flexible readout and integration sensor (FRIS): a bio-inspired, system-on-chip, event-based readout architecture**, Joseph H. Lin, Philippe O. Pouliquen, Andreas G. Andreou, The Johns Hopkins Univ. (USA); Charbel G. Rizk, Arnold C. Goldberg, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8353-54]

Coffee/Exhibition Break. 2:50 to 4:00 pm

SESSION 6

Room: Conv. Ctr. 307 Wed. 4:00 to 5:40 pm

Smart Processing II

Note room change.

Joint Session with Conference 8353

Session Chairs: **Richard L. Espinola**, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA);
Andre Repasi, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany);
Paul L. McCarley, Air Force Research Lab. (USA);
John T. Caulfield, Cyan Systems (USA)

4:00 pm: **ADMIRE: a locally adaptive single-image, non-uniformity correction and denoising algorithm: application to uncooled IR camera**, Yohann Tendero, École Normale Supérieure de Cachan (France); Jerome Gilles, Univ. of California, Los Angeles (USA) [8353-55]

4:20 pm: **Turbulence compensation: an overview**, Adam W. M. van Eekeren, Klamer Schutte, Judith Dijk, Piet B. W. Schwing, Miranda van Iersel, TNO Defence, Security and Safety (Netherlands) [8355-26]

4:40 pm: **A real-time atmospheric turbulence mitigation and superresolution solution for infrared imaging systems**, Douglas R. Droege, L-3 Communications Cincinnati Electronics (USA); Russell C. Hardie, L-3 Communications Cincinnati Electronics (USA) and Univ. of Dayton (USA); Brian S. Allen, Alexander J. Dapore, Jon C. Blevins, L-3 Communications Cincinnati Electronics (USA) [8355-27]

5:00 pm: **Turbulence degradation and mitigation performance for handheld weapon ID**, Richard L. Espinola, Sameer Aghera, Jason Miller, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA) [8355-28]

5:20 pm: **Patch-based local turbulence compensation in anisoplanatic conditions**, Adam W. M. van Eekeren, Maarten Kruithof, Klamer Schutte, Judith Dijk, Miranda van Iersel, Piet B. W. Schwing, TNO Defence, Security and Safety (Netherlands) [8355-29]

Thursday 26 April

SESSION 7

Room: Conv. Ctr. 301 Thurs. 8:00 to 9:20 am

Targets, Background, and Atmospherics III

Session Chairs: **Bernard M. Rosier**, ONERA (France);
Teresa L. Pace, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA)

8:00 am: **High-fidelity simulations of infrared imagery with animated characters**, Fredrik Näsström, Andreas Persson, Jimmy Berggren, Johan Hedström, Jonas Allvar, Mikael Karlsson, Swedish Defence Research Agency (Sweden) [8355-30]

8:20 am: **Simulating the visual and infrared scene of a space-based instrument with spacecraft intrusions**, Michael A. Gauvin, Lambda Research (USA) [8355-31]

8:40 am: **Infrared signature measurements with the ABB dual-band hyperspectral imager**, Louis M. Moreau, Stephane Lantagne, ABB Analytical Measurement (Canada); Ritchie D. Bullis, Naval Air Warfare Ctr. Aircraft Div. (USA) [8355-32]

9:00 am: **Comparison of image restoration algorithms in the context of horizontal-path imaging**, Szymon Gladysz, Claudia Hueber, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Roberto Baena Galle, Univ. de Barcelona (Spain) [8355-60]

SESSION 8

Room: Conv. Ctr. 301 Thurs. 9:20 to 10:05 am

Modeling I

Session Chairs: **Gisele Bennett**, Georgia Institute of Technology (USA);
Ronald G. Driggers, U.S. Naval Research Lab. (USA);
Terrence S. Lomheim, The Aerospace Corp. (USA)

9:20 am: **Modeling boost performance using a 2D implementation of the targeting task performance metric**, Bradley L. Preece, David P. Haefner, Jonathan D. Fanning, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8355-34]

9:40 am: **Performance evaluation of optimization methods for superresolution mosaicking on UAS surveillance videos**, Aldo Camargo, The Univ. of North Dakota (USA) [8355-35]

Coffee Break 10:00 to 10:30 am

SESSION 9

Room: Conv. Ctr. 301 Thurs. 10:30 to 11:50 am

Modeling II

Session Chairs: **Gisele Bennett**, Georgia Institute of Technology (USA);
Ronald G. Driggers, U.S. Naval Research Lab. (USA);
Terrence S. Lomheim, The Aerospace Corp. (USA)

10:30 am: **Understanding 3rd generation dual-band FLIR model versus measured range performance**, Russell Drake, Raytheon Network Centric Systems (USA) [8355-36]

10:50 am: **Validating an analytical technique for calculating detection probability given time-dependent search parameters**, Melvin H. Friedman, Hee-Sue Choi, Jae Cha, Joseph Reynolds, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA) [8355-37]

11:10 am: **A standard data set for performance analysis of advanced IR image processing techniques**, Robert Weiss, Uwe Adomeit, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Philippe Chevalier, Stephane Landeau, Délégation Générale pour l'Armement (France) [8355-38]

11:30 am: **Benchmarking image fusion algorithm performance**, Christopher L. Howell, U. S. Army Night Vision & Electronic Sensors Directorate (USA). [8355-39]

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

SESSION 10

Room: Conv. Ctr. 301 Thurs. 1:00 to 2:20 pm

Modeling III

Session Chairs: **Hector M. Reyes**, Raytheon Co. (USA);
Joseph P. Reynolds, U.S. Army RDECOM CERDEC Night Vision &
 Electronic Sensors Directorate (USA);
Michael A. Soel, FLIR Systems, Inc. (USA);
David P. Forrai, L-3 Communications Cincinnati Electronics (USA)

1:00 pm: **Metrics for image-based modeling of target acquisition**, Jonathan D. Fanning, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA) [8355-41]

1:20 pm: **Assessing the performance of superresolution reconstruction algorithms**, Judith Dijk, Klamer Schutte, Adam W. M. van Eekeren, Piet Bijl, TNO (Netherlands) [8355-42]

1:40 pm: **Weighted contrast metric for imaging system performance**, Brian P. Teaney, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA) [8355-43]

2:00 pm: **Improved fusing infrared and electro-optic signals for high-resolution night images**, Xiaopeng Huang, Stevens Institute of Technology (USA); Ravi Netravali, Columbia Univ. (USA); Hong Man, Victor B. Lawrence, Stevens Institute of Technology (USA) [8355-61]

SESSION 11

Room: Conv. Ctr. 301 Thurs. 2:20 to 4:30 pm

Modeling IV

Session Chairs: **Hector M. Reyes**, Raytheon Co. (USA);
Joseph P. Reynolds, U.S. Army RDECOM CERDEC Night Vision &
 Electronic Sensors Directorate (USA);
Michael A. Soel, FLIR Systems, Inc. (USA);
David P. Forrai, L-3 Communications Cincinnati Electronics (USA)

2:20 pm: **Locally adaptive contrast enhancement and dynamic range compression**, Robert Maschal, S. Susan Young, U.S. Army Research Lab. (USA) [8355-46]

2:40 pm: **Target-to-background contrast behavior of camouflage**, Van A. Hodgkin, Jonathan G. Hixson, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA); William P. Armentrout, Westminster College (USA) [8355-47]

Coffee Break 3:00 to 3:30 pm

3:30 pm: **Performance modeling and assessment of infrared-sensors applicable for TALOS project UGV as a function of target/background and environmental conditions**, Stephane Barbe, Jean-Claude Krapez, Yolande Louvet, ONERA (France) [8355-48]

3:50 pm: **Evaluating the efficiency of a nighttime, middle-range infrared sensor for applications in human detection and recognition**, Thirimachos Bourlai, West Virginia Univ. (USA); Christopher Kolanko, EyeMarker Systems Inc. (USA); Nikolaos Mavridis, New York Univ., Abu Dhabi (United Arab Emirates); John Von Dollen, West Virginia Univ. (USA) [8355-50]

4:10 pm: **Compensating internal temperature effects in uncooled microbolometer-based infrared cameras**, Felipe Pedreros, Jorge E. Pezoa, Sergio N. Torres, Univ. de Concepción (Chile) and Ctr. for Optics and Photonics, Univ. de Concepción (Chile) [8355-51]

PANEL DISCUSSION

Room: Conv. Ctr. 301 Thurs. 5:30 to 6:30 pm

Night Vision Integrated Performance Model (NIV-IPM)

Panel Moderators: **Joseph P. Reynolds**, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA);
Brian P. Teaney, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA)

POSTERS—THURSDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Determining detection, recognition, and identification ranges of thermal cameras on the basis of laboratory measurements and TTP model, Jaroslav Barela, Mariusz Kastek, Krzysztof Firmanty, Rafal Dulski, Piotr Trzaskawka, Military Univ. of Technology (Poland) [8355-52]

Testing of infrared image enhancing algorithm in different spectral bands, Rafal Dulski, Piotr Trzaskawka, Tadeusz Piatkowski, Mariusz Kastek, Military Univ. of Technology (Poland) [8355-53]

An experimental validation of the Gauss-Markov model for nonuniformity noise in infrared focal plane array sensors, Octavio A. Zapata, Sergio N. Torres, Jorge E. Pezoa, Univ. de Concepcion (Chile) [8355-54]

Modification of infrared signature of naval vessels, Rafal Dulski, Military Univ. of Technology (Poland); Stanislaw Milewski, Polish Naval Academy (Poland); Mariusz Kastek, Piotr Trzaskawka, Jaroslav Barela, Krzysztof Firmanty, Military Univ. of Technology (Poland) [8355-55]

Radiometric calibration software for MWIR cameras, Hyunjin Yang, Joohwan Chun, Korea Advanced Institute of Science and Technology (Korea, Republic of); Doochun Seo, Jiyeon Yang, Korea Aerospace Research Institute (Korea, Republic of) [8355-56]

Automatic target detection from infrared imaging with the multivariate Gaussian mixture modeling, Dong-Su Lee, Seokwon Yeom, Daegu Univ. (Korea, Republic of) [8355-58]

Evaluation of the effects of some remarkable internal and external factors on an infrared seeker, Altug Uçar, Bülent Özkan, Kutlu D. Kandemir, TÜBITAK SAGE (Turkey) [8355-59]

Courses of Related Interest

- SC067 **Testing and Evaluation of E-O Imaging Systems** (Holst) Tuesday, 8:30 am to 5:30 pm
- SC154 **Electro-Optical Imaging System Performance** (Holst) Friday, 8:30 am to 5:30 pm
- SC713 **Engineering Approach to Imaging System Design** (Holst) Monday, 8:30 am to 5:30 pm
- 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, 8:30 am to 5:30 pm
- SC892 **Infrared Search and Track Systems** (Schwering) Thursday, 8:30 am to 5:30 pm
- SC900 **Uncooled Thermal Imaging Detectors and Systems** (Hanson) Monday, 8:30 am to 5:30 pm

See *Course Materials Desk*, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

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

Conference Chair: **James A. Buford, Jr.**, U. S. Army Aviation & Missile Research, Development and Engineering Ctr. (AMRDEC) (USA)

Conference Co-Chairs: **R. Lee Murrer, Jr.**, Millennium Engineering and Integration Co. (USA); **Gary H. Ballard**, U.S. Army AMRDEC (USA)

Program Committee: **James A. Annos**, Naval Air Warfare Ctr. Weapons Div. (USA); **David B. Beasley**, Optical Sciences Corp. (USA); **Dennis H. Bunfield**, The AEGIS Technologies Group, Inc. (USA); **Raul Fainchtein**, The Johns Hopkins Univ. Applied Physics Lab. (USA); **Kevin Fisher**, ACUTRONIC Switzerland Ltd. (Switzerland); **William L. Herald**, MacAulay Brown Inc. (USA); **Hajin J. Kim**, U.S. Army AMRDEC (USA); **John M. Lannon, Jr.**, RTI International (USA); **Heard Lowry**, Aerospace Testing Alliance-Arnold Engineering Development Ctr. (AEDC) (USA); **William M. Lowry**, U.S. Army Redstone Test Ctr. (USA); **Robert W. Mitchell**, Ideal Aeromsmith, Inc. (USA); **Scott B. Mobley**, U.S. Army AMRDEC (USA); **Ronald J. Rapp**, Air Force Research Lab. (USA); **Richard M. Robinson**, The AEGIS Technologies Group, Inc. (USA); **Donald R. Snyder**, Air Force Research Lab. (USA); **Florence C. Solomon**, U.S. Air Force (USA); **Leszek Swierkowski**, Defence Science and Technology Organisation (Australia); **Owen M. Williams**, Defence Science and Technology Organisation (Australia); **Brian K. Woode**, Naval Air Warfare Ctr. Aircraft Div. (USA); **Mark Umansky**, U.S. Army AMRDEC (USA)

Wednesday 25 April

Welcome and Announcements

Room: Conv. Ctr. 304Wed. 8:15 to 8:30 am

Session Chair: **James A. Buford, Jr.**, U.S. Army Aviation & Missile Research, Development and Engineering Ctr. AMRDEC (USA)

SESSION 1

Room: Conv. Ctr. 304 Wed. 8:30 am to 12:40 pm

IR Scene Projectors

Session Chairs: **Heard Lowry**, Aerospace Testing Alliance-Arnold Engineering Development Ctr. (AEDC) (USA); **Robert W. Mitchell**, Ideal Aeromsmith, Inc. (USA); **Ronald J. Rapp**, Air Force Research Lab. (USA)

8:30 am: **Spectral shift of infrared LEDs and resistive sources**, Mary L. Fedde, Aerospace Testing Alliance (USA) [8356-01]

8:50 am: **Contrast analysis for DMD-based IR scene projector**, Julia Rentz Dupuis, David J. Mansur, Samuel Grant, Scott P. Newbry, OPTRA, Inc. (USA) [8356-02]

9:10 am: **Large-scale Si photonic infrared scene projector by light-down conversion**, Volodymyr K. Malyutenko, V. Lashkaryov Institute of Semiconductor Physics (Ukraine) [8356-03]

9:30 am: **Performance of bottom emitting isolated LWIR LED devices for IR scene projection**, Naresh Das, U.S. Army Research Lab. (USA) [8356-04]

9:50 am: **Motivation and challenges of polarization scene projectors**, David B. Chenault, Polaris Sensor Technologies, Inc. (USA) [8356-05]

10:10 am: **Testing updates for the infrared polarized scene generator demonstrator**, Peter S. Erbach, Joseph L. Pezzaniti, John Reinhardt, Todd Aycock, David B. Chenault, Brian Hyatt, Polaris Sensor Technologies, Inc. (USA) [8356-06]

Coffee Break 10:30 to 11:00 am

11:00 am: **JHU/APL's development of an agile IR scene projector based on carbon nanotubes**, Raul Fainchtein, David M. Brown, Karen M. Siegrist, Andrew H. Monica, The Johns Hopkins Univ. Applied Physics Lab. (USA); Ehren Hwang, Stuart D. Milner, Christopher C. Davis, Univ. of Maryland, College Park (USA) [8356-07]

11:20 am: **Photonic crystal multiband infrared scene projection technology**, Jerry A. Wilson, Cyan Systems (USA); B. Burckel, Sandia National Labs. (USA); John T. Caulfield, Cyan Systems (USA); Scott M. Cogan, Mark A. Massie, Nova Sensors (USA); Ronald J. Rapp, Donald R. Snyder, Air Force Research Lab. (USA) [8356-08]

11:40 am: **Liquid crystal on silicon (LCOS) devices and their application to scene projection**, Teresa K. Ewing, Steve Serati, Anna M. Linnenberger, Hugh Masterson, Jay E. Stockley, Joseph R. Buck, Boulder Nonlinear Systems (USA) [8356-09]

12:00 pm: **The design, construction, and testing challenges of all reflective large format scene projector**, Darin A. Murray, Steven H. Vogel, StingRay Optics, LLC (USA) [8356-10]

12:20 pm: **GaSb-based LEDs and LED addressable arrays for infrared scene projection**, David Westerfeld, Power Photonic (United Kingdom) [8356-11]

Lunch/Exhibition Break 12:40 to 2:00 pm

SESSION 2

Room: Conv. Ctr. 304 Wed. 2:00 to 5:20 pm

Resistor Array Projectors

Session Chairs: **Raul Fainchtein**, The Johns Hopkins Univ. Applied Physics Lab. (USA); **David B. Beasley**, Optical Sciences Corp. (USA); **Donald R. Snyder**, Air Force Research Lab. (USA); **Brian K. Woode**, Naval Air Warfare Ctr. Aircraft Div. (USA)

2:00 pm: **A hybrid non-uniformity correction method for IRSP arrays**, Joseph D. LaVeigne, Gregory Franks, Marcus Prewarski, Santa Barbara Infrared, Inc. (USA) [8356-12]

2:20 pm: **Update of IRSP development programs at SBIR**, Joseph D. LaVeigne, Kevin Sparkman, Steve W. McHugh, Santa Barbara Infrared, Inc. (USA) [8356-13]

2:40 pm: **Radical rise-time enhancement of a resistive IRSP array**, Joseph D. LaVeigne, Gregory Franks, Santa Barbara Infrared, Inc. (USA) [8356-14]

3:00 pm: **Design considerations for a high-temperature, high-dynamic range IRSP**, Joseph D. LaVeigne, Santa Barbara Infrared, Inc. (USA); Breck A. Sieglinger, MacAulay-Brown, Inc. (USA) [8356-15]

Coffee/Exhibition Break 3:20 to 4:20 pm

4:20 pm: **Challenges associated with real-time nonuniformity correction (RNUC) of ultra-high-temperature scene projectors**, Breck A. Sieglinger, Air Force Research Lab. (USA) [8356-16]

4:40 pm: **Resistor arrays enabled by 'quilt packaging' edge interconnects**, Jason M. Kulick, Indiana Integrated Circuits, LLC (USA); Joseph D. Laveigne, Santa Barbara Infrared, Inc. (USA); John M. Lannon, Jr., RTI International (USA); Michael J. Padberg, Indiana Integrated Circuits, LLC (USA) [8356-17]

5:00 pm: **256x256 high-performance thermal emitter array**, Kaiyan Zhang, K Lab Corp. (USA) [8356-18]

Thursday 26 April

Welcome and Announcements

Room: Conv. Ctr. 304 Thurs. 8:15 to 8:30 am

Session Chair: James A. Buford, Jr., U.S. Army Aviation & Missile Research, Development and Engineering Ctr. AMRDEC (USA)

SESSION 3

Room: Conv. Ctr. 304 Thurs. 8:30 to 10:30 am

Facilities, Scene Generation, and Flight Simulators

Session Chairs: James A. Annos, Naval Air Warfare Ctr. Weapons Div. (USA); Kevin Fischer, Univ. of Wisconsin-Madison (USA); Richard M. Robinson, The AEgis Technologies Group, Inc. (USA); Leszek Swierkowski, Defence Science and Technology Organisation (Australia)

8:30 am: **Scene projection technology development for imaging sensor testing at AEDC**, Heard Lowry, Aerospace Testing Alliance (USA) [8356-19]

8:50 am: **Application of scene projection technologies at the AMRDEC SSDD HWIL Test Facilities**, Daniel A. Saylor, Optical Sciences Corp. (USA); James A. Buford, Jr., U.S. Army Aviation & Missile Research, Development and Engineering Ctr. (USA); Gary H. Ballard, U.S. Army Aviation & Missile Research, Development and Engineering Ctr (USA) [8356-20]

9:10 am: **Infrared projector optical system characterisation and its application to nonuniformity correction**, Leszek Swierkowski, Robert A. Joyce, Chad L. Christie, Defence Science and Technology Organisation (Australia) [8356-21]

9:30 am: **Performance parameters in the design of flight motion simulators**, Robert W. Mitchell, Ideal Aerosmith, Inc. (USA) [8356-22]

9:50 am: **Common hardware-in-the-loop framework development**, Hajin J. Kim, U.S. Army Aviation & Missile Research, Development and Engineering Ctr. (USA) [8356-23]

10:10 am: **Dynamic plume simulator**, Yakov G. Soskind, Richard Gifford, DHPC Technologies (USA) [8356-24]

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, 8:30 am to 5:30 pm
- SC900 **Uncooled Thermal Imaging Detectors and Systems** (Hanson) Monday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

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Tuesday · 10:00 am to 5:00 pm

Wednesday · 10:00 am to 5:00 pm

Thursday · 10:00 am to 2:00 pm

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

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

Program Committee: **Benjamin Barrowes**, U.S. Army Engineer Research and Development Ctr. (USA); **Steven S. Bishop**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Leslie M. Collins**, Duke Univ. (USA); **Gerald J. Dobeck**, Naval Surface Warfare Ctr. Panama City Div. (USA); **Paul Gader**, Univ. of Florida (USA); **Jan M. H. Hendrickx**, New Mexico Institute of Mining and Technology (USA); **James M. Keller**, Univ. of Missouri-Columbia (USA); **Aaron LaPointe**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **John E. McFee**, Defence Research and Development Canada (Canada); **Henric Östmark**, Swedish Defence Research Agency (Sweden); **Motoyuki Sato**, Tohoku Univ. (Japan); **Mehmet Sezgin**, TÜBITAK Marmara Research Ctr. (Turkey); **Waymond R. Scott, Jr.**, Georgia Institute of Technology (USA); **Harold R. Suiter**, Naval Surface Warfare Ctr. Panama City Div. (USA); **Richard C. Weaver**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 314 Mon. 8:30 to 10:10 am

Electromagnetic Induction I

Session Chairs: **Benjamin Barrowes**, U.S. Army Engineer Research and Development Ctr. (USA); **Jon Miller**, Sky Research, Inc. (USA)

8:30 am: **Pedemis: a portable electromagnetic induction sensor with integrated positioning**, Benjamin Barrowes, U.S. Army Engineer Research and Development Ctr. (USA); Fridon Shubitidze, Thayer School of Engineering at Dartmouth (USA); Juan Pablo Fernandez, Univ. of Massachusetts Amherst (USA); Tomasz M. Grzegorzcyk, Delpsi, LLC (USA); Kevin O'Neill, U.S. Army Engineer Research and Development Ctr. (USA) [8357-01]

8:50 am: **Optimizing EMI transmitter and receiver configurations to enhance detection and identification of small and deep metallic targets**, Juan Pablo Fernandez, Alex Bijamov, Thayer School of Engineering at Dartmouth (USA); Irma Shamatava, Sky Research, Inc. (USA); Benjamin Barrowes, U.S. Army Engineer Research and Development Ctr. (USA); Kevin O'Neill, Fridon Shubitidze, Thayer School of Engineering at Dartmouth (USA) [8357-02]

9:10 am: **Live-site, production-level, metal-mapper data sets inversion and classification studies**, Fridon Shubitidze, Thayer School of Engineering at Dartmouth (USA) and Sky Research, Inc. (USA); Jon Miller, Joe Keranen, Sky Research, Inc. (USA); Alex Bijamov, Thayer School of Engineering at Dartmouth (USA) [8357-03]

9:30 am: **Inversion-free discrimination of unexploded ordnance in real time**, Fridon Shubitidze, Juan Pablo Fernandez, Thayer School of Engineering at Dartmouth (USA); Irma Shamatava, Sky Research, Inc. (USA); Alejandro Luperon, Thayer School of Engineering at Dartmouth (USA); Benjamin Barrowes, U.S. Army Engineer Research and Development Ctr. (USA); Kevin O'Neill, Thayer School of Engineering at Dartmouth (USA) [8357-04]

9:50 am: **Camp Beale live-site, hand-held EMI sensors data inversion and classification using advanced EMO models**, Irma Shamatava, Sky Research, Inc. (USA); Fridon Shubitidze, Juan Pablo Fernandez, Alex Bijamov, Thayer School of Engineering at Dartmouth (USA); Benjamin Barrowes, U.S. Army Engineer Research and Development Ctr. (USA); Kevin O'Neill, Thayer School of Engineering at Dartmouth (USA) [8357-05]

Coffee Break 10:10 to 10:40 am

SESSION 2

Room: Conv. Ctr. 314 Mon. 10:40 am to 12:20 pm

Electromagnetic Induction II

Session Chairs: **Benjamin Barrowes**, U.S. Army Engineer Research and Development Ctr. (USA); **Jon Miller**, Sky Research, Inc. (USA)

10:40 am: **Large loop EMI sensor for detection of deeply buried munitions in magnetic soils**, Jon Miller, Joe Keranen, Gregory Schultz, Sky Research, Inc. (USA); Stephen Billings, Sky Research, Inc. (Australia) [8357-06]

11:00 am: **Feature extraction and processing of spatial frequency-domain electromagnetic induction sensor data for improved landmine discrimination**, Stacy L. Tatum, Kenneth Colwell, Kenneth D. Morton, Jr., Duke Univ. (USA); Waymond R. Scott, Jr., Georgia Institute of Technology (USA); Leslie M. Collins, Peter A. Torriano, Duke Univ. (USA) [8357-07]

11:20 am: **On the estimation of target depth using the single-transmit multiple-receive metal detector array**, Dominic K. Ho, Univ. of Missouri-Columbia (USA); Paul Gader, Univ. of Florida (USA) [8357-08]

11:40 am: **Robust estimation of the discrete spectrum of relaxations from multiple-electromagnetic induction responses**, Mu-Hsin Wei, Waymond R. Scott, Jr., James H. McClellan, Georgia Institute of Technology (USA) .. [8357-09]

12:00 pm: **Landmine detection using two-tapped joint orthogonal matching pursuits**, Sean Goldberg, Taylor Glenn, Joseph N. Wilson, Paul Gader, Univ. of Florida (USA) [8357-83]

Lunch Break 12:20 to 1:30 pm

SESSION 3

Room: Conv. Ctr. 314 Mon. 1:30 to 2:50 pm

Electromagnetic Induction III

Session Chairs: **Waymond R. Scott, Jr.**, Georgia Institute of Technology (USA); **Juan Pablo Fernandez**, Thayer School of Engineering at Dartmouth (USA)

1:30 pm: **Progress on a system for measuring wide-band electromagnetic induction responses**, Waymond R. Scott, Jr., Michael J. McFadden, Georgia Institute of Technology (USA) [8357-10]

1:50 pm: **Location and orientation estimation of buried targets using electromagnetic-induction sensors**, Kyle R. Krueger, Waymond R. Scott, Jr., James H. McClellan, Georgia Institute of Technology (USA) [8357-11]

2:10 pm: **Induction detection of concealed bulk banknotes**, Christopher Fuller, Antao Chen, Univ. of Washington (USA) [8357-12]

2:30 pm: **Pinpointing error analysis of metal detectors under field conditions**, Kazunori Takahashi, Holger Preetz, Leibniz Institute for Applied Geophysics (Germany) [8357-13]

Coffee Break 2:50 to 3:30 pm

SESSION 4

Room: Conv. Ctr. 314 Mon. 3:30 to 4:30 pm

A Melange of Interesting Techniques I

Session Chair: **Steven S. Bishop**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

3:30 pm: **Towards a military-standard wireless sensor platform for the detection of improvised explosive devices**, Arun Gunasekaran, Neil Patel, Sahra Sedigh, Missouri Univ. of Science and Technology (USA) [8357-14]

3:50 pm: **Experimental investigation of buried landmine detection using time division multiplexing of multibeam laser Doppler vibrometer channels**, Richard D. Burgett, Vyacheslav Aranchuk, James M. Sabatier, Ina Aranchuk, The Univ. of Mississippi (USA) [8357-15]

4:10 pm: **Synthetic aperture acoustic imaging of non-metallic cords**, Joseph Vignola, John A. Judge, The Catholic Univ. of America (USA); Steven S. Bishop, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Chelsea E. Good, The Catholic Univ. of America (USA); Peter M. Gugino, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Mehrdad Soumekh, Soumekh Consultant (USA) [8357-16]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 5

Room: Conv. Ctr. 314 Tues. 8:20 to 10:00 am

Infrared and Electro-Optic I

Session Chairs: **Owen J. Eslinger**, U.S. Army Engineer Research and Development Ctr. (USA); **J. Thomas Broach**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

8:20 am: **Overview of computational testbed for evaluating EO/IR sensor systems**, Raju V. Kala, Joshua R. Fairley, Stephanie J. Price, Alex R. Carrillo, Stacy E. Howington, Owen J. Eslinger, Amanda M. Hines, Ricky A. Goodson, Ernest S. Berney IV, Jerrell R. Ballard, Jr., U.S. Army Engineer Research and Development Ctr. (USA) [8357-17]

8:40 am: **Examining the influence of sub-surface characterization on simulated IR imagery**, Owen J. Eslinger, Stacy E. Howington, Corey Winton, Raju V. Kala, Stephanie J. Price, Josh R. Fairley, U.S. Army Engineer Research and Development Ctr. (USA) [8357-18]

9:00 am: **Cloud cover effects on airborne infrared sensors for buried mines/IED detection**, Zenon I. Derzko, Chung D. Phan, Richard M. Lydic, Jr., Timothy R. Moore, Oanh Nguyen, J. Thomas Broach, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8357-19]

9:20 am: **Precipitation effects on airborne infrared sensors for buried mines/IED detection**, Zenon I. Derzko, Richard M. Lydic, Jr., Chung D. Phan, Timothy R. Moore, Oanh Nguyen, J. Thomas Broach, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8357-20]

9:40 am: **Schedule optimization of airborne infrared sensors for buried mine/IED detection**, Zenon I. Derzko, U.S. Army Night Vision & Electronic Sensors Directorate (USA); John Eytlander, U.S. Army Engineer Research and Development Ctr. (USA); J. Thomas Broach, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8357-21]

Coffee Break 10:00 to 10:30 am

SESSION 6

Room: Conv. Ctr. 314 Tues. 10:30 to 11:30 am

Infrared and Electro-Optic II

Session Chair: **Neal E. Blackwell**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

10:30 am: **The evaluation hyperspectral imaging for the detection of person-borne threat objects over the 400nm to 1700nm spectral region**, David W. Allen, Catherine Cooksey, Jorge E. Neira, National Institute of Standards and Technology (USA) [8357-22]

10:50 am: **Role of moisture and density of sand for microwave enhancement of thermal detection of buried mines**, Waldemar Swiderski, Pawel Hlosta, Jozef Jarzemski, Leszek Szugajew, Military Institute of Armament Technology (Poland) [8357-23]

11:10 am: **Buried mine detection using fractal geometry analysis to the LWIR successive line scan data image**, Kan Araki, Yukinori Fuse, Ministry of Defence (Japan) [8357-24]

Lunch/Exhibition Break 11:30 am to 1:20 pm

SESSION 7

Room: Conv. Ctr. 314 Tues. 1:20 to 2:40 pm

Infrared and Electro-Optic III

Session Chair: **Neal E. Blackwell**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

1:20 pm: **Three-dimensional material identification and hazard detection with shortwave, infrared, supercontinuum-based spectral lidar**, Michael A. Powers, General Dynamics Robotic Systems (USA) [8357-25]

1:40 pm: **Road detection and buried object detection in elevated EO/IR imagery**, Levi Kennedy, Mark P. Kolba, Joshua R. Walters, Signal Innovations Group, Inc. (USA) [8357-26]

2:00 pm: **Anomaly detection ensemble fusion for buried explosive material detection in forward looking infrared imaging for addressing diurnal temperature variation**, Derek T. Anderson, Mississippi State Univ. (USA); Kevin E. Stone, James M. Keller, Univ. of Missouri-Columbia (USA); John Rose, Mississippi State Univ. (USA) [8357-27]

2:20 pm: **Standoff detection and identification of powders and gaseous chemicals using hyperspectral imaging**, Jean-Philippe Gagnon, Simon Savary, Vincent Farley, Martin Chamberland, Telops (Canada) [8357-28]

Coffee/Exhibition Break 2:40 to 4:00 pm

SESSION 8

Room: Conv. Ctr. 314 Tues. 4:00 to 5:40 pm

Bulk Explosive Detection

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

4:00 pm: **Improved thermal neutron activation sensor for detection of bulk explosives**, John E. McFee, Anthony A. Faust, Defence Research and Development Canada, Suffield (Canada); Hugh Robert Andrews, Ted Clifford, Bubble Technology Industries, Inc. (Canada); Cristian Mosquera, Defence Research and Development Canada, Suffield (Canada) [8357-29]

4:20 pm: **Detection of bulk explosives in culverts using thermal neutron activation**, Anthony A. Faust, John E. McFee, Cristian Mosquera, Defence Research and Development Canada, Suffield (Canada); Ted Clifford, Hugh Robert Andrews, Andrew Shinn, Bubble Technology Industries, Inc. (Canada) . . [8357-30]

4:40 pm: **Pixelated diffraction signatures for explosive detection**, Daniel O'Flynn, Caroline Reid, Univ. College London (United Kingdom); Matt Wilson, Matthew C. Veale, Paul Seller, Rutherford Appleton Lab. (United Kingdom); Robert Speller, Univ. College London (United Kingdom) [8357-31]

5:00 pm: **Steady state free precession (SSFP) sequence compared to one-pulse sequence for RDX detection at 5.192 MHz**, Thérèse Schunck, Karl Darée, Denis Krüger, Ralf Himmelsbach, Lionel Merlat, Institut Franco-Allemand de Recherches de Saint-Louis (France) [8357-32]

5:20 pm: **Novel approaches in nuclear magnetic/quadrupole resonance techniques for explosives detection**, Georgy V. Mozhukhin, Gebze Institute of Technology (Turkey) and Kazan Power State Engineering Univ. (Russian Federation); Bulat Rameev, Gebze Institute of Technology (Turkey) and E.K. Zavoisky Physical-Technical Institute (Russian Federation); Bekir Aktas, Gebze Institute of Technology (Turkey); Andrey Konov, Yakh'ya Fattakhov, D. D. Gabidullin, Kev M. Salikhov, E.K. Zavoisky Physical-Technical Institute (Russian Federation) [8357-33]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Improving the detection range via correlation of long PN codes, Saurav Subedi, Missouri Univ of Science and Technology (USA); Zhonghai Wang, Yahong R. Zheng, Missouri Univ. of Science and Technology (USA) [8357-84]

Wednesday 25 April

SESSION 9

Room: Conv. Ctr. 314 Wed. 8:00 to 10:00 am

Radar

Session Chairs: **Brian P. Burns**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Brian C Barlow**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

8:00 am: **Landmine detection by 3D GPR system**, Motoyuki Sato, Yuya Yokota, Kazunori Takahashi, Tohoku Univ. (Japan) [8357-34]

8:20 am: **GPR hardware performance baseline**, Ryan Feeley, Timothy Chevalier, Adam D. Mulliken, Exponent, Inc. (USA) [8357-35]

8:40 am: **Modeling GPR data from lidar soil surface profile**, Brian P. Burns, William W. Clark, Ian T. McMichael, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8357-36]

9:00 am: **Forward looking GPR sidelobe reduction using L1-norm minimization**, Brian P. Burns, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8357-37]

9:20 am: **A novel forward and backward scattering wave measurement system for optimizing GPR standoff mine/IED detector**, Yukinori Fuse, Kan Araki, Ministry of Defence (Japan) [8357-38]

9:40 am: **Variable focusing antenna for wireless power transmission and remote sensing in millimeter-wave wavelengths**, Erez Danieli, Ariel Univ. Ctr. of Samaria (Israel) [8357-39]

Coffee Break 10:00 to 10:30 am

SESSION 10

Room: Conv. Ctr. 314 Wed. 10:30 to 11:50 am

A Melange of Interesting Techniques II

Session Chair: **Steven S. Bishop**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

10:30 am: **X-ray backscatter imaging of pressure-plate improvised explosive devices**, Johan C. van den Heuvel, Franco Fiore, NATO C3 Agency (Netherlands) [8357-40]

10:50 am: **The use of laser-induced x-rays for detection and imaging**, Robert M. Deas, Defence Science and Technology Lab. (United Kingdom) [8357-41]

11:10 am: **Laser neutralization of surface and buried munitions**, James D. Habersat, Bradley W. Schilling, Joe Alexander, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8357-42]

11:30 am: **Design and construction of a proton magnetometer for detection of metals**, Natalia Ramirez, Univ. EAFIT (Colombia) [8357-44]

Lunch/Exhibition Break 11:50 am to 2:00 pm

SESSION 11

Room: Conv. Ctr. 314 Wed. 2:00 to 2:40 pm

Hand-Held Systems

Session Chair: **Charles A. Amazeen**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

2:00 pm: **ALIS deployment in Cambodia**, Motoyuki Sato, Kazunori Takahashi, Tohoku Univ. (Japan) [8357-45]

2:20 pm: **Investigation of the effects of operator technique on handheld sensor data for landmine detection**, Stacy L. Tantum, Kenneth D. Morton, Jr., Leslie M. Collins, Peter A. Torriano, Duke Univ. (USA) [8357-46]

Coffee/Exhibition Break 2:40 to 3:40 pm

SESSION 12

Room: Conv. Ctr. 314 Wed. 3:40 to 5:00 pm

Stand-Off Detection Technologies I

Session Chair: **James M. Keller**, Univ. of Missouri-Columbia (USA)

3:40 pm: **On the evaluation and improvement of spectral features for the detection of buried explosive hazards using forward-looking, ground-penetrating radar**, Justin W. Farrell, Timothy C. Havens, Dominic K. Ho, James M. Keller, Univ. of Missouri-Columbia (USA); Tuan T. Ton, David C. Wong, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Mehrdad Soumekh, Univ. at Buffalo (USA) [8357-48]

4:00 pm: **Multiple outlook learning for explosive hazard detection in forward-looking ground-penetrating radar**, Timothy C. Havens, James M. Keller, Justin W. Farrell, Dominic K. Ho, Univ. of Missouri-Columbia (USA); Tuan T. Ton, David C. Wong, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate (USA); Mehrdad Soumekh, Univ. at Buffalo (USA) [8357-49]

4:20 pm: **An automatic detection system for buried explosive hazards in FL-LWIR and FL-GPR data**, Kevin E. Stone, James M. Keller, Univ. of Missouri-Columbia (USA); Derek T. Anderson, Mississippi State Univ. (USA); David B. Lewis, Univ. of Missouri-Columbia (USA) [8357-50]

4:40 pm: **Enhanced buried object detection using fusion of UHF-SAR detections and lidar elevation information**, Arnab Shaw, Wright State Univ. (USA) [8357-51]

Thursday 26 April

SESSION 13

Room: Conv. Ctr. 314 Thurs. 8:20 to 10:00 am

Trace Particle/Vapor Explosive Sensing

Session Chairs: **Aaron LaPointe**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Anna K. Pettersson**, Swedish Defence Research Agency (Sweden)

8:20 am: **Optimizing a lab-on-a-fiber optic device for trace TNT explosive detection**, Jianjun Ma, Wojtek J. Bock, Univ. du Québec en Outaouais (Canada); Wenhui Hao, Zhi Yuan Wang, Carleton Univ. (Canada) [8357-52]

8:40 am: **Explosives particle detection using multispectral imaging Raman spectroscopy**, Markus Nordberg, Henric Östmark, Swedish Defence Research Agency (Sweden) [8357-53]

9:00 am: **Time-of-flight mass spectrometry for explosives trace detection**, Anna K. Pettersson, Anders Elfving, Ahmed Al-Khalili, Petra Käck, Tomas Hurtig, Mattias Elfsberg, Henric Östmark, Swedish Defence Research Agency (Sweden) [8357-54]

9:20 am: **Quantum dot material for the detection of chemicals associated with landmines, IEDs, and HME material**, Vincent P. Schnee, Marc D. Woodka, Daniel W. Pinkham, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8357-55]

9:40 am: **Spectral feature selection for use in chemometrics**, Daniel W. Pinkham, James R. Bonick, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8357-57]

Coffee Break 10:00 to 10:30 am

SESSION 14

Room: Conv. Ctr. 314 Thurs. 10:30 to 11:50 am

Stand-Off Detection Technologies II

Session Chair: Robert H. Luke III,

U.S. Army Night Vision & Electronic Sensors Directorate (USA)

10:30 am: **Line matching for automatic change detection algorithm**, Jérôme Dhollande, Institut Franco-Allemand de Recherches de Saint-Louis (France) and Univ. de Haute Alsace (France); David Monnin, Laetitia Gond, Institut Franco-Allemand de Recherches de Saint-Louis (France); Christophe Cudel, Sophie Kohler, Alain Dieterlen, Univ. de Haute Alsace (France) [8357-58]

10:50 am: **Change-based threat detection in urban environments with a forward-looking camera**, Kenneth D. Morton, Jr., Christopher R. Ratto, Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) [8357-59]

11:10 am: **Optimized feature-detection for on-board vision-based surveillance**, Laetitia Gond, David Monnin, Armin L. Schneider, Institut Franco-Allemand de Recherches de Saint-Louis (France) [8357-60]

11:30 am: **Processing forward-looking data for anomaly detection: single-look, multi-look, and spatial classification**, Jordan M. Malof, Univ. of Louisville (USA); Kenneth D. Morton, Jr., Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) [8357-61]

Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 15

Room: Conv. Ctr. 314 Thurs. 1:20 to 3:00 pm

Marine Environment

Session Chair: Gerald J. Dobeck,

Naval Surface Warfare Ctr. Panama City Div. (USA)

1:20 pm: **Inspection of the objects on the sea floor for the presence of explosives**, Vladivoj Valkovic, Darovin Sudac, Jasmina Obhodas, Institut Ruder Boškovic (Croatia); Zoran Domitran, Univ. of Zagreb (Croatia) [8357-62]

1:40 pm: **Detection of floating mines in infrared sequences by multiscale geometric filtering**, Dominique Florins, Antoine Manzanera, Ecole Nationale Supérieure de Techniques Avancées (France) [8357-63]

2:00 pm: **Correction of underwater pincushion distortion by compensating camera lens**, Harold R. Suiter, Naval Surface Warfare Ctr. Panama City Div. (USA) [8357-64]

2:20 pm: **Mine countermeasures theory modernization: an integrated approach for automated adaptive mine hunting**, Gregory Garcia, Naval Surface Warfare Ctr. Panama City Div. (USA) [8357-65]

2:40 pm: **Preconcentration for the detection of explosives in water**, Marc D. Woodka, James C. Shpil, Vincent P. Schnee, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Michael P. Polcha, Corbin Co. (USA) [8357-66]

Coffee Break 3:00 to 3:30 pm

SESSION 16

Room: Conv. Ctr. 314 Thurs. 3:30 to 5:10 pm

**Signal Processing I:
GPR Ground Tracking and Change Detection**

Session Chair: Richard C. Weaver,

U.S. Army Night Vision & Electronic Sensors Directorate (USA)

3:30 pm: **Integration of lidar with the NIITEK GPR for improved performance on rough terrain**, Christopher R. Ratto, Kenneth D. Morton, Jr., Duke Univ. (USA); Ian T. McMichael, Brian P. Burns, William W. Clark, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) [8357-67]

3:50 pm: **Ground tracking using Microsoft Kinect sensor for ground-penetrating radar**, Robert H. Luke III, Mark A. Cumo, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8357-68]

4:10 pm: **Extracting edge histogram detector features from ground-penetrating radar data without ground alignment**, Joshua J. Wood, Joseph N. Wilson, Jeremy Bolton, Univ. of Florida (USA); Hichem Frigui, Univ. of Louisville (USA) [8357-69]

4:30 pm: **Efficient multiple layer boundary detection in ground-penetrating radar data using an extended Viterbi algorithm**, Brandon Smock, Joseph N. Wilson, Univ. of Florida (USA) [8357-70]

4:50 pm: **Image registration**, Richard A. Mueller, NIITEK, Inc. (USA) . . . [8357-71]

Friday 27 April

SESSION 17

Room: Conv. Ctr. 314 Fri. 8:00 to 10:00 am

Signal Processing II

Session Chairs: Robert H. Luke III, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Peter A. Torrione, Duke Univ. (USA)

8:00 am: **Keypoint-based image processing for landmine detection in GPR data**, Rayn T. Sakaguchi, Kenneth D. Morton, Jr., Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) [8357-72]

8:20 am: **Weighted principal component analysis for real-time background removal in GPR data**, Yakov Shkolnikov, Exponent, Inc. (USA) [8357-73]

8:40 am: **Multiple instance learning for landmine detection using ground penetrating radar**, Achut Manandhar, Kenneth D. Morton, Jr., Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) [8357-74]

9:00 am: **Incorporation of operator knowledge for improved HMDS GPR classification**, Levi Kennedy, Jessee R. McClelland, Joshua R. Walters, Signal Innovations Group, Inc. (USA) [8357-75]

9:20 am: **A Bayesian method for discriminative context-dependent fusion of GPR-based detection algorithms**, Christopher R. Ratto, Kenneth D. Morton, Jr., Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) [8357-76]

9:40 am: **Uncertainty analysis for a GPR detection algorithm based on the singular value decomposition**, Mitchell Walters, Ephraim Garcia, Cornell Univ. (USA) [8357-78]

Coffee Break 10:00 to 10:30 am

SESSION 18

Room: Conv. Ctr. 314 Fri. 10:30 to 11:50 am

Signal Processing III

Session Chairs: Pete Howard, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Christopher R. Ratto, Duke Univ. (USA)

10:30 am: **Dynamic scene analysis in ground penetrating radar array data**, Taylor Glenn, Brandon Smock, Paul Gader, Joseph N. Wilson, Univ. of Florida (USA) [8357-79]

10:50 am: **Classification by using Prony's method with a polynomial model**, Wen-Hsiung Lee, NIITEK, Inc. (USA) [8357-80]

11:10 am: **Quick Scan (QSCAN): method for real-time anomaly detection using GPR imaging**, Ali Etebari, NIITEK, Inc. (USA); Magdi A. Mohamed, Matthew A. Laffin, NIITEK, Inc (USA) [8357-81]

11:30 am: **Evaluation of various feature extraction methods for landmine detection using hidden Markov models**, Anis Hamdi, Hichem Frigui, Univ. of Louisville (USA) [8357-82]

Courses of Related Interest

- SC993 **Soil Physics For Non-Soil Engineers: Moisture, Thermal, And Dielectric Soil Properties Affecting IED Detection** (Hendrickx) Wednesday, 8:30 am to 5:30 pm
- SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm
- SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

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

Conference Chair: **Augustus Way Fountain III**, U.S. Army Edgewood Chemical Biological Ctr. (USA)

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

Tuesday 24 April

SESSION 1

Room: Conv. Ctr. 319 Tues. 8:00 to 10:00 am

Bioaerosol Detection Strategies

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

8:00 am: **The future of biosurveillance-biosensing strategies** (Keynote Presentation), Franca R. Jones, Office of Science and Technology Policy (USA) [8358-01]

8:20 am: **Spectrally resolved fluorescence cross sections of aerosolized live biological agents and simulants**, Yongle Pan, Steven C. Hill, Chatt Williamson, Ronald G. Pinnick, Mark Coleman, Kristan P. Gurton, U.S. Army Research Lab. (USA); Kelly Brinkley, The Johns Hopkins Univ. Applied Physics Lab. (USA); Joshua Santaripa, Sandia National Labs. (USA); Melvin A. Felton, U.S. Army Research Lab. (USA); Neal Baker, Jon Eshbaugh, Jerry Hahn, Emily Smith, Ben Alvarez, The Johns Hopkins Univ. Applied Physics Lab. (USA); Todd Sickler, Warren Gardner, U.S. Army Edgewood Chemical Biological Ctr. (USA) . [8358-02]

8:40 am: **Ambient background particulate composition, outdoor natural background: interferents/clutter**, Dorothea A. Paterno, U.S. Army Edgewood Chemical Biological Ctr. (USA) [8358-03]

9:00 am: **Proposal for a standoff bioagent detection SWIR/MWIR DISC lidar**, François Babin, Nicolas Ho, INO (Canada); Simon Lambert-Girard, Ctr. d'optique, photonique et laser (Canada); Bruno Bourliaguet, INO (Canada); Paul-Francois Paradis, Jet Propulsion Lab. (USA) [8358-04]

9:20 am: **Automated recognition and tracking of aerosol threat plumes with an IR camera pod**, Ryan A. Fauth, Thomas C. Gruber, Jr., Christopher Powell, MESH, Inc. (USA); Dan Clapp, Ipswich Engineering Group (USA) [8358-05]

9:40 am: **XPairIt: novel software toolkit design for smart reagent development**, Michael S. Sellers, Margaret M. Hurley, U.S. Army Research Lab. (USA) [8358-06]

Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 319 Tues. 10:30 to 11:50 am

Biosurveillance and Biosensing

Session Chair: **Cynthia R. Swim**, U.S. Army Edgewood Chemical Biological Ctr. (USA)

10:30 am: **Multiplex pathogen and toxin assays using a microflow cytometer**, Peter B. Howell, Jr., U.S. Naval Research Lab. (USA) [8358-07]

10:50 am: **Novel utilization of the outer membrane proteins for the identification and differentiation of pathogenic versus nonpathogenic microbial strains using mass spectrometry-based proteomics approach**, Rabih E. Jabbour, U.S. Army Edgewood Chemical Biological Ctr. (USA) [8358-08]

11:10 am: **Bacterial display peptides for use in biosensing applications**, Dimitra N. Stratis-Cullum, Joshua M. Kogot, Michael S. Sellers, Margaret M. Hurley, Joseph M. Pennington, Bryn Adams, Irene Val-Addo, U.S. Army Research Lab. (USA); Candice R. Warner, James P. Carney, Rebecca L. Brown, U.S. Army Edgewood Chemical Biological Ctr. (USA); Paul M. Pellegrino, U.S. Army Research Lab. (USA) [8358-09]

11:30 am: **Multi-wavelength, resonance Raman spectroscopy of bacteria to study the effects of growth phase and culture medium**, Nagapratima Kunapareddy, Sergei Nikitin, Research Support Instruments, Inc. (USA); Jacob Grun, David Gillis, Robert Lunsford, Zheng Wang, U.S. Naval Research Lab. (USA) [8358-10]

Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 3

Room: Conv. Ctr. 319 Tues. 1:20 to 3:00 pm

Novel Devices for Biodetection I

Session Chair: **Steven W. Waugh**, Defense Threat Reduction Agency (USA)

1:20 pm: **Remote sensing and testing capabilities at U.S. Army Dugway Proving Ground**, James T. Pearson, U.S. Army Dugway Proving Ground (USA) [8358-11]

1:40 pm: **Biomolecule Raman spectral temporal flux from resting Bacilli spores in deionized water matrix**, A. Peter Snyder, U.S. Army Edgewood Chemical Biological Ctr. (USA); Ashish Tripathi, SAIC (USA); Rabih E. Jabbour, Phillip G. Wilcox, Jason A. Guicheteau, U.S. Army Edgewood Chemical Biological Ctr. (USA) [8358-12]

2:00 pm: **Spectroscopic investigations of surface deposited bacterial BW simulants**, Matthew J. Baker, Stephen J. Barrington, Suzanne Pelfrey, Defence Science and Technology Lab. (United Kingdom) [8358-13]

2:20 pm: **Eyesafe fusion detection (ESFD) of CBE threats**, Matthew P. Nelson, Patrick J. Treado, Oksana Klueva, Robert C. Schweitzer, ChemImage Corp. (USA) [8358-14]

2:40 pm: **Detection of single-digit Bacillus anthracis spores in water within 15 minutes by SERS**, Stuart R. Farquharson, Real-Time Analyzers, Inc. (USA) [8358-15]

Coffee Break 3:00 to 3:30 pm

SESSION 4

Room: Conv. Ctr. 319 Tues. 3:30 to 4:30 pm

Novel Devices for Biodetection II

Session Chair: **Steven W. Waugh**, Defense Threat Reduction Agency (USA)

3:30 pm: **Empirical methods for identifying specific peptide-protein interactions for smart reagent development**, Joshua M. Kogot, Deborah A. Sarkes, U.S. Army Research Lab. (USA); Candice R. Warner, Terry J. Henderson, James P. Carney, U.S. Army Edgewood Chemical Biological Ctr. (USA); Dimitra N. Stratis-Cullum, U.S. Army Research Lab. (USA) [8358-16]

3:50 pm: **The use of handheld Raman system for virus detection**, Chunyuan Song, The Univ. of Georgia (USA); Jeremy D. Driskell, Illinois State Univ. (USA); Ralph A. Tripp, Yiping Zhao, The Univ. of Georgia (USA) [8358-17]

4:10 pm: **Testing and comparison of the coating materials for immunosensors on QCM**, Hasan Nazir, Ankara Univ. (Turkey); Ali Öztuna, Gulhane Military Medical Academy (Turkey) [8358-18]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

New methods and an optical device for active remote sensing of chemical and biological agents, Vitaliy A. Yatsenko III, Institute of Space Research (Ukraine) [8358-68]

Optical properties of diffuse thin films that also fluoresce, Richard I. Joseph, Michael E. Thomas, David M. Brown, Evan P. Thrush, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8358-69]

I-SCAD® overview, Mirela Popa, Chemring Detection Systems, Inc. (USA) [8358-70]

Micro-optics for simultaneous multispectral imaging applied to chemical/biological and IED detection, Michele Hinrichs, Pacific Advanced Technology, Inc. (USA) [8358-73]

The effect of morphology on the detection of explosive traces by ultraviolet spectroscopic differential reflectometry, Thierry A. Dubroca, Gael Guetard, Rolf E. Hummel, Univ. of Florida (USA) [8358-74]

Isolation and characterization of anti-SEB peptides using magnetic sorting, Joseph M. Pennington, Joshua M. Kogot, Deborah A. Sarkes, Dimitra N. Stratis-Cullum, U.S. Army Research Lab. (USA) [8358-75]

Wednesday 25 April

SESSION 5

Room: Conv. Ctr. 319 Wed. 8:00 to 11:50 am

Proximal and Standoff Detection of Explosives

Session Chair: Aaron LaPointe,

U.S. Army Night Vision & Electronic Sensors Directorate (USA)

8:00 am: **Deep-UV Raman measurements of energetic materials and their photochemical products**, Sanford A. Asher, Univ. of Pittsburgh (USA); David D. Tuschel, HORIBA Jobin Yvon Inc. (USA); Luling Wang, Manash K. Ghosh, Todd A. Vargson, Univ. of Pittsburgh (USA) [8358-19]

8:20 am: **High-resolution optical signatures of fresh and aged explosives**, Robert Lunsford, Jacob Grun, U.S. Naval Research Lab. (USA); Jared C. Gump, Naval Surface Warfare Ctr. Indian Head Div. (USA) [8358-21]

8:40 am: **Use of a spectroscopic lidar for standoff explosives detection through Raman spectra**, François Babin, Rosalie Forest, David Gay, Nicolas Ho, Ovidiu Pancrati, Simon Deblois, INO (Canada); Sylvain Desilets, Jean Maheux, Defence Research and Development Canada, Valcartier (Canada) [8358-22]

9:00 am: **Recent improvements and testing of a check point explosives detection system**, Alan Ford, Robert D. Waterbury, Darius Vunck, Thomas B. Blank, Adam J. Hopkins, Butch Ferguson, Troy McVay, Edwin Dottery, Alakai Defense Systems, Inc. (USA) [8358-23]

9:20 am: **Standoff detection results with the infrared hyperspectral MoDDIFS sensor**, Gilles Fortin, AEREX avionique inc. (Canada); Jean-Marc Thériault, Defence Research and Development Canada, Valcartier (Canada); Paul Lacasse, AEREX avionique inc. (Canada); Francois Bouffard, Hugo Lavoie, Eldon Puckrin, Sylvain Desilets, Defence Research and Development Canada, Valcartier (Canada); Yan Montembeault, Vincent Farley, Telops (Canada) [8358-24]

9:40 am: **Possibilities for standoff Raman detection applications for explosives**, Sara Wallin, Anna K. Pettersson, Hans G. Önnnerud, Henric Östmark, Markus Nordberg, Anneli Ehlerding, Ida Johansson, Swedish Defence Research Agency (Sweden) [8358-25]

Coffee Break 10:00 to 10:30 am

10:30 am: **Coded-aperture Raman imaging for standoff explosive detection**, Scott McCain, Bob Guenther, Applied Quantum Technologies, Inc. (USA) [8358-26]

10:50 am: **Coherent anti-stokes Raman spectroscopy for detecting explosives in real time**, Arthur Dogariu, Princeton Univ. (USA); Alex Pidwerbetsky, LGS Innovations Inc. (USA) [8358-27]

11:10 am: **Smart multiple explosives detection and identification using surface plasmon-coupled emission**, Shiou-Jyh Ja, ICx Nomadics, Inc. (USA) [8358-28]

11:30 am: **Challenges of infrared reflective spectroscopy of solid-phase explosives and chemicals on surfaces**, Mark C. Phillips, Bruce E. Bernacki, Jonathan D. Suter, Timothy J. Johnson, Pacific Northwest National Lab. (USA) [8358-20]

Lunch/Exhibition Break 11:50 am to 1:40 pm

SESSION 6

Room: Conv. Ctr. 319 Wed. 1:40 to 5:20 pm

Point Detection of Explosives

Session Chair: Anna Tedeschi, Strategic Analysis, Inc. (USA)

1:40 pm: **Photo-assisted electrochemical detection (PAED) following HPLC-UV for the determination of nitro explosives and degradation products**, Jennifer Fedorowski, William R. LaCourse, Univ. of Maryland, Baltimore County (USA); Michelle M. Lorah, U.S. Geological Survey (USA) [8358-30]

2:00 pm: **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) [8358-31]

2:20 pm: **Ion mobility spectrometry for detection of explosives, taggants, and related materials using an existing, fielded chemical agent detector: the M4A1-JCAD**, Charles S. Harden, SAIC (USA); Gretchen E. Blethen, U.S. Army Edgewood Chemical Biological Ctr. (USA); Christina L. Crawford, Washington State Univ. (USA); Brian S. Ince, Vincent M. McHugh, Augustus W. Fountain III, U.S. Army Edgewood Chemical Biological Ctr. (USA); Herbert H. Hill, Washington State Univ. (USA) [8358-32]

2:40 pm: **Multi-dimensional detection of explosives and explosive signatures via laser electrospray mass spectrometry**, John J. Brady, Paul M. Flanigan, Johnny J. Perez, Temple Univ. (USA); Elizabeth J. Judge, Los Alamos National Lab. (USA); Robert J. Levis, Temple Univ. (USA) [8358-33]

Coffee/Exhibition Break 3:00 to 4:00 pm

4:00 pm: **Silica-anchored fluorescent organo-silicon polymers for explosives separation and detection**, H. Paul Martinez, Univ. of California, San Diego (USA); Christian D. Grant, John G. Reynolds, Lawrence Livermore National Lab. (USA); William C. Trogler, Univ. of California, San Diego (USA) [8358-34]

4:20 pm: **Portable thin layer chromatography (TLC) for field detection of explosives**, Joe H. Satcher, Jon L. Maienschein, Philip F. Pagonia, Ana Racoveanu, M. Leslie Carman, John G. Reynolds, Lawrence Livermore National Lab. (USA) [8358-35]

4:40 pm: **Silicone-hydrogels as immobilization matrices for enzyme-based sensors: optochemical detection of peroxide explosives and their precursors**, Stephan Meskath, Freiburger Materialforschungszentrum (Germany); Juergen Heinze, Gerald A. Urban, Albert-Ludwigs-Univ. Freiburg (Germany) [8358-36]

5:00 pm: **Portable standoff Raman system for fast detection of homemade explosives through glass, plastic containers, and water**, Anupam K. Misra, Shiv K. Sharma, Tayro E. Acosta, John N. Porter, Paul G. Lucey, David E. Bates, Univ. of Hawai'i (USA) [8358-37]

Thursday 26 April

SESSION 7

Room: Conv. Ctr. 319 Thurs. 8:00 to 11:50 am

Laser-Based Approaches to Chemical Detection

Session Chair: Paul M. Pellegrino, U.S. Army Research Lab. (USA)

8:00 am: **Reduced LIBS plasma model via thermodynamics**, Steven T. Griffin, Brandon Dent, The Univ. of Memphis (USA) [8358-38]

8:20 am: **Real-time residue and powder analysis with laser-assisted infrared imaging**, Miles J. Weida, Peter R. Buerki, Michael Henson, Timothy Day, Daylight Solutions Inc. (USA) [8358-39]

8:40 am: **Non-contact detection of trace materials using infrared lasers**, Michael R. Papantonakis, Christopher A. Kendziora, Robert Furstenberg, Viet Q. Nguyen, R. Andrew McGill, U.S. Naval Research Lab. (USA) [8358-40]

9:00 am: **Highly efficient SERS substrates based on filter paper loaded with plasmonic nanostructures**, Srikanth Singamaneni, Chang Lee, Washington Univ. in St. Louis (USA); Mikella E. Hankus, U.S. Army Research Lab. (USA); Limei Tian, Washington Univ. in St. Louis (USA); Paul M. Pellegrino, U.S. Army Research Lab. (USA) [8358-41]

9:20 am: **Next-generation surface-enhanced Raman scattering (SERS) substrates for hazard detection**, Mikella E. Hankus, Dimitra N. Stratis-Cullum, U.S. Army Research Lab. (USA) [8358-42]

9:40 am: **Femtosecond fiber-laser-based laser-induced breakdown spectroscopy**, Huan Huang, Lih-Mei Yang, Jian Liu, PolarOnyx, Inc. (USA) [8358-43]

Coffee Break 10:00 to 10:30 am

10:30 am: **Nondestructive detection and imaging of trace chemicals with high-chemical specificity using single-beam coherent anti-stokes Raman scattering in a standoff configuration**, Marcos M. Dantus, Marshall T. Bremer, Vadim V. Lozovoy, Michigan State Univ. (USA) [8358-44]

10:50 am: **Time evolution of infrared signatures of chemicals on outdoor surfaces**, Anish K. Goyal, Melissa Spencer, Edward C. Wack, Antonio Sanchez, MIT Lincoln Lab. (USA) [8358-45]

11:10 am: **Improved sensing using simultaneous deep-UV Raman and fluorescence detection**, William F. Hug, Photon Systems, Inc. (USA); Rohit Bhartia, Jet Propulsion Lab. (USA); Ray D. Reid, Photon Systems, Inc. (USA) [8358-46]

11:30 am: **Stand-off CWA imaging system: second sight MS**, Philippe F. Bernascolle, Audrey Elichabe, Franck Fervel, Jean-Baptiste Haumonté, Bertin Technologies (France) [8358-47]

Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 8

Room: Conv. Ctr. 319 Thurs. 1:20 to 4:50 pm

Novel Detection Strategies for Chemical Detection

Session Chair: Jason A. Guicheteau, U.S. Army Edgewood Chemical Biological Ctr. (USA)

1:20 pm: **Selective cavity enhanced trace gas detection via diffusion time-of-flight spectroscopy**, Anthony Miller, Jason McKeever, Cesar R. Viteri, Bruce Richman, Entanglement Technologies, Inc. (USA) [8358-48]

1:40 pm: **Detection of trace gases using frequency modulated off-axis cavity ring-down spectroscopy**, Andreas Karpf, Gottipaty N. Rao, Adelphi Univ. (USA) [8358-49]

2:00 pm: **Lightweight autonomous chemical identification system (LACIS)**, George Lozos, Smiths Detection Edgewood (USA); Hai Lin, Timothy Burch, Intelligent Optical Systems, Inc. (USA) [8358-50]

2:20 pm: **Spatiotemporal sampling of diffusion processes on meshes and networks**, Yue M. Lu, Harvard Univ. (USA) [8358-51]

2:40 pm: **A microfluidic toolbox approach to CBRNE sensing**, Claudia Gärtner, Richard Klemm, Nadine Hlawatsch, Holger Becker, microfluidic ChipShop GmbH (Germany) [8358-52]

Coffee Break 3:00 to 3:30 pm

3:30 pm: **Advances in field-portable ion-trap GC/MS instrumentation**, Eric Diken, Josep Arnó, Ed Skvorc, David Manning, Greger Andersson, Kevin Judge, Kenneth Fredeen, Smiths Detection (USA); Charles Sadowski, Torion Technologies, Inc. (USA) [8358-53]

3:50 pm: **Photoacoustic spectroscopy for chemical sensing**, Ellen L. Holthoff, Paul M. Pellegrino, U.S. Army Research Lab. (USA) [8358-54]

4:10 pm: **Real-time quantitative hydrocarbon gas imaging with the gas cloud imager (GCI)**, Nathan A. Hagen, Robert T. Kester, Rebellion Photonics (USA) [8358-55]

4:30 pm: **Photoacoustic spectroscopy (PAS) system for remote detection of explosives, chemicals, and special nuclear materials**, Hual-Te Chien, Kevin K. Wang, Shuh-Haw Sheen, Apostolos Paul C. Raptis, Argonne National Lab. (USA) [8358-57]

Friday 27 April

SESSION 9

Room: Conv. Ctr. 319 Fri. 8:20 to 11:50 am

Radiological and Nuclear Detection

Session Chair: James G. Placke, Jr., Y-12 National Security Complex (USA)

8:20 am: **Possible standoff detection of ionizing radiation with high-power THz electromagnetic waves**, Gregory S. Nusinovich, Carlos A. Romero-Talamas, Ruifeng Pu, Thomas M. Antonsen, Jr., Victor L. Granatstein, Univ. of Maryland, College Park (USA); Phillip Sprangle, U.S. Naval Research Lab. (USA) [8358-58]

8:40 am: **Characterization of CdZnTe crystals and radiation detectors**, Ralph B. James, Aleksey E. Bolotnikov, Giuseppe S. Camarda, Yonggang Cui, Anwar M. Hossain, Ki-Hyun Kim, Rubi Gul, Ge Yang, Brookhaven National Lab. (USA) [8358-59]

9:00 am: **Gamma discrimination in pillar-structured, thermal-neutron detectors**, Qinghui Shao, Radoslav P. Radev, Adam M. Conway, Lars F. Voss, Tzu F. Wang, Rebecca J. Nikolic, Lawrence Livermore National Lab. (USA) [8358-60]

9:20 am: **Coherent x-ray scatter projection imaging using an array of mono-energetic pencil beams**, Karl Landheer, Paul C. Johns, Carleton Univ. (Canada) [8358-62]

9:40 am: **MOX assay using He-4 scintillation detectors**, David Murer, Hannes Friederich, Rico Chandra, Ulisse Gendotti, Giovanna Davatz, Arktis Radiation Detectors Ltd. (Switzerland) [8358-63]

Coffee Break 10:00 to 10:30 am

10:30 am: **Study of the time structure of the fast neutron background using high-pressured helium-4 scintillators**, David Murer, Rico Chandra, Ulisse Gendotti, Giovanna Davatz, Hannes Friederich, Arktis Radiation Detectors Ltd. (Switzerland) [8358-64]

10:50 am: **Investigations into the polymorphs and hydration products of UO₃**, Lucas Sweet, David L. Blanchard, Edgar C. Buck, Charles H. Henager, Jr., Shenyang Hu, David E. Meier, Shane M. Peper, Jon M. Schwantes, Yin-Fong Su, Robert L. Sams, Thomas A. Blake, Timothy J. Johnson, Pacific Northwest National Lab. (USA); Thomas J. Kulp, Ricky L. Sommers, Joshua D. Sugar, Sandia National Labs., California (USA); Jeffrey D. Chames, Sandia National Labs., California (USA) [8358-65]

11:10 am: **Thermal neutron detection with PMMA nanocomposites containing dysprosium fluoride nanocrystals**, Antonio C. Rivera, Natasha N. Glazener, Nathaniel C. Cook, Salomon Maestas, Brian A. Akins, Leisha M. Armijo, John B. Plumley, Nathan J. Withers, Kenneth Carpenter, Gennady A. Smolyakov, Robert D. Busch, Marek Osinski, The Univ. of New Mexico (USA) [8358-66]

11:30 am: **The use of stimulated electron emission (SEE) in homeland security applications**, Harry Ing, Hugh Robert Andrews, Marius Facina, Bubble Technology Industries, Inc. (Canada); Hsienchi W. Niu, Wai Tak Lee, Hamilton Sundstrand - Energy, Space & Defense - Pomona (USA) [8358-67]

Lunch Break 11:50 am to 1:10 pm

SESSION 10

Room: Conv. Ctr. 317 Fri. 1:10 to 3:00 pm

Nanotechnology for Standoff Detection and Counterterrorism Operations I

Please note room change

Joint Session with Conference 8373

Session Chairs: **Michael K. Rafailov**, The Reger Group (USA);
Thomas G. Thundat, Univ. of Alberta (Canada)

- 1:10 pm: **Phenomenology and system engineering of micro- and nano-antenna FPA sensors for detection of concealed weapons and improvised explosive devices**, Roger Appleby, Queen's Univ. Belfast (United Kingdom) [8373-82]
- 1:40 pm: **Introducing sub-wavelength pixel THz camera for the understanding of close pixel-to-wavelength imaging challenges** (*Invited Paper*), Alain Bergeron, Linda Marchese, Denis G. Dufour, Martin Bolduc, Marc Terroux, Éric Savard, Bruno Tremblay, El -Hassane Oulachgar, Michel Doucet, Loïc Le Noc, Christine Alain, Hubert Jerominek, INO (Canada) [8373-83]
- 2:00 pm: **Optimal coherent control methods for explosives detection** (*Invited Paper*), David S. Moore, Shawn D. McGrane, Margo T. Greenfield, R. Jason Scharff, Los Alamos National Lab. (USA) [8373-84]
- 2:20 pm: **Photodetection with active optical antennas** (*Invited Paper*), Naomi J. Halas, Rice Univ. (USA) [8373-85]
- 2:40 pm: **Canadian approaches for chemical, biological and explosive standoff detection** (*Invited Paper*), Sylvain Désilets, Jean-Marc Thériault, Jean-Robert Simard, Defence Research and Development Canada, Valcartier (Canada) [8373-86]
- Coffee Break 3:00 to 3:30 pm

SESSION 11

Room: Conv. Ctr. 317 Fri. 3:30 to 5:20 pm

Nanotechnology for Standoff Detection and Counterterrorism Operations II

Please note room change

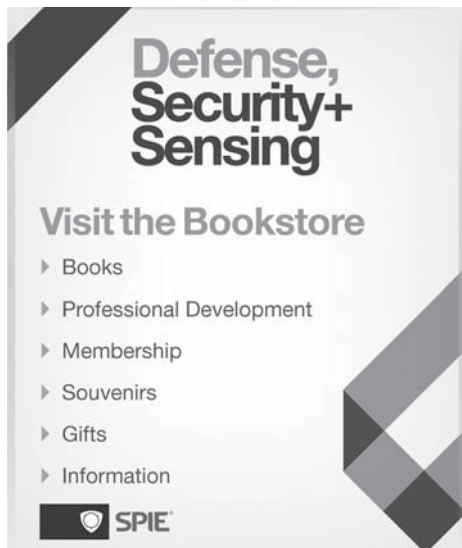
Joint Session with Conference 8373

Session Chairs: **Michael K. Rafailov**, The Reger Group (USA);
Thomas G. Thundat, Univ. of Alberta (Canada)

- 3:30 pm: **QCL as a game changer in mid-IR standoff military applications**, Chandra Kumar N. Patel, Pranalytica, Inc. (USA) [8373-87]
- 4:00 pm: **Standoff detection of explosive residues on unknown surfaces** (*Invited Paper*), Charles W. Van Neste, Xunchen Liu, Lana L. Norman, Manisha Gupta, Seonghwan Kim, Ying Y. Tsui, Thomas G. Thundat, Univ. of Alberta (Canada) [8373-88]
- 4:20 pm: **Broadband tunable external cavity quantum cascade lasers for standoff detection of explosives** (*Invited Paper*), Stefan Hugger, Frank Fuchs, Michel Kinzer, Quankui Yang, Wolfgang Bronner, Rolf Aidam, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany); Kai Degreif, Fraunhofer-Institut für Physikalische Messtechnik (Germany); Frank Schnürer, Fraunhofer-Institut für Chemische Technologie (Germany) [8373-89]
- 4:40 pm: **Infrared photothermal imaging for standoff detection applications** (*Invited Paper*), Christopher A. Kendziora, Robert Furstenberg, Michael R. Papantonakis, Viet Q. Nguyen, R. Andrew McGill, U.S. Naval Research Lab. (USA) [8373-90]
- 5:00 pm: **High-power, military ruggedized QCL-based laser systems** (*Invited Paper*), Eric B. Takeuchi, William B. Chapman, Timothy Day, David B. Arnone, Michael Pushkarsky, David B. Caffey, Michael B. Young, Daylight Solutions Inc. (USA) [8373-91]

Courses of Related Interest

- SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm
 - SC719 **Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies** (Gardner, Popa) Monday, 8:30 am to 5:30 pm
 - SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm
- See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours



Sensors, and Command, Control, Communications, and Intelligence (C3I) Technologies for Homeland Security and Homeland Defense XI

Conference Chair: **Edward M. Carapezza**, General Atomics (USA)

Program Committee: **Zoraida P. Aguilar**, Ocean NanoTech (USA); **John G. Blicht**, Colorado State Univ. (USA); **George Cybenko**, Dartmouth College (USA); **Panos George C. Datskos**, Oak Ridge National Lab. (USA); **Michael J. DeWeert**, BAE Systems (USA); **Susan F. Hallowell**, Transportation Security Lab., Dept. of Homeland Security (USA); **Todd M. Hintz**, Space and Naval Warfare Systems Command (USA); **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA); **Pradeep K. Khosla**, Carnegie Mellon Univ. (USA); **Han Q. Le**, Univ. of Houston (USA); **Daniel Lehrfeld**, Blue Marble Group LLC (USA); **Tariq Manzur**, Naval Undersea Warfare Ctr. (USA); **Jordan Wexler**, Raytheon Applied Signal Technology, Inc. (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 311 Mon. 8:30 to 9:30 am

Keynote Session

Session Chair: **George Cybenko**, Dartmouth College (USA)

8:30 am: **Cyber Security and CyLab: technologies and challenges** (Keynote Presentation), Pradeep K. Khosla, Carnegie Mellon Univ. (USA) [8359-01]

9:00 am: **Cyber adversarial behavior analytics** (Keynote Presentation), George Cybenko, Thayer School of Engineering at Dartmouth (USA) [8359-02]

SESSION 2

Room: Conv. Ctr. 311 Mon. 9:30 am to 12:20 pm

Cyber Security

Session Chairs: **George Cybenko**, Dartmouth College (USA); **Jordan Wexler**, Raytheon Applied Signal Technology, Inc. (USA)

9:30 am: **Novel mechanism of network protection against new generation of cyber attacks**, Alexander Milovanov, Leonid Bukshpun, Ranjit Pradhan, Physical Optics Corp. (USA) [8359-03]

9:50 am: **Inverse game theory: learning the nature of a game through play**, Gabriel F. Stocco, Thayer School of Engineering at Dartmouth (USA) ... [8359-04]

Coffee Break 10:10 to 10:40 am

10:40 am: **An analytic approach to cyber adversarial dynamics**, Patrick J. Sweeney, U. S. Air Force (USA); George Cybenko, Thayer School of Engineering at Dartmouth (USA) [8359-05]

11:00 am: **Exploiting exploration strategies in repeated normal form security games**, James T. House, George Cybenko, Thayer School of Engineering at Dartmouth (USA) [8359-06]

11:20 am: **Generating realistic environments for cyber operations development, testing, and training**, Vincent H. Berk, Ian Gregorio-de Souza, John P. Murphy, Dartmouth College (USA) [8359-07]

11:40 am: **Thwarting enviromentally aware malware**, Daniel Bilar, Dartmouth College (USA) [8359-08]

12:00 pm: **Automated malware detection using data model LUTs**, Holger M. Jaenisch, James W. Handley, Licht Strahl Engineering, Inc. (USA) [8359-09]

Lunch Break 12:20 to 1:30 pm

SESSION 3

Room: Conv. Ctr. 311 Mon. 1:30 to 2:30 pm

Biological and Chemical Sensors

Session Chairs: **Utkan Demirci**, Brigham and Women's Hospital (USA); **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

1:30 pm: **Rapid multiple pathogen detection using a portable microfluidic system**, Utkan Demirci, Harvard Medical School (USA) [8359-10]

1:50 pm: **Noncontact liquid explosive detection device**, Pablo J. Prado, One Resonance, LLC (USA) [8359-11]

2:10 pm: **Use of ISR sensors for detection of chemical and biological agents**, Hans Malik, Northrop Grumman Electronic Systems (USA); Christopher Parker, Camber Corp. (USA) [8359-13]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 4

Room: Conv. Ctr. 311 Tues. 8:00 to 8:30 am

Keynote Session

Session Chairs: **George C. Tillery**, National Institute of Justice (USA); **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

8:00 am: **Intersubband lasers diodes from IR to THZ: recent advances and future trends** (Keynote Presentation), Manijeh Razeghi, Northwestern Univ. (USA) [8359-14]

SESSION 5

Room: Conv. Ctr. 311 Tues. 8:30 to 11:40 am

Command, Control, Communications, and Intelligence (C3I)

Session Chairs: **George C. Tillery**, National Institute of Justice (USA);
Myron E. Hohil, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

8:30 am: **Cost-sensitive hardware encryption of existing wireless communication networks**, Benjamin M. Kaminski, Adam R. Wannemacher, Jeffrey S. Wells, NuWaves Engineering (USA) [8359-15]

8:50 am: **Turbo-prop aircraft against terrorism: a SWOT analysis of turbo-prop aircraft in CAS operations**, Murat Yavuz, Ali Akkas, Turkish Air War College (Turkey) [8359-16]

9:10 am: **Multirobot terrain coverage and task allocation for autonomous detection of landmines**, Raj Dasgupta, Angelica Munoz Melendez, K. R. Guruprasad, Univ. of Nebraska at Omaha (USA) [8359-17]

9:30 am: **Strategic military message system oriented to obtain the tactical picture**, Gustavo Perez, Stefany Marrugo, COTECMAR (Colombia) [8359-18]

9:50 am: **Catastrophe extraction of anomalous events**, Tomasz P. Jansson, Thomas C. Forrester, Sookwang Ro, Physical Optics Corp. (USA) [8359-19]

Coffee Break 10:10 to 10:40 am

10:40 am: **Resource management tools based on renewable energy sources**, Tomasz P. Jansson, Thomas C. Forrester, Physical Optics Corp. (USA) . [8359-20]

11:00 am: **Application of the replicator equations to decision-making processes in border security**, David Sicilia, George Cybenko, Thayer School of Engineering at Dartmouth (USA) [8359-21]

11:20 am: **Nirvana: managing large-scale heterogeneous data structures for real-time C3I**, David P. Schissel, General Atomics (USA) [8359-22]

Lunch/Exhibition Break 11:40 am to 1:00 pm

SESSION 6

Room: Conv. Ctr. 311 Tues. 1:00 to 2:00 pm

Keynote Session

Session Chairs: **Tariq Manzur**, Naval Undersea Warfare Ctr. (USA);
Sachi V. Desai, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

1:00 pm: **Situational awareness and informed decision making for law enforcement responders** (*Keynote Presentation*), George C. Tillery, National Institute of Justice (USA) [8359-23]

1:30 pm: **Revolutionary development of Type 11 GaSb/InAs superlattices for third generation of IR imaging** (*Keynote Presentation*), Manijeh Razeghi, Northwestern Univ. (USA) [8359-24]

SESSION 7

Room: Conv. Ctr. 311 Tues. 2:00 to 5:00 pm

EO/Imaging Devices and Systems

Session Chairs: **Tariq Manzur**, Naval Undersea Warfare Ctr. (USA);
Sachi V. Desai, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

2:00 pm: **Using VIS/NIR and IR spectral cameras for detecting and separating crime scene details**, Jaana Kuula, Ismo J. Pellikka, Heikki Salo, Ilkka Pölonen, Univ. of Jyväskylä (Finland); Heikki Saari, VTT Technical Research Ctr. of Finland (Finland) [8359-25]

2:20 pm: **Re-identification of persons in multicamera surveillance under varying viewpoints and illumination**, Henri Bouma, Sander Borsboom, Richard den Hollander, Sander Landsmeer, TNO Defence, Security and Safety (Netherlands); Marcel Worring, Univ. of Amsterdam (Netherlands) [8359-26]

2:40 pm: **Picosecond gating of optical and x-ray images with electron pulse dilation**, Terance Hilsbeck, General Atomics (USA) [8359-27]

Coffee Break 3:00 to 4:00 pm

4:00 pm: **3D vision system for enhanced robotic tele-operation for the homeland security mission**, Richard Edmondson, Polaris Sensor Technologies, Inc. (USA) [8359-28]

4:20 pm: **LIBS data analysis using a predictor-corrector-based digital signal processor algorithm**, Steven T. Griffin, Aaron L. Robinson, Alex Sanders, The Univ. of Memphis (USA) [8359-29]

4:40 pm: **Development of a high-sensitivity UV photocathode using GaN film that works in transmission mode**, Yoshihiro Ishigami, Keisuke Akiyama, Takaaki Nagata, Kazumasa Kato, Tsuneo Ihara, Kimitsugu Nakamura, Itaru Mizuno, Hamamatsu Photonics K.K. (Japan); Tetsuji Matsuo, Emiko Chino, Sanken Electric Co., Ltd. (Japan); Hiroyuki Kyushima, Hamamatsu Photonics K.K. (Japan) [8359-30]

Wednesday 25 April

SESSION 8

Room: Conv. Ctr. 311 Wed. 8:00 to 9:00 am

Keynote Session

Session Chairs: **Edward M. Carapezza**, General Atomics (USA);
Daniel Lehrfeld, Blue Marble Group LLC (USA)

8:00 am: **Trends in transportation security** (*Keynote Presentation*), Susan F. Hallowell, Transportation Security Lab. (USA) [8359-31]

8:30 am: **Guardian counter-manpad system implementation status** (*Keynote Presentation*), David Denton, Northrop Grumman Electronic Systems (USA) [8359-32]

SESSION 9

Room: Conv. Ctr. 311 Wed. 9:00 to 11:10 am

EO/Imaging Devices and Systems

Session Chairs: **Daniel Lehrfeld**, Blue Marble Group LLC (USA);
Myron E. Hohil, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

9:00 am: **Action vision sensor (AVS): a bio-inspired sensor for detection and localization of action and transient events**, Joseph H. Lin, Philippe O. Poulliquen, Andreas G. Andreou, The Johns Hopkins Univ. (USA); Charbel G. Rizk, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8359-33]

9:20 am: **Archiving image sequences with regard to associated geographical and nongeographical attributes to allow reconnaissance and surveillance tasks to be performed more efficiently**, Stefan T. Bruestle, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [8359-34]

9:40 am: **High-performance, event-driven, low cost, and SWaP imaging sensor for hostile fire detection, homeland protection, and border security**, Charbel G. Rizk, Stephen W. Kennerly, Arnold C. Goldberg, Kim Strohhenn, The Johns Hopkins Univ. Applied Physics Lab. (USA); Joseph H. Lin, Philippe O. Poulliquen, Andreas G. Andreou, The Johns Hopkins Univ. (USA) [8359-35]

Coffee Break 10:00 to 10:30 am

10:30 am: **3D scanning and imaging for quick documentation of crime and accident scenes**, Marco Scaioni, Politecnico di Milano (Italy); Cristina Cattaneo, Univ. degli Studi di Milano (Italy); Remo Sala, Alberto Giussani, Luigi Barazzetti, Fabio Roncoroni, Politecnico di Milano (Italy); Pasquale Poppa, Daniele Gibelli, Univ. degli Studi di Milano (Italy) [8359-36]

10:50 am: **Large area, clear, transparent superhydrophobic coatings**, John T. Simpson, Scott R. Hunter, Oak Ridge National Lab. (USA) [8359-37]

Lunch/Exhibition Break 11:10 am to 1:00 pm

SESSION 10

Room: Conv. Ctr. 311 Wed. 1:00 to 1:30 pm

Keynote Session

Please note room change

Joint with Conference 8388

Session Chairs: **Edward M. Carapezza**, General Atomics (USA); **Daniel Lehrfeld**, Blue Marble Group LLC (USA)

1:00 pm: **Non-lethal weapons: technologies and challenges** (Keynote Presentation), David B. Law, Joint Non-Lethal Weapons Directorate (USA) [8359-38]

SESSION 11

Room: Conv. Ctr. 311 Wed. 1:30 to 2:30 pm

Non-lethal Weapon and Surveillance Systems

Please note room change

Joint with Conference 8388

Session Chairs: **David B. Law**, Joint Non-Lethal Weapons Directorate (USA); **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

1:30 pm: **Characterization the influence of micro and terahertz waves on human in security systems**, Marek Zyczkowski, Norbert Palka, Mateusz Karol, Military Univ. of Technology (Poland); Beata Uzieblo-Zyczkowska, Military Institute of Medicine (Poland) [8359-39]

1:50 pm: **Direct electromagnetic stopper: an innovative nonlethal weapon working in time domain**, Michele D'Urso, Aniello Buonanno, Maria Grazia Labate, SELEX Sistemi Integrati S.p.A. (Italy); Domenico Pavone, Consorzio Nazionale di Ricerca per le Tecnologie Optoelettroniche dell'InP (Italy) . . [8359-40]

2:10 pm: **Detection and localization of R/C electronic devices using Hurst parameter**, Vivek Thotla, Mohammad Tayeb Ahmad Ghasr, Maciej Zawodniok, Sarangapani Jagannathan, Missouri Univ. of Science and Technology (USA); Sanjeev Agarwal, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8359-41]

SESSION 12

Room: Conv. Ctr. 311 Wed. 2:30 to 3:30 pm

Weapons, Projectiles, and Small Arms I

Please note room change

Joint Session with Conference 8388

Session Chairs: **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Sachi V. Desai**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

2:30 pm: **Passive electro-optical projectiles tracker**, Ilya P. Agurok, Waqidi Falicoff, Roberto Alvarez, Will Shatford, Light Prescriptions Innovators, LLC (USA) [8359-42]

2:50 pm: **Real-time vehicle noise cancellation techniques for gunshot acoustics**, Antonio L. Ramos, Hogskolen i Buskerud (Norway); Sverre Holm, Univ. of Oslo (Norway); Sigmund Gudvangen, Hogskolen i Buskerud (Norway); Ragnvald Otterlei, PosiCom AS (Norway) [8359-43]

3:10 pm: **Small arms mini-fire control system: projectile tracker sensor**, Slobodan Rajic, Oak Ridge National Lab. (USA) [8359-44]

Coffee Break 3:30 to 4:00 pm

SESSION 13

Room: Conv. Ctr. 311 Wed. 4:00 to 5:00 pm

Weapons, Projectiles, and Small Arms II

Please note room change

Joint Session with Conference 8388

Session Chairs: **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Sachi V. Desai**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

4:00 pm: **Small arms mini-fire control system: fiber optic barrel deflection sensor**, Slobodan Rajic, Oak Ridge National Lab. (USA) [8359-45]

4:20 pm: **A fusion solution for soldier wearable gunfire detection systems**, George Cakiades, Sachi V. Desai, U.S. Army Armament Research, Development and Engineering Ctr. (USA); Socrates Deligeorges, BioMimetic Systems, Inc. (USA) [8388-01]

4:40 pm: **Examination of techniques utilized to evaluate muzzle suppression systems**, David Grasing, U.S. Army Research, Development and Engineering Command (USA); Sachi V. Desai, U.S. Army Armament Research, Development and Engineering Ctr. (USA) [8388-02]

Courses of Related Interest

SC1068 **Introduction to Night Vision** (Browne) Thursday, 8:30 am to 12:30 pm

SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm

SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours



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Airborne Intelligence, Surveillance, Reconnaissance (ISR) Systems and Applications IX

Conference Chair: **Daniel J. Henry**, Rockwell Collins, Inc. (USA)

Conference Co-Chairs: **Davis A. Lange**, Goodrich Corp. (USA); **Dale Linne von Berg**, U.S. Naval Research Lab. (USA); **Darrell L. Young**, Raytheon Intelligence & Information Systems (USA); **Kenneth L. Bernier**, The Boeing Co. (USA); **Jeff J. Guell**, The Boeing Co. (USA); **Sreekanth Danny Rajan**, ITT Exelis (USA)

Tuesday 24 April

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Part-template matching-based target detection and identification in UAV videos, Hyuncheol Kim, Jaehyun Im, Taekyung Kim, Chung-Ang Univ. (Korea, Republic of); Jongsue Bae, Sanghoon Lee, Hanwha Corp. (Korea, Republic of); Joonki Paik, Chung-Ang Univ. (Korea, Republic of) [8360-31]

Polarimetric imaging for ISR, David B. Chenault, Joseph L. Pezzaniti, Jonathan Hanks, Polaris Sensor Technologies, Inc. (USA) [8360-32]

Wednesday 25 April

SESSION 1

Room: Conv. Ctr. 320 Wed. 8:20 to 10:00 am

Sensors and Systems I

Session Chair: **Davis A. Lange**, Goodrich Corp. (USA)

8:20 am: **Foveated imager providing reduced time-to-threat detection for micro unmanned aerial system**, Robert M. Bates, Kenneth S. Kubala, Adam D. Greengard, FiveFocal LLC (USA) [8360-01]

Note: presentation F380-12 will also be made in Session 4 of conference 8380.

2:00 pm: **Fast, compact, computer-free holographic adaptive optics**, Geoff P. Andersen, Fossil Ghebremichael, HUA Inc. (USA); Ravi Gaddipati, Phani Gaddipati, Centum Engineering (USA) [8380-12]

9:00 am: **Condor TAC: EO/IR tactical aerial reconnaissance photography system**, Vladimir Petrushevsky, David Tsur, Elbit Systems Electro-Optics El-Op Ltd. (Israel) [8360-02]

9:20 am: **Airborne infrared hyperspectral imager for intelligence, surveillance, and reconnaissance applications**, Jean-Philippe Gagnon, Telops (Canada); Eldon Puckrin, Caroline S. Turcotte, Defence Research and Development Canada, Valcartier (Canada); Vincent Farley, Telops (Canada); John Bastedo, PV Labs (Canada); Martin Chamberland, Telops (Canada) [8360-03]

9:40 am: **UAV-based multispectral environmental monitoring**, Thomas Arnold, Martin DeBiasio, Raimund Leitner, Carinthian Tech Research AG (Austria) [8360-04]

Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 320 Wed. 10:30 am to 12:10 pm

Sensors and Systems II

Session Chair: **Dale Linne von Berg**, U.S. Naval Research Lab. (USA)

10:30 am: **Characterization and discrimination of large caliber gun blast and flash signatures**, Bryan J. Steward, Kevin C. Gross, Glen P. Perram, Air Force Institute of Technology (USA) [8360-05]

10:50 am: **Fiber optic snapshot hyperspectral imager**, David J. Mansur, Julia Rentz Dupuis, Robert Vaillancourt, OPTRA, Inc. (USA) [8360-06]

11:10 am: **Lidar flecks: modeling the influence of canopy type on tactical foliage penetration by airborne, active sensor platforms**, Richard D. Massaro, Julie Zinnert, John Anderson, Army Geospatial Ctr. (USA) [8360-07]

11:30 am: **Image stabilization for moving platform surveillance**, Zahir A. Ansari, Instruments Research & Development Establishment (India) and Indian Institute of Technology Kharagpur (India); Somnath Sengupta, Indian Institute of Technology Kharagpur (India); Arun K. Singh, Avnish Kumar, Instruments Research & Development Establishment (India) [8360-08]

11:50 am: **Enhanced intelligence through optimized TCPED concepts for airborne ISR**, Martin Spitzer, Eduard Kappes, Dietmar Böker, IABG mbH (Germany) [8360-09]

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

SESSION 3

Room: Conv. Ctr. 320 Wed. 1:40 to 3:00 pm

Image Processing I

Session Chair: **Sreekanth Danny Rajan**, ITT Exelis (USA)

1:40 pm: **Rugged GPUs in airborne ISR applications**, Dustin Franklin, GE Intelligent Platforms (USA) [8360-10]

2:00 pm: **Shape-based topologies for real-time onboard image generation**, Allison Bright, Sol M. Cruz-Rivera, Omid E. Kia, ITT Corp. Geospatial Systems (USA) [8360-11]

2:20 pm: **Saliency region selection in large aerial imagery using multiscale SLIC segmentation**, Samir Sahli, Yunlong Sheng, Univ. Laval (Canada); Daniel A. Lavigne, Defence Research and Development Canada, Valcartier (Canada) [8360-12]

2:40 pm: **Context switching system and architecture for intelligence, surveillance, and reconnaissance (ISR)**, Paul C. Hershey, Christopher J. Graham, Leslie A. Ledda, Raytheon Co. (USA) [8360-13]

Coffee/Exhibition Break 3:00 to 4:00 pm

SESSION 4

Room: Conv. Ctr. 320 Wed. 4:00 to 5:40 pm

Image Processing II

Session Chair: Darrell L. Young,
Raytheon Intelligence & Information Systems (USA)

- 4:00 pm: **Robust tracking and anomaly detection in video surveillance sequences**, Hoover F. Rueda, Univ. Industrial de Santander (Colombia); Luisa F. Polania, Kenneth E. Barner, Univ. of Delaware (USA) [8360-14]
- 4:20 pm: **A static architecture for compressive target tracking**, Phillip K. Poon, The Univ. of Arizona (USA); Daniel Townsend, Scott Wehrwein, The MITRE Corp. (USA); Esteban M. Vera, The Univ. of Arizona (USA); Michael D. Stenner, The MITRE Corp. (USA); Michael E. Gehm, The Univ. of Arizona (USA) [8360-15]
- 4:40 pm: **Parallax visualization of UAV FMV and WAMI imagery**, Christopher A. Mayhew, Craig M. Mayhew, Vision III Imaging, Inc. (USA) [8360-16]
- 5:00 pm: **Kalman filter outputs for inclusion in video-stream metadata: accounting for temporal correlation of errors for optimal target extraction**, John Dolloff, Integrity Applications, Inc. (USA) [8360-17]
- 5:20 pm: **Automated assessment of video image quality: implications for processing and exploitation**, John M. Irvine, Draper Lab. (USA) [8360-18]

Thursday 26 April

SESSION 5

Room: Conv. Ctr. 320 Thurs. 8:20 to 10:00 am

Degraded Visual Environments (DVE) Requirements and Flight Systems

Session Chair: Kenneth L. Bernier, The Boeing Co. (USA)

- 8:20 am: **Degraded environments and ESVS applications**, Jeff J. Guell, The Boeing Co. (USA) [8360-19]
- 8:40 am: **Operational requirements for short-term solution in visual display specifically for DVE**, Thorsten W. Eger, German School of Army Aviation (Germany) [8360-20]
- 9:00 am: **Brownout landing aid system technology (BLAST): system overview and flight test results**, Brian Sykora, BAE Systems (USA) [8360-21]
- 9:20 am: **LandSafe aircraft survivability system: the DVE solution**, Pri Mamidipudi, Elizabeth Dakin, Daniel Dakin, Optical Air Data Systems, LLC (USA) [8360-22]
- 9:40 am: **Advanced distributed aperture system**, Trevor L. Bushell, Raytheon Network Centric Systems (USA) [8360-23]
- Coffee Break 10:00 to 10:30 am

SESSION 6

Room: Conv. Ctr. 320 Thurs. 10:30 am to 11:50 pm

Degraded Visual Environments (DVE) Symbology and Technologies I

Session Chair: Jeff J. Guell, The Boeing Co. (USA)

- 10:30 am: **Evaluation of DVE landing display formats**, Hans-Ullrich Doehler, Patrizia M. Knabl, Sven Schmerwitz, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Thorsten W. Eger, German School of Army Aviation (Germany); Ofer Klein, Elbit Systems Ltd. (Israel) [8360-24]
- 10:50 am: **Use of 3D conformal symbology on HMD for a safer flight in degraded visual environment**, Ofer Klein, Elbit Systems Ltd. (Israel); Hans-Ullrich Doehler, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) [8360-25]
- 11:10 am: **Developing an obstacle display for helicopter brownout situations**, Niklas Peinecke, Patrizia M. Knabl, Sven Schmerwitz, Hans-Ullrich Doehler, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) [8360-26]
- 11:30 am: **High dynamic range fusion for enhanced vision**, Yuchi Liu, Tsinghua Univ. (China) and Radar Academy (China); Yipeng Li, Qionghai Dai, Tsinghua Univ. (China) [8360-28]
- Lunch/Exhibition Break 11:50 am to 1:40 pm

SESSION 7

Room: Conv. Ctr. 320 Thurs. 1:40 to 3:20 pm

Degraded Visual Environments (DVE) Symbology and Technologies II

Session Chair: Jeff J. Guell, The Boeing Co. (USA)

- 1:40 pm: **Enhancement of vision systems based on runway detection by image processing techniques**, Nusrettin Gulec, Sabanci Univ. (Turkey) and SDT A.S. (Turkey); Nigar Sen Koptas, SDT A.S. (Turkey) [8360-30]
- 2:00 pm: **Airplane vertical situation awareness (Invited Paper)**, William F. Spencer V, The Boeing Co. (USA) [8360-33]
- 2:30 pm: **Vertical situational awareness (SA) extensions for rotorcraft (Invited Paper)**, William F. Spencer V, The Boeing Co. (USA) [8360-34]
- 3:00 pm: **Visual information, sparse decomposition, and transmission for multi-UAV visual navigation**, Hui Liu, Qionghai Dai, Tsinghua Univ. (China) [8360-29]

Radar Sensor Technology XVI

Conference Chairs: **Kenneth I. Ranney**, U.S. Army Research Lab. (USA); **Armin W. Doerry**, Sandia National Labs. (USA)

Program Committee: **Fauzia Ahmad**, Villanova Univ. (USA); **Joseph C. Deroba**, U.S. Army CERDEC Intelligence and Information Warfare Directorate (USA); **Doreen M. Dyck**, Defence Research and Development Canada, Ottawa (Canada); **Benjamin C. Flores**, The Univ. of Texas at El Paso (USA); **Majeed M. Hayat**, The Univ. of New Mexico (USA); **Todd A. Kastle**, Air Force Research Lab. (USA); **Seong-Hwoon Kim**, Raytheon Space & Airborne Systems (USA); **James L. Kurtz**, Univ. of Florida (USA); **Changzhi Li**, Texas Tech Univ. (USA); **Jenshan Lin**, Univ. of Florida (USA); **David G. Long**, Brigham Young Univ. (USA); **Jia-Jih Lu**, General Atomics Aeronautical Systems, Inc. (USA); **Anthony F. Martone**, U.S. Army Research Lab. (USA); **George J. Moussally**, Mirage Systems (USA); **Ram M. Narayanan**, The Pennsylvania State Univ. (USA); **Lam Nguyen**, U.S. Army Research Lab. (USA); **Hector A. Ochoa-Gutierrez**, The Univ. of Texas at Tyler (USA); **Meppalli K. Shandas**, dB Control (USA); **Jerry Silvious**, U.S. Army Research Lab. (USA); **Brian Smith**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Helmut H. Suess**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **David Tahmouh**, U.S. Army Research Lab. (USA); **Steven J. Weiss**, U.S. Army Research Lab. (USA); **Lars M. Wells**, Sandia National Labs. (USA)

Monday 23 April

Opening Remarks

Room: Conv. Ctr. 318 Mon. 8:30 to 8:40 am

Session Chairs: **Armin W. Doerry**, Sandia National Labs. (USA); **Kenneth I. Ranney**, U.S. Army Research Lab. (USA)

SESSION 1

Room: Conv. Ctr. 318 Mon. 8:40 to 10:00 am

Algorithms and Processing I

Session Chair: **Jerry Silvious**, U.S. Army Research Lab. (USA)

8:40 am: **Interferometric measurement of the angular velocity of moving humans**, Jeffrey A. Nanzer, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8361-01]

9:00 am: **Adaptive waveform scheduling in radar: an information theoretic approach**, Pawan Setlur, Natasha Devroye, Univ. of Illinois at Chicago (USA) [8361-02]

9:20 am: **Testing a transmission line model for homogeneous subsurface media using ground-penetrating radar**, Berta Rodriguez Hervas, The Univ. of Texas at El Paso (USA) [8361-03]

9:40 am: **High-resolution time-frequency representations based on the local polynomial Fourier transform for over-the-horizon radars**, Igor Djurovic, Slobodan Djukanovic, Univ. of Montenegro (Montenegro); Moeness G. Amin, Yimin D. Zhang, Villanova Univ. (USA) [8361-04]

Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 318 Mon. 10:30 to 11:50 am

Algorithms and Processing II

Session Chair: **Lam H. Nguyen**, U.S. Army Research Lab. (USA)

10:30 am: **Refocusing vibrating targets in SAR images**, Qi Wang, Matthew P. Pepin, Balu Santhanam, Majeed M. Hayat, The Univ. of New Mexico (USA) [8361-05]

10:50 am: **3D ISAR image reconstruction of targets through filtered back projection**, Zhijun Qiao, Jaime X. Lopez, Timothy P. Ray, The Univ. of Texas-Pan American (USA) [8361-06]

11:10 am: **Features for landcover classification of fully polarimetric SAR data**, Jorge V. Geaga, Independent Consultant (USA) [8361-07]

11:30 am: **Accurate reconstruction of frequency-sparse signals from non-uniform samples**, Kang-Yu Ni, Xiangming Kong, Roy M. Matic, Mohiuddin Ahmed, HRL Labs., LLC (USA) [8361-08]

Lunch Break 11:50 am to 1:00 pm

SESSION 3

Room: Conv. Ctr. 318 Mon. 1:00 to 3:00 pm

Systems and Applications I

Session Chair: **Ann M. Raynal**, Sandia National Labs. (USA)

1:00 pm: **Multifunctional millimeter-wave radar system for helicopter safety**, Darren S. Goshi, Honeywell International Inc. (USA); Timothy J. Case, John B. McKitterick, Honeywell Technology (USA); Long Q. Bui, Honeywell International Inc. (USA) [8361-09]

1:20 pm: **Flexible end-to-end system design for synthetic aperture radar applications**, Evan C. Zaugg, Matthew C. Edwards, ARTEMIS, Inc. (USA) [8361-10]

1:40 pm: **Radar-based full-body screening of passengers with constant motion**, Sebastian Hantscher, Beverly Schlenther, Stefan A. Lang, Manfred Hägelen, Helmut W. Essen, Fraunhofer FHR (Germany); Axel Tessmann, Fraunhofer IAF (Germany) [8361-11]

2:00 pm: **Radar tracking and classification of littoral targets**, Jerry Silvious, David Tahmouh, U.S. Army Research Lab. (USA) [8361-12]

2:20 pm: **3D synthetic aperture processing on high-frequency, wide-beam, microwave systems**, Edison Cristofani, Anna Brook, Marijke Vandewal, Royal Belgian Military Academy (Belgium) [8361-14]

2:40 pm: **Analysis of spaceborne, fully polarimetric SAR data**, Helmut H. Suess, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) [8361-13]

Coffee Break 3:00 to 3:30 pm

SESSION 4

Room: Conv. Ctr. 318 Mon. 3:30 to 4:30 pm

Systems and Applications II

Session Chair: **David Tahmouh**, U.S. Army Research Lab. (USA)

3:30 pm: **SAR change detection for monitoring the impact of the rehabilitation of the Arghandab irrigation system in Afghanistan**, Jennifer Busler, Mohsen Ghazel, Vinay Kotamraju, MacDonald, Dettwiler and Associates Ltd. (Canada); Lisa Vandehei, Canadian International Development Agency (Canada); Guy Aubé, Canadian Space Agency (Canada); Corey Froese, Alberta Geological Survey (Canada) [8361-15]

3:50 pm: **Detection of clandestine tunnels in complex environments using a mobile focused-source electromagnetic data measurement and interpretation unit**, Michael Frenkel, Sofia Davydycheva, Border Security Technologies, LLC (USA) [8361-16]

4:10 pm: **Cooperative control of MAVs for a hidden emitter localization**, Miguel D. Gates, Rastko R. Selmic, Christopher R. Barber, Louisiana Tech Univ. (USA); Raul Ordenez, Univ. of Dayton (USA) [8361-17]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 5

Room: Conv. Ctr. 318 Tues. 8:00 to 10:00 am

Special Topic: Through-the-Wall Sensing

Session Chairs: Gregory J. Mazzaro, U.S. Army Research Lab. (USA); Anthony F. Martone, U.S. Army Research Lab. (USA)

- 8:00 am: **Synthetic aperture radar imaging of a two-story building**, Traian V. Dogaru, U.S. Army Research Lab. (USA) [8361-18]
- 8:20 am: **Indoor imagery with a 3D through-wall synthetic aperture radar**, Pascale Sevigny, David J. DiFilippo, Defence Research and Development Canada, Ottawa (Canada); Jonathan Fournier, Defence Research and Development Canada, Valcartier (Canada); Tony Laneve, Defence Research and Development Canada, Ottawa (Canada) [8361-19]
- 8:40 am: **Micro-Doppler processing for ultra-wideband radar**, Graeme E. Smith, Fauzia Ahmad, Moeness G. Amin, Villanova Univ. (USA) [8361-20]
- 9:00 am: **Histogram-based segmentation for stationary indoor target detection**, Moeness G. Amin, Villanova Univ. (USA); Pawan Settur, Univ. of Illinois at Chicago (USA); Fauzia Ahmad, Villanova Univ. (USA); Pascale Sevigny, David J. DiFilippo, Defence Research and Development Canada, Ottawa (Canada) [8361-21]
- 9:20 am: **A novel system for indoor situational awareness**, Michele D'Urso, Giancarlo Prisco, Maurizio Felaco, SELEX Sistemi Integrati S.p.A. (Italy); Marcello Ascione, Consorzio SESM (Italy); Aniello Buonanno, SELEX Sistemi Integrati S.p.A. (Italy) [8361-22]
- 9:40 am: **Evaluation of polarimetric through-the-wall radar measurements**, Tommy Johansson, Ain Sume, Jonas Rahm, Stefan Nilsson, Anders Örbom, Swedish Defence Research Agency (Sweden) [8361-23]
- Coffee Break 10:00 to 10:30 am

SESSION 6

Room: Conv. Ctr. 318 Tues. 10:30 to 11:50 am

Components and Technology

Session Chair: Seong-Hwoon Kim, Raytheon Space & Airborne Systems (USA)

- 10:30 am: **High-efficiency switching power amplifiers for multiband radar**, Jarred W. Lawler, Justin S. Wells, NuWaves Ltd. (USA) [8361-24]
- 10:50 am: **Antenna array devised for amplifier integration**, Bernd H. Strassner II, Sandia National Labs. (USA) [8361-25]
- 11:10 am: **Compensating for inconsistent high-power vircator microwave radar pulse sources**, Alastair D. McAulay, Lehigh Univ. (USA) [8361-26]
- 11:30 am: **Developments in extraordinary transmission metallic lens**, Miguel Navarro-Cia, Imperial College London (United Kingdom); Miguel Beruete, Francisco Falcone, Mario Sorolla, Univ. Pública de Navarra (Spain) [8361-27]
- Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 7

Room: Conv. Ctr. 318 Tues. 1:20 to 3:00 pm

Algorithms and Processing III

Session Chair: Fauzia Ahmad, Villanova Univ. (USA)

- 1:20 pm: **Image-based target detection with UWB OFDM radar with randomized sub-carrier assignment**, Travis Bufler, Dmitriy S. Garmatyuk, Miami Univ. (USA) [8361-28]
- 1:40 pm: **A new phase space method for target discrimination**, Frederic J. Rachford, Thomas L. Carroll, U.S. Naval Research Lab. (USA) [8361-29]
- 2:00 pm: **Implementation of generalized detector for distributed sources using sensor arrays**, Vyacheslav P. Tuzlukov, Kyungpook National Univ. (Korea, Republic of) [8361-30]
- 2:20 pm: **Detection and depth estimation of shallow, buried non-metallic dummy landmines without explosives using independent component analysis of multipolarization data in microwave X band region**, Kailash C. Tiwari, Bharati Vidyapeeth's College of Engineering (India); Dharmendra P. Singh, Manoj K. Arora, Indian Institute of Technology Roorkee (India) [8361-31]
- 2:40 pm: **Classification and modeling of human activities using empirical mode decomposition with S-band and millimeter-wave micro-Doppler radars**, Dustin P. Fairchild, Ram M. Narayanan, The Pennsylvania State Univ. (USA) [8361-32]
- Coffee/Exhibition Break 3:00 to 4:00 pm

SESSION 8

Room: Conv. Ctr. 318 Tues. 4:00 to 5:20 pm

Phenomenology

Session Chair: Meppalli K. Shandas, dB Control (USA)

- 4:00 pm: **Radar cross-section statistics of cultural clutter at Ku-band**, Ann M. Raynal, Douglas L. Bickel, Armin W. Doerry, Sandia National Labs. (USA) [8361-33]
- 4:20 pm: **Radar micro-Doppler simulations of classification capability with frequency**, David Tahmouh, Jerry Silvious, U.S. Army Research Lab. (USA) [8361-34]
- 4:40 pm: **EM investigation on imaging of disturbed Earth feature for buried target detection**, DaHan Liao, U.S. Army Research Lab. (USA) [8361-35]
- 5:00 pm: **In-situ permittivity measurements using ring resonators**, Gregory J. Mazzaro, U.S. Army Research Lab. (USA) [8361-36]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

- A better trihedral corner reflector for low-grazing angles**, Armin W. Doerry, Billy C. Brock, Sandia National Labs. (USA) [8361-47]
- What maritime ISAR designers should know about ship dynamics**, Armin W. Doerry, Sandia National Labs. (USA) [8361-48]
- Designing interpolation kernels for SAR data resampling**, Armin W. Doerry, Sandia National Labs. (USA); Edward Bishop, John Miller, Volker Horndt, General Atomics Aeronautical Systems, Inc. (USA); Donald Small, Sandia National Labs. (USA) [8361-49]
- Multitarget detection algorithm for automotive FMCW radar**, Eugin Hyun, Jong-Hun Lee, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of) [8361-50]
- Tunnel monitoring with an advanced InSAR technique**, Bernhard Rabus, Jayson Eppler, Jayanti Sharma, Jennifer Busler, MacDonald, Dettwiler and Associates Ltd. (Canada) [8361-51]
- Integrated radar-camera security system: range test**, Marek Zyczkowski, Wieslaw Ciurapinski, Mieczyslaw Szustakowski, Mateusz Karol, Military Univ. of Technology (Poland) [8361-53]
- Fast stereo matching under variable illumination**, Sarala Arunagiri, Esthela Gallardo, Adriana Contreras, Patricia J. 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, Dale R. Shires, Song Jun Park, U.S. Army Research Lab. (USA) [8361-56]
- Novel nonlinear phase distortion estimation in wideband linear frequency modulated waveform using intermediate frequency signal**, Heeseong Yang, Joohwan Chun, KAIST (Korea, Republic of); Sung-Chan Song, Samsung Thales Co., Ltd. (Korea, Republic of) [8361-58]
- Target detection in forward-looking radar**, Roberto I. Innocenti, Kenneth I. Ranney, Lam H. Nguyen, U.S. Army Research Lab. (USA) [8361-59]
- Contrast-based moving target detection with the randomized linear receive array**, Kenneth I. Ranney, Anthony F. Martone, Roberto I. Innocenti, Lam H. Nguyen, U.S. Army Research Lab. (USA) [8361-60]
- Multiresolution SAR image processing for forward-looking radar**, Lam Nguyen, Kenneth I. Ranney, U.S. Army Research Lab. (USA) [8361-61]
- Persistent ISR using Predator B / MQ-9 Reaper demonstrating integration with Navy networks using surrogate platform**, Ralf Dunkel, Zach Link, Tobias J. Verge, Jeff Laue, General Atomics Aeronautical Systems, Inc. (USA) [8361-62]
- An efficient means to mitigate wavefront curvature effects in polar format processed SAR imagery**, Robert Linnehan, Mark Yasuda, General Atomics Aeronautical Systems, Inc. (USA); Armin W. Doerry, Sandia National Labs. (USA) [8361-63]

Conference 8361 · Room: Conv. Ctr. 318

Wednesday 25 April

Room:Wed. 8:40 to 8:50 am

Opening Remarks

Session Chair: **Ram M. Narayanan**, The Pennsylvania State Univ. (USA)

SESSION 9

Room: Conv. Ctr. 318Wed. 8:50 to 10:10 am

Special Topic: Noise Radar I

Session Chair: **Ram M. Narayanan**, The Pennsylvania State Univ. (USA)

8:50 am: **Low-cost chaotic radar design**, G. Martin Hall, E. Jeff Holder, Propagation Research Associates, Inc. (USA); Seth D. Cohen, Daniel J. Gauthier, Duke Univ. (USA). [8361-37]

9:10 am: **Information retrieval and cross-correlation function analysis of random noise radar signal through dispersive media**, Ana V. Alejos, Muhammad Dawood, New Mexico State Univ. (USA) [8361-38]

9:30 am: **Analysis of the ambiguity function for an FM signal derived from the Lorenz chaotic flow**, Chandra S. Pappu, Benjamin C. Flores, The Univ. of Texas at El Paso (USA); Patrick S. Debroux, U.S. Army Research Lab. (USA) . . [8361-40]

9:50 am: **Detection performance of the LFM noise radar waveform**, Mark Govoni, U.S. Army Research, Development and Engineering Command (USA); John Kosinski, Monmouth Univ. (USA) [8361-41]

Coffee Break 10:10 to 10:40 am

SESSION 10

Room: Conv. Ctr. 318 Wed. 10:40 am to 12:20 pm

Special Topic: Noise Radar II

Session Chair: **Mark Govoni**, U.S. Army Research, Development and Engineering Command (USA)

10:40 am: **Noisy linear stepped frequency (NLSF) waveform in rf tomography**, Russell Vela, Univ. of Dayton Research Institute (USA); Justin E. Bracken, Lorenzo Lo Monte, Air Force Research Lab. (USA) [8361-42]

11:00 am: **Ultra-wideband noise radar based on optical waveform generation**, Daniel Grodensky, Daniel Kravitz, Avinoam Zadok, Bar-Ilan Univ. (Israel) [8361-43]

11:20 am: **Impulse response characterization of the propagation and scattering environment in through-wall applications using an S-band noise radar**, Sonny Smith, Ram M. Narayanan, The Pennsylvania State Univ. (USA) [8361-44]

11:40 am: **Simultaneous human detection and ranging using a millimeter-wave radar system transmitting wideband noise with an embedded tone**, Kyle A. Gallagher, Ram M. Narayanan, The Pennsylvania State Univ. (USA) [8361-45]

12:00 pm: **Microwave noise fields: active radiometry principles and applications**, Jiri G. Polivka, Spacek Labs. Inc. (USA). [8361-46]

Courses of Related Interest

SC1070 **Radar Waveforms and Signal Processing** (Welstead) Thursday, 8:30 am to 12:30 pm

SC1031 **Radar Micro-Doppler Signatures - Principles and Applications** (Chen, Tahmoush) Wednesday, 8:30 am to 12:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Passive and Active Millimeter-Wave Imaging XV

Conference Chairs: **David A. Wikner**, U.S. Army Research Lab. (USA); **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 (USA); **Christopher A. Martin**, Trex Enterprises Corp. (USA)

Thursday 26 April

SESSION 1

Room: Conv. Ctr. 316 Thurs. 8:40 to 10:00 am

Device Technology

Session Chair: **Arttu R. Luukanen**,
VTT Technical Research Ctr. of Finland (Finland)

8:40 am: **Array technology for terahertz imaging**, Theodore J. Reck, Jet Propulsion Lab. (USA) [8362-01]

9:00 am: **Millimeter-wave, electronically scanned reflectarray optimization and analysis**, Abigail Hedden, Charles Dietlein, David A. Wikner, U.S. Army Research Lab. (USA) [8362-02]

9:20 am: **Millimeter-wave beam forming and dynamic steering using an optically controlled photo-injected Fresnel zone plate antenna at 94GHz**, Tom F. Gallacher, Duncan A. Robertson, Graham M. Smith, Univ. of St. Andrews (United Kingdom) [8362-03]

9:40 am: **Reflectarray for 120-GHz beam steering application: design, simulations, and measurements**, Alekski A. Tamminen, Juha Ala-Laurinaho, Aalto Univ. School of Science and Technology (Finland); Sampo Mäkelä, Aalto Univ. School of Electrical Engineering (Finland); David Gomes-Martins, Janne Häkili, Päivi Koivisto, Pekka Pursula, Jussi Säily, Reijo Tuovinen, Markku Sipilä, Arttu R. Luukanen, VTT Technical Research Ctr. of Finland (Finland); Antti V. Räisänen, Aalto Univ. School of Science and Technology (Finland) [8362-04]

Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 316 Thurs. 10:30 to 11:50 am

Systems I

Session Chair: **David A. Wikner**, U.S. Army Research Lab. (USA)

10:30 am: **340GHz 3D radar imaging test bed with 10Hz frame rate**, Duncan A. Robertson, Paul N. Marsh, David R. Bolton, Robert J. C. Middleton, Robert I. Hunter, Peter J. Speirs, David G. Macfarlane, Scott L. Cassidy, Graham M. Smith, Univ. of St. Andrews (United Kingdom) [8362-05]

10:50 am: **Wide field-of-view millimeter-wave telescope design with ultra-low cross polarization**, Bruce E. Bernacki, James F. Kelly, David M. Sheen, Brian K. Hatchell, Patrick L. J. Valdez, Jonathan R. Tedeschi, Thomas E. Hall, Douglas L. McMakin, Pacific Northwest National Lab. (USA) [8362-06]

11:10 am: **Stand-off, real-time, synthetic imaging at mm-wave frequencies**, Matthias Kahl, Univ. Siegen (Germany); Andreas Keil, Torsten Löffler, Jörn Peuser, SynView GmbH (Germany); Martin Pätzold, Andreas Kolb, Univ. Siegen (Germany); Thorsten Sprenger, Hübner GmbH (Germany); Bernd Hils, Johann Wolfgang Goethe-Univ. Frankfurt am Main (Germany); Peter Haring Bolívar, Univ. Siegen (Germany) [8362-07]

11:30 am: **Measured performance of a high-resolution passive video-rate submillimeter-wave imaging system demonstrator for stand-off imaging**, Arttu R. Luukanen, Markus Grönholm, Mikko M. Leivo, Hans Toivanen, Anssi Rautiainen, VTT Technical Research Ctr. of Finland (Finland) [8362-08]

Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 3

Room: Conv. Ctr. 316 Thurs. 1:20 to 2:40 pm

Systems II

Session Chair: **Roger Appleby**, Queen's Univ. Belfast (United Kingdom)

1:20 pm: **Polarimetric passive millimeter-wave imagery from a sensor based on an optical up-conversion architecture**, John Wilson, Univ. of Delaware (USA); Christopher A. Schuetz, Thomas E. Dillon, Richard D. Martin, Phase Sensitive Innovations, Inc. (USA); Dennis W. Prather, Univ. of Delaware (USA) [8362-09]

1:40 pm: **First results for a low-cost fast millimeter-wave radiometric imaging system**, Markus Peichl, Stephan Dill, Daniel Rudolf, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) [8362-10]

2:00 pm: **Real-time video rate imaging with a 1k-pixel THz CMOS focal-plane array**, Janusz Grzyb, Bergische Univ. Wuppertal (Germany); Hani Sherry, STMicroelectronics (France) and Bergische Univ. Wuppertal (Germany) and ISEN/IEMN (France); Yan Zhao, Richard Al Hadi, Bergische Univ. Wuppertal (Germany); Andreia Cathelin, STMicroelectronics (France); Andreas Kaiser, Institut d'Electronique, de Microélectronique, et de Nanotechnologie (France); Ullrich Pfeiffer, Bergische Univ. Wuppertal (Germany) [8362-11]

2:20 pm: **Flight test of MMW radar for brown-out helicopter landing**, Christopher A. Martin, Vladimir G. Kolinko, Gregory P. Otto, John A. Lovberg, Trex Enterprises Corp. (USA) [8362-12]

SESSION 4

Room: Conv. Ctr. 316 Thurs. 2:40 to 5:10 pm

Phenomenology and Image Processing

2:40 pm: **Simulation of millimeter-wave body images and its application to biometric recognition**, Miriam Moreno-Moreno, Julian Fierrez, Ruben Vera-Rodriguez, Univ. Autónoma de Madrid (Spain); Josep Parron, Univ. Autónoma de Barcelona (Spain) [8362-13]

Coffee Break 3:00 to 3:30 pm

3:30 pm: **Applicability of radio astronomy techniques to the processing and interpretation of aperture synthesis passive millimetre-wave applications**, Christopher T. Taylor, Peter N. Wilkinson, The Univ. of Manchester (United Kingdom); Neil A. Salmon, MMW Sensors Ltd. (United Kingdom); Colin D. Cameron, QinetiQ Ltd. (United Kingdom) [8362-14]

3:50 pm: **Subwavelength resolution of MMW imaging systems using extremely inexpensive scanning glow discharge detector (GDD) double-row camera**, Natan S. Kopeika, Ben-Gurion Univ. of the Negev (Israel); Amir Abramovich, Daniel Rozban, Ariel Univ. Ctr. of Samaria (Israel); Assaf Levanon III, Ben-Gurion Univ. of the Negev (Israel); Avihai Akram, Ben-Gurion Univ. of the Negev (Israel) and Ariel Univ. Ctr. of Samaria (Israel); Yitzhak Yitzhaky, Orly Yadid-Pecht, Alex Belenky, Ben-Gurion Univ. of the Negev (Israel) [8362-15]

4:10 pm: **Automatic real-time concealed object detection and recognition with passive millimeter-wave imaging**, Seokwon Yeom, Daegu Univ. (Korea, Republic of); Dong-Su Lee, Daegu Univ. (USA); Mun-Kyo Lee, Yu-Shin Chang, Samsung Thales Co., Ltd. (Korea, Republic of); Sang-Won Jung, Samsung Thales Co., Ltd. (USA) [8362-16]

4:30 pm: **Evaluation of passive millimeter-wave system performance in adverse weather conditions**, Nachappa Gopalsami, Shaolin Liao, Alexander Heifetz, Eugene R. Koehl, Thomas W. Elmer, Sr., Apostolos Paul C. Raptis, Argonne National Lab. (USA) [8362-17]

4:50 pm: **Real-time computer treatment of THz passive device images with the high image quality**, Vyacheslav A. Trofimov, Vladislav V. Trofimov, Lomonosov Moscow State Univ. (Russian Federation) [8362-18]

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A Thurs. 6:00 to 7:30 pm

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Thermal human phantom for testing of millimeter-wave cameras, Norbert Palka, Radoslaw Ryniec, Marek Piszczek, Mieczyslaw Szustakowski, Marek Zyczkowski, Marcin Kowalski, Military Univ. of Technology (Poland) . . . [8362-19]

Terahertz Physics, Devices, and Systems VI: Advance Applications in Industry and Defense

Conference Chairs: **A. F. Mehdi Anwar**, Univ. of Connecticut (USA); **Nibir K. Dhar**, Defense Advanced Research Projects Agency (USA); **Thomas W. Crowe**, Virginia Diodes, Inc. (USA)

Conference Co-Chair: **Tariq Manzur**, Naval Undersea Warfare Ctr. (USA)

Program Committee: **Alexander G. Davies**, Univ. of Leeds (United Kingdom); **Gottfried H. Döhler**, Max Planck Institute for the Science of Light (Germany); **Achyut Dutta**, Banphil Photonics, Inc. (USA); **M. Saif Islam**, Univ. of California, Davis (USA); **Hiroshi Ito**, NTT Photonics Labs. (Japan); **Peter Uhd Jepsen**, Technical Univ. of Denmark (Denmark); **Edmund Linfield**, Univ. of Leeds (United Kingdom); **Amir Hamed Majedi**, Univ. of Waterloo (Canada); **Taiichi Otsuji**, Tohoku Univ. (Japan); **B. M. Azizur Rahman**, The City Univ. (United Kingdom); **Victor Ryzhii**, Univ. of Aizu (Japan); **Ashok K. Sood**, Magnolia Optical Technologies, Inc. (USA); **K. Sigfrid Yngvesson**, Univ. of Massachusetts Amherst (USA); **Weili Zhang**, Oklahoma State Univ. (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 316 Mon. 8:30 to 10:10 am

THz Spectroscopy

Session Chairs: **Thomas W. Crowe**, Virginia Diodes, Inc. (USA); **Nibir K. Dhar**, Defense Advanced Research Projects Agency (USA)

8:30 am: **High-resolution reflection measurements of dielectrics in the w-band (92-100 GHz)**, Erez Danieli, Ariel Univ. Ctr. of Samaria (Israel) . . . [8363-01]

8:50 am: **Evaluation of terahertz spectra using chemometric methods**, Joachim Jonuscheit, Garik Torosyan, Frank Ellrich, Sabine Wohnsiedler, Michael Herrmann, Rene Beigang, Fraunhofer-Institut für Physikalische Messtechnik (Germany); Frank Platte, Konstantinos Nalpantidis, IANUS Simulation GmbH (Germany); Michael Heise, Fachhochschule Südwestfalen (Germany); Thorsten Sprenger, Heiko Wolf, Hübner GmbH (Germany) . . . [8363-02]

9:10 am: **Resonance structure of molecular clusters of β -HMX for THz frequencies**, Ling Huang, Andrew Shabaev, Samuel Lambrakos, U.S. Naval Research Lab. (USA); Lou Massa, Hunter College (USA) . . . [8363-03]

9:30 am: **Integrated phase control on a portable coherent frequency-domain THz spectrometer**, Joseph R. Demers, K. K. Wong, Matthew T. Flach, Bryon Kasper, EMCORE Corp. (USA) . . . [8363-04]

9:50 am: **Terahertz properties of single-crystal ferroelectric and dielectric materials**, S. K. Sundaram, New York State College of Ceramics at Alfred Univ. (USA); R. J. Koch, Alfred Univ. (USA); John S. McCloy, Pacific Northwest National Lab. (USA) . . . [8363-05]

Coffee Break 10:10 to 10:40 am

SESSION 2

Room: Conv. Ctr. 316 Mon. 10:40 to 11:50 am

THz Detection I

Session Chairs: **Tariq Manzur**, Naval Undersea Warfare Ctr. (USA); **B. M. Azizur Rahman**, The City Univ. (United Kingdom)

10:40 am: **THz detectors based on heating of two-dimensional electron gas in disordered nitride heterostructures** (*Invited Paper*), Vladimir V. Mitin, Rahul Ramaswamy, Roman Olac-Vaw, Univ. at Buffalo (USA); Andrey V. Muraviev, Michael S. Shur, Rensselaer Polytechnic Institute (USA); Xuhong Hu, Remis Gaska, Sensor Electronic Technology, Inc. (USA); Andrei V. Sergeev, Univ. at Buffalo (USA) . . . [8363-06]

11:10 am: **Kinetics and dynamics of soldier protective materials via real-time terahertz scanning reflectometry**, Anis Rahman, Applied Research & Photonics, Inc. (USA); Mark A. Mentzer, U.S. Army Aberdeen Test Ctr. (USA) . . . [8363-07]

11:30 am: **Tunable THz absorption using Al/SiO₂ planar periodic structures**, Fabio Alves, Brian Kearney, Dragoslav Grbovic, Gamani Karunasiri, Naval Postgraduate School (USA) . . . [8363-08]

Lunch Break 11:50 am to 1:20 pm

SESSION 3

Room: Conv. Ctr. 316 Mon. 1:20 to 3:10 pm

THz Imaging

Session Chairs: **Taiichi Otsuji**, Tohoku Univ. (Japan); **Mehdi Anwar**, Univ. of Connecticut (USA)

1:20 pm: **Proposal for real-time terahertz imaging system with palm-size terahertz camera and compact quantum cascade laser** (*Invited Paper*), Naoki Oda, NEC TOSHIBA Space Systems, Ltd. (Japan); Alan W. M. Lee, LongWave Photonics LLC (USA); Qing Hu, Massachusetts Institute of Technology (USA) . . . [8363-09]

1:50 pm: **Catadioptric optics for a high-resolution terahertz imager**, Nathalie Blanchard, Linda Marchese, Anne L. Martel, Marc Terroux, Éric Savard, Claude Chevalier, Luc Mercier, Lucie Gagnon, Julie Lambert, Martin Bolduc, Alain Bergeron, INO (Canada) . . . [8363-10]

2:10 pm: **Uncooled photomechanical terahertz imagers**, Matthew Erdtmann, Lei Zhang, Shankar Radhakrishnan, Shuyun Wu, Agiltron, Inc. (USA); Andrew J. Gatesman, Univ. of Massachusetts Lowell (USA) . . . [8363-11]

2:30 pm: **Real-time imaging with THz fully customized uncooled amorphous-silicon microbolometer focal plane arrays**, François Simoens, Commissariat à l'Énergie Atomique (France); Jerome Meilhan, Commissariat à l'Énergie Atomique (France) . . . [8363-12]

2:50 pm: **A 3D THz image processing methodology for a fully integrated, semi-automatic and near real-time operational system**, Anna Brook, Edison Cristofani, Marijke Vandewal, Royal Belgian Military Academy (Belgium) [8363-13]

Coffee Break 3:10 to 3:40 pm

SESSION 4

Room: Conv. Ctr. 316 Mon. 3:40 to 4:50 pm

THz Generation and Propagation

Session Chairs: **Mehdi Anwar**, Univ. of Connecticut (USA); **Nibir K. Dhar**, Defense Advanced Research Projects Agency (USA)

3:40 pm: **Recent progress on diode-based sources above 2 THz** (*Invited Paper*), Thomas W. Crowe, Jeffrey L. Hesler, Steven Rezloff, Gerhard Schoenthal, Virginia Diodes, Inc. (USA) . . . [8363-14]

4:10 pm: **An open-path terahertz propagation test range for model-development validation**, Lawrence Scally, Colorado Engineering, Inc. (USA) and Univ. of Colorado at Boulder (USA); Albin J. Gasiewski, Univ. of Colorado at Boulder (USA); Jason P. Fritz, Colorado Engineering, Inc. (USA) . . . [8363-15]

4:30 pm: **Design optimization of low-loss waveguides for THz guidance**, B. M. Azizur Rahman, Anita Quadri, Kejalakshmy Namassivayane, Kenneth T. V. Grattan, The City Univ. (United Kingdom) . . . [8363-16]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 5

Room: Conv. Ctr. 316 Tues. 9:00 to 10:00 am

Tutorial: THz Science and Technology

Session Chairs: **Tariq Manzur**, Naval Undersea Warfare Ctr. (USA);
B. M. Azizur Rahman, The City Univ. (United Kingdom)

9:00 am: **Recent advances in room temperature semiconductor terahertz sources** (*Keynote Presentation*), Manijeh Razeghi, Northwestern Univ. (USA) [8363-17]

Coffee Break 10:00 to 10:30 am

SESSION 6

Room: Conv. Ctr. 316 Tues. 10:30 to 11:50 am

THz Detection II

Session Chairs: **Nibir K. Dhar**, Defense Advanced Research Projects Agency (USA); **Thomas W. Crowe**, Virginia Diodes, Inc. (USA)

10:30 am: **Design, simulation, and characterization of THz metamaterial absorber**, Lee A. Butler, David S. Wilbert, William Baughman, Soner Balci, Patrick Kung, Seongsin M. Kim, The Univ. of Alabama (USA); Henry O. Everitt, U.S. Army Aviation and Missile Command (USA) [8363-18]

10:50 am: **Down-conversion detection in 300 GHz radiation using glow discharge detector (GDD)**, Avihai Akram, Ariel Univ. Ctr. of Samaria (Israel) and Ben-Gurion Univ. of the Negev (Israel); Assaf Levanon III, Ben-Gurion Univ. of the Negev (Israel); Daniel Rozban, Ariel Univ. Ctr. of Samaria (Israel) and Ben-Gurion Univ. of the Negev (Israel); Amir Abramovich, Ariel Univ. Ctr. of Samaria (Israel); Natan S. Kopeika, Ben-Gurion Univ. of the Negev (Israel) [8363-19]

11:10 am: **Subwavelength, multimode, tunable plasmonic terahertz lenses and detectors**, Mustafa Karabiyik, Ahmad N. Abbas, Chowdhury Al-Amin, Santanu Das, Nezh Pala, Wonbong Choi, Florida International Univ. (USA) [8363-20]

11:30 am: **Efficiency of the detection and identification of ceramics explosive using the reflected THz signal**, Vyacheslav A. Trofimov, Svetlana A. Varentsova, Lomonosov Moscow State Univ. (Russian Federation); Norbert Palka, Tomasz Trzcinski, Mieczyslaw Szustakowski, Military Univ. of Technology (Poland) [8363-21]

Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 7

Room: Conv. Ctr. 316 Tues. 1:20 to 3:00 pm

Advanced Concepts in THz I

Session Chairs: **Mehdi Anwar**, Univ. of Connecticut (USA);
Tariq Manzur, Naval Undersea Warfare Ctr. (USA)

1:20 pm: **Rigorous modal analysis of THz quantum cascade lasers** (*Invited Paper*), B. M. Azizur Rahman, Huda Tanvir, Kenneth T. V. Grattan, The City Univ. (United Kingdom) [8363-22]

1:50 pm: **Terahertz polarimetry based on metamaterial devices**, Grace D. Metcalfe, Michael Wraback, U.S. Army Research Lab. (USA); Andrew C. Strikwerda, Kebin Fan, Xin Zhang, Richard Averitt, Boston Univ. (USA) [8363-23]

2:10 pm: **Ultrahigh-sensitive plasmonic terahertz detectors based on an asymmetric dual-grating gate HEMT structure** (*Invited Paper*), Taiichi Otsuji, Stephane Boubanga Tombet, Takayuki Watanabe, Yudai Tanimoto, Akira Satou, Tetsuya Suemitsu, Tohoku Univ. (Japan); Yuye Wang, Hiroaki Minamide, Hiromasa Ito, RIKEN (Japan); Yahya M. Meziani, Univ. Salamanca (Spain); Dominique Coquillat, Wojciech Knap, Univ. Montpellier 2 (France); Viacheslav Popov, Kotelnikov Institute of Radio Engineering and Electronics (Russian Federation); Denis V. Fateev, Institute of Radio Engineering and Electronics (Russian Federation) [8363-24]

2:40 pm: **Plasmonic gratings for photoconductive terahertz generation: eliminating the need for short-carrier lifetime semiconductors**, Mona Jarrahi, Christopher W. Berry, Univ. of Michigan (USA) [8363-25]

Coffee/Exhibition Break 3:00 to 4:00 pm

SESSION 8

Room: Conv. Ctr. 316 Tues. 4:00 to 5:30 pm

Advanced Concepts in THz II

Session Chairs: **Taiichi Otsuji**, Tohoku Univ. (Japan);
Thomas W. Crowe, Virginia Diodes, Inc. (USA)

4:00 pm: **A modular and adaptable system architecture for real-time terahertz imaging applications** (*Invited Paper*), Chris M. Mann, ThruVision Systems Ltd. (United Kingdom) [8363-26]

4:30 pm: **Graphene-based field-effect transistor structures for terahertz applications**, Ahmad N. Abbas, Nezh Pala, Mustafa Karabiyik, Chowdhury Al-Amin, Santanu Das, Wonbong Choi, Florida International Univ. (USA) [8363-27]

4:50 pm: **Resonant bolometric subterahertz detection in a 2D plasmonic cavity**, Gregory C. Dyer, Albert D. Grine, John L. Reno, Sandia National Labs. (USA); Gregory R. Aizin, Kingsborough Community College (USA); Joel M. Hensley, Physical Sciences Inc. (USA); S. James Allen, Jr., Univ. of California, Santa Barbara (USA); Eric A. Shaner, Sandia National Labs. (USA) [8363-28]

5:10 pm: **THz power generation from nitride-based quantum cascade laser (QCLs)**, Hung Chi Chou, A. F. Mehdi Anwar, Univ. of Connecticut (USA) [8363-29]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

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Beam-driven linear and nonlinear THz source technology, Paul Schoessow, Alexei Kanareykin, C. Jing, Euclid TechLabs, LLC (USA); Stanislav Baturin, Saint Petersburg Electrotechnical Univ. (Russian Federation) [8363-31]

Comparative reconstructions of THz spectroscopic imaging for non-destructive testing and biomedical imaging, William Baughman, David S. Wilbert, Soner Balci, Michael Bolus, Mathieu Baker, Patrick Kung, Seongsin M. Kim, The Univ. of Alabama (USA); Henry O. Everitt, U.S. Army Aviation and Missile Command (USA) [8363-32]

Terahertz imaging with missing data analysis for optical metamaterials characterization, Andre U. Sokolnikov, Visual Solutions and Applications (USA) [8363-33]

Development and optimization of THz NDT on aeronautics composite multilayered structures, Marijke Vandewal, Edison Cristofani, Anna Brook, Royal Belgian Military Academy (Belgium) [8363-34]

Courses of Related Interest

SC547 **Terahertz Wave Technology and Applications** (Zhang) Thursday, 8:30 am to 12:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Polarization: Measurement, Analysis, and Remote Sensing X

Conference Chairs: **David B. Chenault**, Polaris Sensor Technologies, Inc. (USA); **Dennis H. Goldstein**, Polaris Sensor Technologies, Inc. (USA)

Program Committee: **Eustace L. Dereniak**, College of Optical Sciences, The Univ. of Arizona (USA); **Aed M. El-Saba**, Univ. of South Alabama (USA); **Michael G. Gartley**, Rochester Institute of Technology (USA); **Kristan P. Gurton**, U.S. Army Research Lab. (USA); **Neelam Gupta**, U.S. Army Research Lab. (USA); **James D. Howe**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Charles Kim**, Northrop Grumman Electronic Systems (USA); **Michael W. Kudenov**, College of Optical Sciences, The Univ. of Arizona (USA); **Joao M. Romano**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Joseph A. Shaw**, Montana State Univ. (USA); **J. Scott Tyo**, College of Optical Sciences, The Univ. of Arizona (USA)

Monday 23 April

SESSION 3

Room: Conv. Ctr. 308 Mon. 1:20 to 3:00 pm

Mathematics of Polarization

Session Chair: **Michael Gartley**, Rochester Institute of Technology (USA)

1:20 pm: **Exact first order scattering correction for vector radiative transfer in coupled atmosphere and ocean systems**, Pengwang Zhai, Yongxiang Hu, Damien B. Josset, Charles R. Trepte, Patricia L. Luckner, Bing Lin, NASA Langley Research Ctr. (USA) [8364-10]

1:40 pm: **Calibration of a visible polarimeter**, Mark C. Gibney, ITT Corp. Geospatial Systems (USA) [8364-11]

2:00 pm: **Real-time sub-pixel registration of imagery for an IR polarimeter**, Jonathan Hanks, David B. Chenault, Polaris Sensor Technologies, Inc. (USA) [8364-12]

2:20 pm: **Polarimetric discrimination of atmospheric particulate matter**, Prashant Raman, Kirk A. Fuller, Don A. Gregory, The Univ. of Alabama in Huntsville (USA) [8364-36]

2:40 pm: **Material surface's multiband polarization characteristic analysis**, Yongqiang Zhao, Northwestern Polytechnical Univ. (China) [8364-14]

Coffee Break 3:00 to 3:30 pm

SESSION 4

Room: Conv. Ctr. 308 Mon. 3:30 to 4:30 pm

Polarimetric Data Interpretation/Presentation

Session Chair: **David B. Chenault**, Polaris Sensor Technologies, Inc. (USA)

3:30 pm: **Relation between degree of polarization and Pauli color-coded image to characterize scattering mechanisms**, Sanjit Maitra, Michael G. Gartley, John P. Kerekes, Rochester Institute of Technology (USA) [8364-15]

3:50 pm: **Image processing: digital vs. polarization-based enhancement/encoding techniques**, Aed M. El-Saba, Univ. of South Alabama (USA) [8364-16]

4:10 pm: **Methods for presentation of polarimetric data: how do we show off polarimetry?**, David B. Chenault, Polaris Sensor Technologies, Inc. (USA) [8364-17]

DISCUSSION Mon. 4:30 to 4:50 pm

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Polarization Nomenclature and Background
Room: Conv. Ctr. 308 Mon. 8:20 to 8:40 am

Session Chair: **David B. Chenault**, Polaris Sensor Technologies, Inc. (USA)

This session will cover definitions and terminology relevant to the polarization field.

SESSION 1

Room: Conv. Ctr. 308 Mon. 8:40 to 10:00 am

Instrument Algorithms and Analysis

Session Chair: **Charles F. LaCasse IV**, College of Optical Sciences, The Univ. of Arizona (USA)

8:40 am: **Task-specific snapshot Mueller matrix channeled spectropolarimeter optimization**, Andrey Alenin, J. Scott Tyo, College of Optical Sciences, The Univ. of Arizona (USA) [8364-01]

9:00 am: **Modulated polarimeter operators in the presence of stochastic signals**, Charles F. LaCasse IV, J. Scott Tyo, College of Optical Sciences, The Univ. of Arizona (USA) [8364-02]

9:20 am: **Mueller matrix by imaging polarimeter**, Charles Kim, Northrop Grumman Electronic Systems (USA); Bea Thai, Northrop Grumman Aerospace System (USA); David Edwards, Air Force Research Lab. (USA) [8364-03]

9:40 am: **Polarimetric wavelet fractal remote sensing principles for space materials**, George C. Giakos, The Univ. of Akron (USA); Richard H. Picard, Peter N. Crabtree, Phan D. Dao, Patrick J. McNicholl, Air Force Research Lab. (USA) [8364-04]

Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 308 Mon. 10:30 to 11:50 am

Instruments

Session Chair: **Joseph A. Shaw**, Montana State Univ. (USA)

10:30 am: **Optimization of a mid-wave tunable polarimetric optical scatter instrument**, Jason C. Vap, Air Force Research Lab. (USA); Stephen Nauyoks, Michael A. Marciniak, Air Force Institute of Technology (USA) [8364-05]

10:50 am: **Development and evaluation of a multispectral LWIR imaging polarimeter**, Dennis Goldstein, David Edwards, James C. Savage, Air Force Research Lab. (USA) [8364-06]

11:10 am: **Development of a polarization hyperspectral image projector**, Teresa K. Ewing, Hugh Masterson, Sharon V. King, Nicholas Gonzales, Dane Elshof, Boulder Nonlinear Systems (USA) [8364-07]

11:30 am: **Implementation of liquid crystal-based polarimeters: trade-off between speed and performance**, Laurent Bigu , Univ. de Haute Alsace (France) [8364-08]

Lunch Break 11:50 am to 1:20 pm

Tuesday 24 April

SESSION 9

Room: Conv. Ctr. 308 Tues. 2:20 to 3:00 pm

Polarimetric Signatures I

Session Chair: Charles Kim,
Northrop Grumman Electronic Systems (USA)

2:20 pm: **Mueller matrix representation of a dicot leaf**, Vern C. Vanderbilt, NASA Ames Research Ctr. (USA); Craig S. T. Daughtry, U.S. Dept. of Agriculture (USA) [8364-27]

2:40 pm: **Material classification using active polarimetry**, Israel J. Vaughn, College of Optical Sciences, The Univ. of Arizona (USA) and Advanced Optical Technologies (USA); J. Scott Tyo, College of Optical Sciences, The Univ. of Arizona (USA); Brian G. Hoover, Advanced Optical Technologies (USA) . [8364-29]

Coffee Break 3:00 to 3:30 pm

SESSION 10

Room: Conv. Ctr. 308 Tues. 3:30 to 4:50 pm

Polarimetric Signatures II

Session Chair: Dennis Goldstein,
Polaris Sensor Technologies, Inc. (USA)

3:30 pm: **Polarimetric imaging for air-accident investigation**, Mark Ashe, Grant J. Privett, Defence Science Technology Lab. (United Kingdom); Matthew Greaves, Cranfield Univ. (United Kingdom); Dennis Holland, Royal Air Force (United Kingdom); Les Davidson, Defence Science Technology Lab. (United Kingdom) [8364-30]

3:50 pm: **Polarimetric imaging and radiometry in shallow waters**, Alberto Tonizzo, Alexander Gilerson, Carlos Carrizo, Jean Paul Israel, Samir A. Ahmed, The City College of New York (USA) [8364-31]

4:10 pm: **Polarimetric image contrast between healthy and cancerous human tissues: experimental evidence and Monte Carlo simulations**, Tatiana Novikova, Angelo Pierangelo, Ecole Polytechnique (France); Abdelali Benali, Pierre Validire, Brice Gayet, Institut Mutualiste Montsouris (France); André Nazac, CHU Bicêtre (France); Antonello De Martino, Ecole Polytechnique (France) [8364-32]

4:30 pm: **Detection of buried IEDs and landmines using a microbolometer and MCT-based LWIR polarimetric sensors**, Kristan P. Gurton, Melvin A. Felton, U.S. Army Research Lab. (USA); David B. Chenault, Joseph L. Pezzaniti, Polaris Sensor Technologies, Inc. (USA) [8364-33]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A Tues. 6:00 to 7:30 pm

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Development of polarizer in capillary optical fiber, Jau-sheng Wang, Yung-Hsin Tseng, National Sun Yat-Sen Univ. (Taiwan) [8364-34]

Enhanced standoff detection through polarimetric signatures, Joseph L. Pezzaniti, Polaris Sensor Technologies, Inc. (USA) [8364-35]

Courses of Related Interest

SC206 **Polarized Light: A Practical Hands-on Introduction** (Fisher)
Wednesday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Polarization Nomenclature and Background
Room: Conv. Ctr. 308 Tues. 8:20 to 8:40 am

Session Chair: David B. Chenault,
Polaris Sensor Technologies, Inc. (USA)

This session will cover definitions and terminology relevant to the polarization field.

SESSION 5

Room: Conv. Ctr. 308 Tues. 8:40 to 9:20 am

Components

Session Chair: Neelam Gupta, U.S. Army Research Lab. (USA)

8:40 am: **Achromatic wave plates for the near- and mid-infrared**, Donald Beasley, Philip D. Marlowe, Gooch & Housego, Cleveland (USA) [8364-18]

9:00 am: **Optical tests of 200mm MWIR polarizer wafers: methodology and results**, Peter S. Erbach, Joseph L. Pezzaniti, John Reinhardt, David B. Chenault, Dennis Goldstein, Polaris Sensor Technologies, Inc. (USA) [8364-19]

SESSION 6

Room: Conv. Ctr. 308 Tues. 9:20 to 10:00 am

DoFP Polarimeter Considerations I

Session Chair: Aed M. El-Saba, Univ. of South Alabama (USA)

9:20 am: **Division of focal plane spectral-polarization imaging sensor**, Meenal Kulkarni, Viktor Gruev, Washington Univ. in St. Louis (USA) [8364-20]

9:40 am: **A correlation-based interpolation method for division of focal plane polarimeters**, Xiaoxiao Xu, Arye Nehorai, Viktor Gruev, Washington Univ. in St. Louis (USA) [8364-21]

Coffee Break 10:00 to 10:30 am

SESSION 7

Room: Conv. Ctr. 308 Tues. 10:30 to 11:30 am

DoFP Polarimeter Considerations II

Session Chair: Kristan P. Gurton, U.S. Army Research Lab. (USA)

10:30 am: **Optical characterization of a microgrid polarimeter**, Kenneth D. Fourspring, Zoran Ninkov, Rochester Institute of Technology (USA) [8364-22]

10:50 am: **Adaptive scene-based correction algorithm for removal of residual fixed-pattern noise in microgrid image data**, Bradley M. Ratliff, Space Computer Corp. (USA); Daniel A. LeMaster, Air Force Research Lab. (USA) [8364-23]

11:10 am: **Plasmonic micropolarizers for full Stokes vector imaging**, R. E. Hollingsworth, ITN Energy Systems, Inc. (USA); J. J. Peltzer, K. A. Bachman, P. D. Flammer, T. E. Furtak, R. T. Collins, Colorado School of Mines (USA) [8364-24]

Lunch/Exhibition Break 11:30 am to 1:40 pm

SESSION 8

Room: Conv. Ctr. 308 Tues. 1:40 to 2:20 pm

Modeling

Session Chair: Michael W. Kudenov, College of Optical Sciences, The Univ. of Arizona (USA)

1:40 pm: **On the suitability of polarimetric reflectance and emission models for synthetic image generation**, Michael G. Gartley, Rochester Institute of Technology (USA) [8364-25]

2:00 pm: **Examining epsilon near zero structures through effective medium theory and optical thin-film analysis**, Jason C. Vap, Air Force Research Lab. (USA); Michael A. Marciniak, Air Force Institute of Technology (USA); Linda F. Johnson, Mark B. Moran, Naval Air Warfare Ctr. Weapons Div. (USA) . . [8364-26]

Compressive Sensing

Conference Chair: **Fauzia Ahmad**, Villanova Univ. (USA)

Program Committee: **Moeness G. Amin**, Villanova Univ. (USA); **Abdesselam Salim Bouzerdoun**, Univ. of Wollongong (Australia); **Rabinder N. Madan**, Office of Naval Research (USA); **Ram M. Narayanan**, The Pennsylvania State Univ. (USA); **Athina P. Petropulu**, Rutgers, The State Univ. of New Jersey (USA)

Thursday 26 April

Opening Remarks

Room: Conv. Ctr. 303 Thurs. 8:10 to 8:20 am

SESSION 1

Room: Conv. Ctr. 303 Thurs. 8:20 to 10:00 am

Compressive Sensing I

Session Chair: **Nathan A. Goodman**, The Univ. of Oklahoma (USA)

8:20 am: **Redirected ell-1 greedy algorithm for sparse representations recovery**, Alexander Petukhov, The Univ. of Georgia (USA); Inna Kozlov, Algosoft Tech USA (USA) [8365-01]

8:40 am: **An entropic cost-function-based sparse recovery**, Ali Cafer Gurbuz, TOBB Ekonomi ve Teknoloji Üniv. (Turkey); Mert Pilanci, Univ. of California, Berkeley (USA); Orhan Arikan, Bilkent Univ. (Turkey) [8365-02]

9:00 am: **An examination of the effects of sub-Nyquist sampling on SNR**, Bruce R. Pollock, Nathan A. Goodman, The Univ. of Arizona (USA) [8365-03]

9:20 am: **Coherence of random Toeplitz-block matrices: bounds and implications**, Waheed U. Bajwa, Rutgers, The State Univ. of New Jersey (USA) [8365-04]

9:40 am: **On linear block codes and deterministic compressive sampling**, Nicholas Tsagkarakis, Dimitris A. Pados, Univ. at Buffalo (USA) [8365-05]

Coffee 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 303 Thurs. 10:30 to 11:30 am

Compressive Sensing II

Session Chair: **Waheed U. Bajwa**, Rutgers, The State Univ. of New Jersey (USA)

10:30 am: **Sparse iterative off the grid reconstruction with physically related basis sets**, Ali Cafer Gurbuz, TOBB Ekonomi ve Teknoloji Üniv. (Turkey); Mert Pilanci, Univ. of California, Berkeley (USA); Orhan Arikan, Bilkent Univ. (Turkey) [8365-06]

10:50 am: **Improving sparse representation algorithms for watercraft detection and classification**, Leslie B. Smith, Jonathan Nichols, Colin C. Olson, K. Peter Judd, U.S. Naval Research Lab. (USA) [8365-08]

11:10 am: **Low-complexity FPGA implementation of compressive sensing reconstruction**, Jerome M. Stanislaus, Tinoosh Mohsenin, Univ. of Maryland, Baltimore County (USA) [8365-09]

Lunch/Exhibition Break 11:30 am to 1:20 pm

SESSION 3

Room: Conv. Ctr. 303 Thurs. 1:20 to 3:00 pm

Compressive Sensing for Spectral Imaging and Medicine

Session Chair: **Ali Cafer Gurbuz**, TOBB Ekonomi ve Teknoloji Üniv. (Turkey)

1:20 pm: **Super-resolution code aperture spectral imaging**, Henry Arguello, Gonzalo R. Arce, Univ. of Delaware (USA); Hoover F. Rueda, Univ. Industrial de Santander (Colombia) [8365-10]

1:40 pm: **Adaptive, feature-specific spectral imaging**, Peter A. Jansen, Matthew J. Dunlop, Dathon R. Golish, Michael E. Gehm, The Univ. of Arizona (USA) [8365-11]

2:00 pm: **Compressive hyperspectral sensor for LWIR gas detection**, Thomas A. Russell, Raytheon Applied Signal Technology, Inc. (USA); Lenore McMackin, Bob Bridge, Inview Technology Corp. (USA) [8365-12]

2:20 pm: **On exploiting interbeat correlation in compressive sensing-based ECG compression**, Luisa F. Polania, Univ. of Delaware (USA); Rafael E. Carrillo, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Manuel Blanco-Velasco, Univ. de Alcalá de Henares (Spain); Kenneth E. Barner, Univ. of Delaware (USA) [8365-13]

2:40 pm: **Compressive sensing exploiting wavelet-domain dependencies for ECG compression**, Luisa F. Polania, Univ. of Delaware (USA); Rafael E. Carrillo, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Manuel Blanco-Velasco, Univ. de Alcalá de Henares (Spain); Kenneth E. Barner, Univ. of Delaware (USA) [8365-14]

Coffee Break 3:00 to 3:30 pm

SESSION 4

Room: Conv. Ctr. 303 Thurs. 3:30 to 5:50 pm

Compressive Sensing for Images and Video

Session Chair: **Dimitris A. Pados**, Univ. at Buffalo (USA)

3:30 pm: **Single-image super-resolution via sparse reconstruction**, Maarten Kruithof, Adam W. M. van Eekeren, Judith Dijk, Klammer Schutte, TNO Defence, Security and Safety (Netherlands) [8365-15]

3:50 pm: **Classifying chart images with sparse coding**, Jinglun Gao, Yin Zhou, Kenneth E. Barner, Univ. of Delaware (USA) [8365-16]

4:10 pm: **An enhanced sparse representation strategy for signal classification**, Yin Zhou, Jinglun Gao, Kenneth E. Barner, Univ. of Delaware (USA) [8365-17]

4:30 pm: **Progressive compressive imager**, Sergei Evladov, Adrian Stern, Ben-Gurion Univ. of the Negev (Israel) [8365-18]

4:50 pm: **Adaptive compressive sensing for video acquisition using a single pixel camera**, Imama Noor, Eddie Jacobs, The Univ. of Memphis (USA) [8365-19]

5:10 pm: **Compressive imaging: exploiting multiple frames for enhanced video reconstruction**, Jonathan D. Tucker, Robert R. Muiise, Lockheed Martin Corp. (USA) [8365-20]

5:30 pm: **Decoding of purely compressed-sensed video**, Ying Liu, Ming Li, Dimitris A. Pados, Univ. at Buffalo (USA) [8365-21]

POSTERS—THURSDAY

Room: Conv. Ctr. Hall A Thurs. 6:00 to 7:30 pm

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Remote sensing images recognition based on constrained independent component analysis via compressed sensing, Jinhui Lan, Yiliang Zeng, Univ. of Science and Technology Beijing (China) [8365-34]

Compressive sensing-based image denoising using adaptive multiple samplings and reconstruction error control, Wonseok Kang, Eunsung Lee, Sangjin Kim, Chung-Ang Univ. (Korea, Republic of); Doochun Seo, Korea Aerospace Research Institute (Korea, Republic of); Joonki Paik, Chung-Ang Univ. (Korea, Republic of) [8365-35]

Friday 27 April

Remarks

Room: Fri. 8:30 to 8:40 am

SESSION 5

Room: Conv. Ctr. 303 Fri. 8:40 to 10:00 am

Compressive Sensing for Communications

Session Chair: Rabinder N. Madan, Office of Naval Research (USA)

8:40 am: **CHOCS: a framework for estimating compressive, higher-order cyclostationary statistics**, Chia Wei Lim, Michael B. Wakin, Colorado School of Mines (USA) [8365-22]

9:00 am: **Tracking the sparseness of the underlying support in shallow water acoustic communications**, Ananya Sen Gupta, James Preisig, Woods Hole Oceanographic Institution (USA) [8365-23]

9:20 am: **Random versus structured projections: compressed channel sensing for underwater communications with waveguide constraints**, Zhi Tian, Michigan Technological Univ. (USA) [8365-24]

9:40 am: **Compressive sensing of frequency-hopping spread spectrum signals**, Feng Liu, Yookyung Kim, Nathan A. Goodman, Amit Ashok, Ali Bilgin, The Univ. of Arizona (USA) [8365-25]

Coffee Break 10:00 to 10:30 am

SESSION 6

Room: Conv. Ctr. 303 Fri. 10:30 to 11:50 am

Compressive Sensing for Radar I

Session Chair: Eric L. Mokole, U.S. Naval Research Lab. (USA)

10:30 am: **Dictionary reduction technique for 3D stepped-frequency GPR imaging using compressive sensing and the FFT**, Kyle R. Krueger, James H. McClellan, Waymond R. Scott, Jr., Georgia Institute of Technology (USA) [8365-26]

10:50 am: **Through-the-wall moving target detection and localization using sparse regularization**, Moeness G. Amin, Fauzia Ahmad, Villanova Univ. (USA) [8365-27]

11:10 am: **Group-sparse target recovery in widely distributed MIMO radar systems**, Yao Yu, Athina P. Petropulu, Rutgers, The State Univ. of New Jersey (USA) [8365-28]

11:30 am: **Target detection based on information theory for compressive sensing radar systems**, Yangsoo Kwon, Ram M. Narayanan, The Pennsylvania State Univ. (USA); Muralidhar Rangaswamy, Air Force Research Lab. (USA) [8365-29]

Lunch Break 11:50 am to 12:50 pm

SESSION 7

Room: Conv. Ctr. 303 Fri. 12:50 to 1:50 pm

Compressive Sensing for Radar II

Session Chair: Ram M. Narayanan, The Pennsylvania State Univ. (USA)

12:50 pm: **Band-limited random waveforms in compressive radar imaging**, Mahesh C. Shastry, Ram M. Narayanan, The Pennsylvania State Univ. (USA); Muralidhar Rangaswamy, Air Force Research Lab. (USA) [8365-31]

1:10 pm: **A high resolution SWIR camera via compressed sensing (Presentation Only)**, Matthew Herman, InView Technology Corp. (USA) . [8365-37]

1:30 pm: **Partially sparse reconstruction of behind-the-wall scenes**, Fauzia Ahmad, Moeness G. Amin, Villanova Univ. (USA) [8365-33]

Courses of Related Interest

SC1070 **Radar Waveforms and Signal Processing** (Welstead) Thursday, 8:30 am to 12:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Advanced Environmental, Chemical, and Biological Sensing Technologies IX

Conference Chairs: **Tuan Vo-Dinh**, Duke Univ. (USA); **Robert A. Lieberman**, Intelligent Optical Systems, Inc. (USA); **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. (USA); **Vassili Karanassios**, Univ. of Waterloo (Canada); **Dennis K. Killinger**, Univ. of South Florida (USA); **Heinz-Detlef Kronfeldt**, Technische Univ. Berlin (Germany); **Robert Lascola**, Savannah River National Lab. (USA); **Edgar A. Mendoza**, Redondo Optics, Inc. (USA); **Anna Grazia Mignani**, Istituto di Fisica Applicata Nello Carrara (Italy); **Klaus Schäfer**, Karlsruhe Institut für Technologie (Germany)

Thursday 26 April

SESSION 1

Room: Conv. Ctr. 326 Thurs. 8:40 to 10:00 am

Biological Sensing Systems

Session Chair: **Robert A. Lieberman**, Intelligent Optical Systems, Inc. (USA)

8:40 am: **Next generation Klarite substrates for targeting biological sensing**, Mikella E. Hankus, Dimitra N. Stratis-Cullum, U.S. Army Research Lab. (USA) [8366-01]

9:00 am: **Multispectral diode-laser-based shifted excitation Raman difference spectroscopy for biological sample identification**, Kay Sowoidnich, Heinz-Detlef Kronfeldt, Technische Univ. Berlin (Germany) [8366-02]

9:20 am: **Infrared surface plasmons polaritons on polyaniline/graphite composite**, Monas Shahzad, Gautam Medhi, Robert E. Peale, Univ. of Central Florida (USA); Walter R. Buchwald, Solid State Scientific Corp. (USA); Yi Liao, Candace Alber, Valentine Johns, Univ. of Central Florida (USA) [8366-03]

9:40 am: **SERS-TLC chip**, Jing Chen, Justin Abell, Yaowen Huang, Yiping Zhao, The Univ. of Georgia (USA) [8366-04]

Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 326 Thurs. 10:30 to 11:50 am

Gas Sensors

Session Chair: **Robert A. Lieberman**, Intelligent Optical Systems, Inc. (USA)

10:30 am: **Miniature wearable direct reading naphthalene and VOC personal exposure monitor**, William F. Hug, Ray D. Reid, Rohit Bhartia, Michael Reid, Arthur L. Lane, Prashant Oswal, Kripa Sijapati, Quoc Nguyen, Kim Sullivan, Photon Systems, Inc. (USA) [8366-05]

10:50 am: **Multiplexed gas spectroscopy using tunable VCSELs**, Mihail Bora, Tiziana Bond, James McCarrick, Allan Chang, Lawrence Livermore National Lab. (USA) [8366-06]

11:10 am: **Laser photoacoustic sensor for air toxic measurements**, Coorg R. Prasad, Jie Lei, Science & Engineering Services, Inc. (USA); Wenhui Shi, Guangkun Li, MassTech Inc. (USA) [8366-07]

11:30 am: **Vapor plumes and chemical releases measurements with ABB hyperspectral infrared imager**, Louis M. Moreau, Florent Prel, ABB Analytical Measurement (Canada); Hugo Lavoie, Jean-Marc Thériault, Defence Research and Development Canada, Valcartier (Canada) [8366-08]

Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 3

Room: Conv. Ctr. 326 Thurs. 1:20 to 3:00 pm

Sensors for Liquids

Session Chair: **Heinz-Detlef Kronfeldt**, Technische Univ. Berlin (Germany)

1:20 pm: **Surface-enhanced in-situ Raman-sensor applied in the arctic area for analyses of water and sediment**, Anna Kolomijeca, Yong-Hyok Kwon, Heinz-Detlef Kronfeldt, Technische Univ. Berlin (Germany) [8366-09]

1:40 pm: **Corrosion monitoring of reinforced concrete structures by using the 14 MeV tagged neutron beams**, Darovin Sudac, Karlo Nad, Institut Ruder Boškovic (Croatia); Robert Kollar, Napredna Energija d.o.o. (Croatia); Jasmina Obhodas, Institut Ruder Boškovic (Croatia); Vladivoj Valkovic, A.C.T. d.o.o. (Croatia) [8366-10]

2:00 pm: **Investigation of optimal size of gold nanoparticles for SERS detection of PAHs in water with 671 nm excitation**, Xiaofeng Shi, Jun Ma, Ronger Zheng, Chunyan Wang, Ocean Univ. of China (China); Heinz-Detlef Kronfeldt, Technische Univ. Berlin (Germany) [8366-11]

2:20 pm: **Solar-powered, battery-operated, atmospheric-pressure, sugar-cube size microplasma on hybrid 3D chips for elemental analysis of liquid microsamples using a portable optical emission spectrometer**, Xu Zhang, Vassili Karanassios, Univ. of Waterloo (Canada) [8366-12]

2:40 pm: **Naturally grown silver nanoparticle ensembles for 488 nm in-situ SERS/SERDS-detection of PAHs in water**, Yong-Hyok Kwon, Technische Univ. Berlin (Germany); Robert Ossig, Univ. Kassel (Germany); Anna Kolomijeca, Technische Univ. Berlin (Germany); Frank Hubenthal, Univ. Kassel (Germany); Heinz-Detlef Kronfeldt, Technische Univ. Berlin (Germany) [8366-13]

Coffee Break 3:00 to 3:30 pm

SESSION 4

Room: Conv. Ctr. 326 Thurs. 3:30 to 4:50 pm

Industrial and Environmental Sensors

Session Chair: **Glenn O. Allgood**, Oak Ridge National Lab. (USA)

3:30 pm: **An energy signature scheme for steam-trap assessment and flow-rate estimation using pipe-induced vibration measurements**, Glenn O. Allgood, Mohammed M. Olama, Teja Phani Kuruganti, Joe E. Lake, Oak Ridge National Lab. (USA) [8366-14]

3:50 pm: **Application of NIR hyperspectral imaging for post-consumer polyolefins recycling**, Silvia Serranti, Giuseppe Bonifazi, Univ. degli Studi di Roma La Sapienza (Italy) [8366-15]

4:10 pm: **Rapid in-situ identification technique of oil spill developed by Gabor wavelet and support vector machines analysis based on concentration-synchronous-matrix-fluorescence spectra**, Chunyan Wang, Wendong Li, Xiaofeng Shi, Ocean Univ. of China (China); Weiwei Ren, Jinliang Zhang, Beijing Normal Univ. (China) [8366-16]

4:30 pm: **Selective detection of heavy metal ion by calixarene-based fluorescent molecular sensor**, Isabelle Leray, Ecole Normale Supérieure de Cachan (France) [8366-17]

Friday 27 April

SESSION 5

Room: Conv. Ctr. 326 Fri. 8:40 to 10:00 am

Stand-off and Remote Atmospheric Sensors

Session Chair: Heinz-Detlef Kronfeldt, Technische Univ. Berlin (Germany)

8:40 am: **Fundamental studies of surface-enhanced Raman scattering (SERS) using aerosolized substrates**, Douglas A. Stuart, Obie Okponyia, Kellie Patton, Brent M. Williams, Univ. of West Georgia (USA) [8366-18]

9:00 am: **CELiS (compact eyesafe lidar system): a portable 1.5 µm elastic lidar system for rapid aerosol concentration measurement**, Michael D. Wojcik, Energy Dynamics Lab. (USA); Alan Bird, Utah State Univ. (USA) [8366-19]

9:20 am: **Standoff stimulated emission in air**, Arthur Dogariu, James Michael, Richard B. Miles, Princeton Univ. (USA) [8366-20]

9:40 am: **Use of passive and active ground and satellite remote sensing to monitor fine particulate pollutants on regional scales**, Lina Cordero, Yonghua Wu, Barry M. Gross, Fred Moshary, Samir A. Ahmed, The City College of New York (USA) [8366-21]

Coffee Break 10:00 to 10:30 am

SESSION 6

Room: Conv. Ctr. 326 Fri. 10:30 to 11:50 am

Advanced Sensor Technologies I

Session Chair: Tuan Vo-Dinh, Duke Univ. (USA)

10:30 am: **Compact laser photoacoustic spectroscopy sensor for atmospheric components measurements**, Wenhui Shi, Science & Engineering Services, Inc. (USA); Guangkun Li, MassTech Inc. (USA); Coorg R. Prasad, Science & Engineering Services, Inc (USA) [8366-22]

10:50 am: **Chip-to-chip SnO₂ nanowire network sensors for room temperature H₂ detection**, Anton Köck, Austrian Institute of Technology (Austria) [8366-23]

11:10 am: **Recent progress toward miniaturization of vacuum pumps for use in portable mass spectrometers**, Kaitlin Badali, Vassili Karanassios, Univ. of Waterloo (Canada) [8366-24]

11:30 am: **Plasmonic nanoprobe systems for SERS chemical and biological sensing**, Hsin-Neng Wang, Tuan Vo-Dinh, Duke Univ. (USA) . [8366-25]

Lunch Break 11:50 am to 1:20 pm

SESSION 7

Room: Conv. Ctr. 326 Fri. 1:20 to 3:00 pm

Advanced Sensor Technologies II

Session Chair: Tuan Vo-Dinh, Duke Univ. (USA)

1:20 pm: **On-chip imaging of dense samples using pixel super-resolution-based multi-height lensfree microscopy**, Alon Greenbaum, Uzair Y. Sikora, Aydogan Ozcan, Univ. of California, Los Angeles (USA) [8366-26]

1:40 pm: **Detection of volatile organic compounds by surface enhanced Raman scattering**, Allan Chang, Amitesh Maiti, Nazar Ileri, Mihail Bora, Elaine Behymer, Hoang T. Nguyen, Cindy Larson, Jerald A. Britten, Tiziana C. Bond, Lawrence Livermore National Lab. (USA) [8366-27]

2:00 pm: **Shot-noise-limited imaging via N-photon photo-detection**, Weiji He, Nanjing Univ. of Science & Technology (China); Yaojin Chen, Science and Technology on LLL Night Vision Lab. (China); Qian Chen, Guohua Gu, Nanjing Univ. of Science & Technology (China); Wei Cheng, Science and Technology on LLL Night Vision Lab. (China) [8366-28]

2:20 pm: **Quantitative measurement of AMS and orange mixtures by terahertz time-domain spectroscopy**, Qiang Wang, Yehao Ma, China Jiliang Univ. (China) [8366-29]

2:40 pm: **Early detection of combustible gas leaks using open-path infrared (IR) gas detectors**, Edward Naranjo, Shankar Baliga, General Monitors Inc. (USA) [8366-30]

Courses of Related Interest

SC194 **Multispectral and Hyperspectral Image Sensors** (Lomheim) Tuesday, 1:30 to 5:30 pm

SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm

SC719 **Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies** (Gardner, Popa) Monday, 8:30 am to 5:30 pm

SC995 **Target Detection Algorithms for Hyperspectral Imagery** (Nasrabadi) Thursday, 8:30 am to 5:30 pm

SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Defense, Security, and Sensing Facility Maps:

Baltimore Convention Center pp. 3–4

Hilton Baltimore p. 5

Smart Biomedical and Physiological Sensor Technology IX

Conference Chairs: **Brian M. Cullum**, Univ. of Maryland, Baltimore County (USA); **Eric S. McLamore**, Univ. of Florida (USA)

Program Committee: **Troy A. Alexander**, U.S. Army Research Lab. (USA); **Karl S. Booksh**, Univ. of Delaware (USA); **Marie-Christine F. Daniel**, Univ. of Maryland, Baltimore County (USA); **Majed El Dweik**, Lincoln Univ. (USA); **Claudia Gärtner**, microfluidic ChipShop GmbH (Germany); **Christopher Geddes**, Univ. of Maryland, Baltimore (USA); **Ilko K. Ilev**, U.S. Food and Drug Administration (USA); **Lori Kamemoto**, Univ. of Hawai'i Medical School (USA); **Chang-Soo Kim**, Missouri Univ. of Science and Technology (USA); **Nicole Y. Morgan**, NIBIB/National Institutes of Health (USA); **Joshua Pfefer**, U.S. Food and Drug Administration (USA); **Marcin Ptaszek**, Univ. of Maryland, Baltimore County (USA); **Shiv K. Sharma**, Univ. of Hawai'i (USA); **Liang Zhu**, Univ. of Maryland, Baltimore County (USA)

Thursday 26 April

SESSION 1

Room: Conv. Ctr. 324 Thurs. 10:30 to 11:50 am

Physiological Sensor Technologies

Session Chairs: **Majed El-Dweik**, Lincoln Univ. (USA);
Eric S. McLamore, Univ. of Florida (USA)

10:30 am: **Approaches for wireless physiological monitoring of dismantled soldiers**, Stephen J. Kilpatrick, Kelvin S. Oie, Alma E. Wickenden, U.S. Army Research Lab. (USA) [8367-01]

10:50 am: **Characterization of the pigment Xanthomonadin in the bacterial genus Xanthomonas using micro- and resonance-Raman spectroscopy**, Mathews L. Paret, Univ. of Florida (USA); Anupam K. Misra, Tayro E. Acosta, Anne M. Alvarez, Shiv K. Sharma, Univ. of Hawai'i (USA) [8367-02]

11:10 am: **Implantable nanobiosensor for real-time and continuous glucose monitoring**, Majed El Dweik, Lincoln Univ. (USA) [8367-03]

11:30 am: **In vitro quantitation of human femoral artery atherosclerosis using near-infrared Raman spectroscopy**, Ava C. Dykes, Shiv K. Sharma, John S. Allen III, Pavlos Anastasiadis, Univ. of Hawai'i (USA) [8367-04]

Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 2

Room: Conv. Ctr. 324 Thurs. 1:20 to 3:00 pm

Guidance and Imaging Technologies

Session Chairs: **Joshua Pfefer**, U.S. Food and Drug Administration (USA); **Brian M. Cullum**, Univ. of Maryland, Baltimore County (USA)

1:20 pm: **Nondestructive imaging of stem cell in 3D scaffold**, Chaowei Chen, Andrew Yeatts, John Fisher, Yu Chen, Univ. of Maryland, College Park (USA) [8367-05]

1:40 pm: **Determination of potential multiphoton photoacoustic spectral signatures and characterization of a novel NMPPAS probe**, Sudhir Dahal, Brian M. Cullum, Univ. of Maryland, Baltimore County (USA) [8367-06]

2:00 pm: **Needle-based optical coherence tomography microendoscopy for deep brain imaging**, Chia-Pin Liang, Jeremiah Wierwille, Univ. of Maryland, College Park (USA); Thais Moreira, Gary Schwartzbrauer, M. Samir Jafri, Cha-Min Tang M.D., Univ. of Maryland School of Medicine (USA); Yu Chen, Univ. of Maryland, College Park (USA) [8367-07]

2:20 pm: **Quantitative evaluation of mucosal vascular contrast in narrow band imaging using Monte Carlo modeling**, Du Le, The Catholic Univ. of America (USA) and U.S. Food and Drug Administration (USA); Quanzeng Wang, U.S. Food and Drug Administration (USA); Jessica C. Ramella-Roman, The Catholic Univ. of America (USA); Joshua Pfefer, U.S. Food and Drug Administration (USA) [8367-08]

2:40 pm: **Computer-aided diagnosis of masses and non-masses in breast MRI**, Anke D. Meyer Baese, The Florida State Univ. (USA) [8367-09]

Coffee Break 3:00 to 3:30 pm

SESSION 3

Room: Conv. Ctr. 324 Thurs. 3:30 to 5:30 pm

Microfluidic Assays and Systems

Session Chairs: **Claudia Gärtner**, microfluidic ChipShop GmbH (Germany); **Nicole Y. Morgan**, National Institutes of Health (USA)

3:30 pm: **Fabrication of microfluidic vascular phantoms by laser micromachining**, Scott A. Mathews, Jessica C. Ramella-Roman, Long Luu, The Catholic Univ. of America (USA) [8367-10]

3:50 pm: **Development of microLIPS: a novel microfluidic assay for rapid serum antibody detection**, Matt Chandrangsou, Peter D. Burbelo, Adnan Zubair, Reid Wilson, Michael J. Iadarola, Paul D. Smith, Nicole Y. Morgan, National Institutes of Health (USA) [8367-11]

4:10 pm: **Lab-on-a-chip platforms from sample preparation via continuous-flow PCR to an ultrafast detection of B-agents**, Claudia Gärtner, Holger Becker, microfluidic ChipShop GmbH (Germany); Nadine Hlawatsch, Richard Klemm, microfluidic ChipShop GmbH (USA); Thomas Clemens, CLEMENS GmbH (Germany) [8367-12]

4:30 pm: **Automated and miniaturized detection of biological threats with a centrifugal microfluidic system**, Daniel Mark, Thomas van Oordt, HSG-IMIT (Germany); Guenter Roth, Roland Zengerle, Felix von Stetten, Albert-Ludwigs-Univ. Freiburg (Germany) [8367-13]

4:50 pm: **Rapid identification of Yersinia pestis and Brucella melitensis by chip based continuous flow PCR**, Michael Dietzsch, Friedrich-Loeffler-Institut (Germany); Nadine Hlawatsch, microfluidic ChipShop GmbH (Germany); Falk Melzer, Herbert Tomaso, Friedrich-Loeffler-Institut (Germany); Claudia Gärtner, microfluidic ChipShop GmbH (Germany); Heinrich Neubauer, Friedrich-Loeffler-Institut (Germany) [8367-14]

5:10 pm: **Automated DNA-preparation system for bacteria out of air sampler liquids**, Rainer Gransee, Klaus S. Drese, Marion Ritz-Lehnert, Institut für Mikrotechnik Mainz GmbH (Germany); Claudia Disque, Molzym GmbH Co. KG (Germany); Gudrun Zoll, Wehrwissenschaftliches Institut für Schutztechnologien (Germany) [8367-15]

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Development and testing of a fluorescence biosensor for continuous glucose sensing, Mamdouh S. Aloraefy, The Catholic Univ. of America (USA) and U.S. Food and Drug Administration (USA); Joshua Pfefer, U.S. Food and Drug Administration (USA); Jessica C. Ramella-Roman, The Catholic Univ. of America (USA); Kim E. Sapsford, U.S. Food and Drug Administration (USA) [8367-16]

Courses of Related Interest

SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm

SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Photonic Applications for Aerospace, Transportation, and Harsh Environment III

Conference Chairs: **Alex A. Kazemi**, The Boeing Co. (USA); **Nicolas Javahiry**, InESS, Ecole Nationale Supérieure de Physique de Strasbourg (France); **Allen S. Panahi**, ARK International (USA); **Simon Thibault**, Univ. Laval (Canada)

Conference Co-Chairs: Program Committee: **Frank Abdi**, AlphaSTAR Corp. (USA); **Mathieu Aubailly**, Univ. of Maryland, College Park (USA); **Eric Y. Chan**, The Boeing Co. (USA); **Bernard Dam**, Technische Univ. Delft (Netherlands); **Peit De Pauw**, Melexis N.V. (Belgium); **James E. Fesmire**, NASA Kennedy Space Ctr. (USA); **Leo R. Gauthier, Jr.**, The Johns Hopkins Univ. Applied Physics Lab. (USA); **Harold E. Hager**, The Boeing Co. (USA); **Zuyuan He**, The Univ. of Tokyo (Japan); **Robert T. Johnson**, The Boeing Co. (USA); **Timo Kahlmann**, ETH Zurich (Switzerland); **Lothar U. Kempen**, Hochschule Ruhr West (Germany); **Peter Kiesel**, Palo Alto Research Center, Inc. (USA); **Dennis G. Koshinz**, The Boeing Co. (USA); **Bernard C. Kress**, USI Photonics Inc. (USA); **Jocelyn Lauzon**, Esterline CMC Electronics (Canada); **Hai Lin**, Intelligent Optical Systems, Inc. (USA); **Jony Jiang Liu**, U.S. Army Research Lab. (USA); **Mark A. Messer**, Carlisle Interconnect Technologies (USA); **Patrick P. Meyrueis**, Ecole Nationale Supérieure de Physique de Strasbourg (France); **Jean-Pierre Moeglin**, Institut Franco-Allemand de Recherches de Saint-Louis (France); **Nezih Mrad**, Defence Research and Development Canada, Ottawa (Canada); **Juock S. Namkung**, Naval Air Warfare Ctr. Aircraft Div. (USA); **Robert A. Nye**, The Boeing Co. (USA); **Mike O'Farrell**, Deutsch UK (United Kingdom); **Douglas Parker**, Deutsch UK (USA); **Saeed Rehman**, Fibertronix AB (Sweden); **Nabeel A. Riza**, Univ. College Cork (Ireland); **Indu F. Saxena**, Intelligent Optical Systems, Inc. (USA); **William St. Cyr**, NASA Stennis Space Ctr. (USA); **Martin Slaman**, Delft Univ. of Technology (Netherlands); **Dmitry S. Starodubov**, Physical Optics Corp. (USA); **Henry J. White**, BAE Systems (United Kingdom)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 322 Mon. 8:30 to 10:20 am

Sensors for Transportation/Aerospace Applications

Session Chair: **Alex A. Kazemi**, The Boeing Co. (USA)

- 8:30 am: **Optical design considerations for both automotive and aerospace environment** (*Invited Paper*), Simon Thibault, Univ. Laval (Canada) [8368-01]
- 9:00 am: **Broad area optical debris impact sensor**, Leo R. Gauthier, Jr., Melissa E. Jansen, John R. Meyer, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8368-02]
- 9:20 am: **A fiber optic sensor for hydrogen detection: surface plasmon resonance sensor based on wavelength modulation**, Nicolas Javahiry, Cedric Perrotton, Patrick P. Meyrueis, Ecole Nationale Supérieure de Physique de Strasbourg (France); Martin Slaman, Bernard Dam, Technische Univ. Delft (Netherlands) [8368-03]
- 9:40 am: **Optical hydrogen sensors based on metal-hydrides**, Martin Slaman, Technische Univ. Delft (Netherlands) [8368-04]
- 10:00 am: **Fiber optic oxygen sensor using fluorescence quenching for aerospace application**, Allen S. Panahi, H2Scan (USA) [8368-05]
- Coffee Break 10:20 to 10:50 am

SESSION 2

Room: Conv. Ctr. 322 Mon. 10:50 am to 12:20 pm

Polymer Optical Fiber Sensors, Bragg Gratings

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

- 10:50 am: **Plastic optical fiber hydrogen detection sensor systems for harsh environment in aerospace application** (*Invited Paper*), Alex A. Kazemi, The Boeing Co. (USA); Edgar A. Mendoza, Redondo Optics, Inc. (USA); Kish Goswami, InnoSense LLC (USA); Lothar U. Kempen, Institut Mess- und Sensortechnik (Germany) [8368-06]
- 11:20 am: **Compact fiber Bragg grating sensor system and its potential for aircraft health monitoring**, Nezih Mrad, Defence Research and Development Canada, Ottawa (Canada) [8368-07]
- 11:40 am: **Installation and through-life operation issues for fiber optic components and systems in aircraft applications**, Henry White, Geoff Proudley, BAE Systems, Alex Kazemi, The Boeing Co. [8368-26]
- 12:00 pm: **Response comparison of two FBG-based hydrophones**, Indu F. Saxena, Intelligent Optical Systems, Inc. (USA) [8368-09]
- Lunch Break 12:20 to 1:50 pm

SESSION 3

Room: Conv. Ctr. 322 Mon. 1:50 to 3:50 pm

Photonics in Harsh Environment, Signal Processing

Session Chair: **Allen S. Panahi**, ARK International (USA)

- 1:50 pm: **Optical embedded dust sensor for engine protection and early warning on M1 Abrams/ground combat vehicles**, Hai Lin, Intelligent Optical Systems, Inc. (USA); Gregor A. Waldherr, Hal Technology, LLC (USA) . . [8368-10]
- 2:10 pm: **Miniature multi-analyte fiber-optic sensor probe** (*Invited Paper*), Lothar U. Kempen, Intelligent Optical Systems, Inc. (USA) [8368-11]
- 2:40 pm: **Comparative spectral analysis of commercial fuel-ethanol blends using a low-cost prototype FT-Raman spectrometer**, Valentin Ortega Clavero, Andreas Weber, Werner W. Schröder, Hochschule Offenburg (Germany); Patrick P. Meyrueis, Nicolas Javahiry, Univ. de Strasbourg (France) [8368-12]
- 3:00 pm: **Aircraft fiber optic structural health monitoring**, Nezih Mrad, Defence Research and Development Canada, Ottawa (Canada) [8368-13]
- 3:20 pm: **Next generation specialty optical fibres for harsh environment applications: challenges, advancements and opportunities** (*Invited Paper*), Saeed Rehman, Fibertronix AB (Sweden) [8368-14]
- Coffee Break 3:40 to 4:10 pm

SESSION 4

Room: Conv. Ctr. 322 Mon. 4:10 to 5:10 pm

Wireless Optical Link, Optical Satellite Communication

Session Chairs: **Juock S. Namkung**, Naval Air Warfare Ctr. Aircraft Div. (USA); **Indu F. Saxena**, Intelligent Optical Systems, Inc. (USA)

- 4:10 pm: **Cross-link space-based laser systems for satellite communications**, Alex A. Kazemi, The Boeing Co. (USA); Allen S. Panahi, ARK International (USA) [8368-15]
- 4:30 pm: **Development of an in-situ wireless strain monitoring system and its integration with FEA SHM simulation models**, Frank Abdi, AlphaSTAR Corp. (USA) [8368-16]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 5

Room: Conv. Ctr. 322 Tues. 8:00 to 10:20 am

Vision-Based, Imaging and High Temperature Sensors

Session Chairs: **Henry White**, BAE Systems (USA);
Jocelyn Lauzon, Esterline CMC Electronics (Canada)

8:00 am: **Content-dependent, on-the-fly visual information fusion for battlefield scenarios**, Mathieu Aubailly, Mikhail A. Vorontsov, Univ. of Maryland, College Park (USA); Gary W. Carhart, Jony Jiang Liu, U.S. Army Research Lab. (USA); Richard L. Espinola, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8368-17]

8:20 am: **Structured IR illumination for relative depth sensing in virtual interface in transportation** (*Invited Paper*), Bernard C. Kress, Vic Hejmadi, USI Photonics Inc. (USA) [8368-18]

8:50 am: **Polarization based vision sensor for automotive**, Pierre Desaulniers, Simon Thibault, Univ. Laval (Canada) [8368-19]

9:10 am: **High temperature cycling resistant, epoxy-bonded FBG strain sensors on metal substrates**, Indu F. Saxena, Intelligent Optical Systems, Inc. (USA) [8368-20]

9:30 am: **Highly-hermetic feedthrough fiber pigtailed circular TO-can electro-optic sensor for avionics applications** (*Invited Paper*), Jocelyn Lauzon, Lorrain Leduc, Daniel Bessette, Nicolas Bélanger, Esterline CMC Electronics (Canada) [8368-21]

10:00 am: **Developing aircraft photonic networks for airplane systems**, Henry J. White, BAE Systems (United Kingdom); Alexandre Bacou, D-Lightsys S.A.S. (France); Henrique M. Salgado, INESC Porto (Portugal); Anders T. Clausen, Technical Univ. of Denmark (Denmark); Peter P. Deimel, EADS Deutschland GmbH (Germany); Mark Farries, Gooch & Housego (Torquay) Ltd. (United Kingdom); Bruce Napier, Vivid Components Ltd. (Germany); Nicholas Brownjohn, AIRBUS Operations GmbH (Germany); João Baptista, GMV (Portugal); Stephane Gauchy, Draka (France); Iija Kopacek, SQS Vláknová optika a.s. (Czech Republic); Andrew Lee, AV Optics Ltd. (United Kingdom); Massimo Traversone, SELEX Galileo S.p.A. (Italy); James Vincent, Agusta Westland (United Kingdom); Armin Zimmer, Technische Univ. Ilmenau (USA) [8368-27]

Coffee Break 10:20 to 10:50 pm

SESSION 6

Room: Conv. Ctr. 322 Tues. 10:50 am to 12:10 pm

Photonics Materials

Session Chairs: **Nicolas Javahiraly**, Ecole Nationale Supérieure de Physique de Strasbourg (France); **Nezih Mrad**, Defence Research and Development Canada, Ottawa (Canada)

10:50 am: **Optimal selection of fiber optic interconnection components and methods based on application, environment and use**, Mike O'Farrell, Douglas Parker, Deutsch UK (United Kingdom) [8368-22]

11:10 am: **Determination of solid materials rigidity modulus by a new nondestructive optical method: application to electrical steering system**, Nicolas Javahiraly, Cedric Perrotton, Ecole Nationale Supérieure de Physique de Strasbourg (France) [8368-23]

11:30 am: **Proven high-reliability assembly methods applied to avionics fiber-optics high-speed transceivers**, Jocelyn Lauzon, Lorrain Leduc, Daniel Bessette, Nicolas Bélanger, Robert Larose, Bruno Dion, Esterline CMC Electronics (Canada) [8368-24]

11:50 am: **Optical fiber sensing of corroded materials with evanescent wave absorption measurements**, Juock S. Namkung, Naval Air Systems Command (USA) [8368-25]

Courses of Related Interest

SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk)
Wednesday, 1:30 to 5:30 pm

SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area,
Pratt St. Lobby, Open during Registration Hours

Sensing for Agriculture and Food Quality and Safety IV

Conference Chairs: Moon S. Kim, USDA Agricultural Research Service (USA); Shu-I Tu, USDA Agricultural Research Service (USA); Kuanglin Chao, USDA Agricultural Research Service (USA)

Program Committee: Arun K. Bhunia, Ctr. for Food Safety Engineering (USA); Suming Chen, National Taiwan Univ. (Taiwan); Bryan Allen Chin, Auburn Univ. (USA); Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of); Stephen R. Delwiche, USDA Agricultural Research Service (USA); Ki-Bok Kim, Korea Research Institute of Standards and Science (Korea, Republic of); Naoshi Kondo, Kyoto Univ. Graduate School of Agriculture (Japan); Kurt C. Lawrence, USDA Agricultural Research Service (USA); Kangjin Lee, National Academy of Agriculture Science (Korea, Republic of); Alan M. Lefcourt, USDA Agricultural Research Service (USA); Renfu Lu, USDA Agricultural Research Service (USA); Bosoon Park, USDA Agricultural Research Service (USA); Yankun Peng, China Agricultural Univ. (China); Yang Tao, Univ. of Maryland, College Park (USA); Gang Yao, Univ. of Missouri-Columbia (USA); Haibo Yao, Mississippi State Univ. (USA); Yibin Ying, Zhejiang Univ. (China); Seung Chul Yoon, USDA Agricultural Research Service (USA)

Tuesday 24 April

SESSION 1

Room: Conv. Ctr. 323 Tues. 1:00 to 3:00 pm

Optical Sensing for Agriculture I

Session Chair: Seung Chul Yoon, USDA Agricultural Research Service (USA)

1:00 pm: **Development of a SMART trap with integrated MEMS acoustic sensor for Asian ambrosia beetles**, J. Jeong, S. Kim, H. Park, H. C. Wickle III, A. M. Gorzlanecyk, D. W. Held, D. Kim, Auburn Univ. (USA) [8369-01]

1:20 pm: **Preliminary results of radiometric measurements of clear air and clouds brightness (antenna) temperatures at 37GHz**, Artashes K. Arakelyan, ECOSERV Remote Observation Ctr. Co. Ltd. (Armenia) [8369-02]

1:40 pm: **A multiplexing fiber optic microsensors system for monitoring oxygen concentration in plants during simulated climate change**, Prachee Chaturvedi, Bernard A. Hauser, Eric S. McLamore, Kenneth J. Boote, L. Hartwell Allen, Univ. of Florida (USA); Eric Karplus, Science Wares, Inc. (USA) . . . [8369-03]

2:00 pm: **Biomass estimator for CIR-image with few additional spectral band images taken from light UAS**, Ilkka Pölonen, Ismo J. Pellikka, Heikki Salo, Univ. of Jyväskylä (Finland); Heikki Saari, VTT Technical Research Ctr. of Finland (Finland); Jere Kaivosoja, MTT Agrifood Research Finland (Finland); Sakari Tuominen, Finnish Forest Research Institute (Finland); Eija Honkavaara, Finnish Geodetic Institute (Finland) [8369-04]

2:20 pm: **Development of band-selective 3CCD camera and application**, Hoyoung Lee, Seoul National Univ. (Korea, Republic of) [8369-05]

2:40 pm: **A nonrigid registration method for multispectral imaging of plants**, Jonas de Vylder, Univ. Gent (Belgium) [8369-06]

Coffee/Exhibition Break 3:00 to 4:00 pm

SESSION 2

Room: Conv. Ctr. 323 Tues. 4:00 to 5:20 pm

Hyperspectral Imaging

Session Chair: Haibo Yao, Mississippi State Univ. (USA)

4:00 pm: **The development of line-scan image recognition algorithms for the detection of frass on mature tomatoes**, Chun-Chieh Yang, Moon S. Kim, Patricia Millner, Kuanglin Chao, Diane E. Chan, USDA Agricultural Research Service (USA) [8369-07]

4:20 pm: **Hyperspectral imaging for detection of non-O157 Shiga-toxin producing Escherichia coli (STEC) serotypes on spread plates of mixed cultures**, Seung Chul Yoon, William R. Windham, Scott R. Ladely, Gerald W. Heitschmidt, Kurt C. Lawrence, Bosoon Park, Neelam Narang, William C. Cray, USDA Agricultural Research Service (USA) [8369-08]

4:40 pm: **Potential method of evaluating pork quality attributes during storage using hyperspectral imaging technique**, Feifei Tao, Yankun Peng, Yulin Song, Hui Guo, China Agricultural Univ. (China) [8369-09]

5:00 pm: **Differentiation of toxigenic and atoxigenic fungi inoculated corn with hyperspectral imaging**, Haibo Yao, Zuzana Hruska, Russell Kincaid, Mississippi State Univ. (USA); Robert L. Brown, Deepak Bhatnagar, Thomas E. Cleveland, USDA Agricultural Research Service (USA) [8369-10]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Hyperspectral imaging based techniques applied to wheat kernels characterization, Silvia Serranti, Daniela Cesare, Giuseppe Bonifazi, Univ. degli Studi di Roma La Sapienza (Italy) [8369-28]

Dried fruits quality assessment by hyperspectral imaging, Silvia Serranti, Giuseppe Bonifazi, Univ. degli Studi di Roma La Sapienza (Italy) [8369-29]

Bacterial detection using novel cell-based sensors, Matthew D. Servinsky, James T. Kiel, U.S. Army Research Lab. (USA); Chen-Yu Tsao, Christopher M. Byrd, Univ. of Maryland, College Park (USA); Christian J. Sund, U.S. Army Research Lab. (USA); William E. Bentley, Univ. of Maryland, College Park (USA) [8369-30]

An investigation of FT-Raman spectroscopy for quantification of additives to milk powder, Yuche Cheng, Jianwei Qin, Moon S. Kim, Kuanglin Chao, USDA Agricultural Research Service (USA) [8369-31]

Integration of independent component analysis with near infrared spectroscopy for evaluation of rice freshness, Yung-Kun Chuang, USDA Agricultural Research Service (USA); Suming Chen, Chao-Yin Tsai, National Taiwan Univ. (Taiwan); I-Chang Yang, USDA Agricultural Research Service (USA); Yi-Ping Hu, National Taiwan Univ. (Taiwan); Y. Martin Lo, Univ. of Maryland, College Park (USA) [8369-32]

classification of Korla fragrant pears using hyperspectral imaging, Xiuqin Rao, Zhejiang Univ. (China); Chun-Chieh Yang, USDA Agricultural Research Service (USA); Yibin Ying, Zhejiang Univ. (China); Moon S. Kim, Kuanglin Chao, USDA Agricultural Research Service (USA) [8369-33]

Capsaicinoids content prediction model development for Korean red-pepper powder using a visible and near-infrared spectroscopy, Jongguk Lim, Kangjin Lee, Chanhyun Mo, Sukwon Kang, National Academy of Agriculture Science (Korea, Republic of) [8369-34]

Real-time multispectral fluorescence imaging techniques for on-line detection of contaminated poultry carcasses, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of); Moon S. Kim, USDA Agricultural Research Service (USA); Dae-Young Kim, In-Seok Baek, Chi-Kook Ahn, Geonwoo Kim, Chungnam National Univ. (Korea, Republic of) [8369-35]

Flipping device for whole-surface online hyper-spectral imaging inspection of spinach, Xiuying Tang, China Agricultural Univ. (China); Chang Yeun Mo, Moon S. Kim, Kuanglin Chao, Diane E. Chan, USDA Agricultural Research Service (USA); Yankun Peng, China Agricultural Univ. (China) [8369-36]

Multi-parameters quality prediction for fresh pork based on multi-spectral imaging and scattering characteristics, Culling Li, Beijing Institute of Technology (China); Yankun Peng, Xiuying Tang, China Agricultural Univ. (China) [8369-37]

Wednesday 25 April

SESSION 3

Room: Conv. Ctr. 323 Wed. 8:30 to 10:10 am

Optical Sensing for Agriculture II

Session Chair: Gang Yao, Univ. of Missouri-Columbia (USA)

- 8:30 am: **Polymer based sensor array for phytochemical detection**, Kanchana A. Weerakoon, Bryan A. Chin, Nitalaksha Hiremath, Auburn Univ. (USA) . [8369-11]
- 8:50 am: **On-line detection of orange soluble solid content using visible and near infrared transmission measurements**, Xiaping Fu, Yibin Ying, Huirong Xu, Bing Qi, Lijuan Xie, Zhejiang Univ. (China) [8369-12]
- 9:10 am: **Development of a single channel, three view imaging system with coherence model for detect and damage assessment of freefalling cereal grains**, I-Chang Yang, Stephen R. Delwiche, USDA Agricultural Research Service (USA); Y. Martin Lo, Univ. of Maryland, College Park (USA) [8369-13]
- 9:30 am: **3D imaging of tomato seeds using frequency domain optical coherence tomography**, Gang Yao, Chuanmao Fan, Univ. of Missouri-Columbia (USA) [8369-14]
- 9:50 am: **Measuring the optical properties of onion dry skin and flesh in the wavelength range from 400 to 1000 nm**, Weilin Wang, Changying Li, The Univ. of Georgia (USA) [8369-15]
- Coffee Break 10:10 to 10:40 am

SESSION 4

Room: Conv. Ctr. 323 Wed. 10:40 am to 12:00 pm

Raman for Food Quality and Safety

Session Chair: Kuanglin Chao, Agricultural Research Service (USA)

- 10:40 am: **Detecting multiple adulterants in dry milk using Raman chemical imaging**, Jianwei Qin, Kuanglin Chao, Moon S. Kim, USDA Agricultural Research Service (USA) [8369-16]
- 11:00 am: **Rapid detection of apple pesticide residue based on Raman spectroscopy**, Yankun Peng, Yunyun Sun, Yongyu Li, China Agricultural Univ. (China); Kuanglin Chao, USDA Agricultural Research Service (USA) [8369-17]
- 11:20 am: **In-situ identification of meat from different animal species by shifted excitation Raman difference spectroscopy**, Kay Sowoidnich, Heinz-Detlef Kronfeldt, Technische Univ. Berlin (Germany) [8369-18]
- 11:40 am: **Rapid analysis of foodborne pathogens by surface-enhanced Raman spectroscopy**, Stuart R. Farquharson, Real-Time Analyzers, Inc. (USA) [8369-19]
- Lunch/Exhibition Break 12:00 to 1:30 pm

SESSION 5

Room: Conv. Ctr. 323 Wed. 1:30 to 3:00 pm

Sensing for Pathogens

Session Chair: Suiqiong Li, Auburn Univ. (USA)

- 1:30 pm: **Identification of Shiga toxin-producing Escherichia coli (STEC) serotypes with hyperspectral microscope imagery (Invited Paper)**, Bosoon Park, William R. Windham, USDA Agricultural Research Service (USA); Heesung Kwon, Prudhvi Gurram, U.S. Army Research Lab. (USA); Scott R. Ladely, Seung Chul Yoon, Kurt C. Lawrence, Neelam Narang, William C. Cray, USDA Agricultural Research Service (USA) [8369-20]
- 2:00 pm: **In-situ detection of Salmonella Typhimurium on tomatoes using magnetoelastic biosensors and a flat magnetic coil**, Yating Chai, Leslie C. Mathison, Suiqiong Li, Shin Horikawa, Mi-Kyung Park, Valery A. Petrenko, Bryan A. Chin, Auburn Univ. (USA) [8369-21]
- 2:20 pm: **Rapid, enhanced detection of Salmonella Typhimurium on fresh spinach leaves using micron-scale, phage-coated magnetoelastic biosensors**, Shin Horikawa, Kiril Vaglenov, Dana M. Gerken, Yating Chai, Mi-Kyung Park, Suiqiong Li, Valery A. Petrenko, Bryan A. Chin, Auburn Univ. (USA) [8369-22]
- 2:40 pm: **Identification and characterization of Salmonella serotypes using their DNA/RNA fingerprints analysis by Fourier transform infrared (FT-IR) spectroscopy**, Jaya Sundaram, Bosoon Park, Arthur Hinton, Seung Chul Yoon, Kurt C. Lawrence, USDA Agricultural Research Service (USA) [8369-23]
- Coffee Break 3:00 to 3:30 pm

SESSION 6

Room: Conv. Ctr. 323 Wed. 3:30 to 4:50 pm

Biosensors for Pathogens

Session Chair: Bosoon Park, Agricultural Research Service (USA)

- 3:30 pm: **Detection of Salmonella using autonomous magnetoelastic biosensor system**, Suiqiong Li, Yating Chai, Mi-Kyung Park, Shin Horikawa, Bryan A. Chin, Auburn Univ. (USA) [8369-24]
- 3:50 pm: **Impedance biosensor based on double interdigitated electrode arrays for detection of E.coli O157:H7 in food products**, Shibajyoti Ghosh Dastider, Univ. of Missouri-Columbia (USA); Syed Barizuddin, Majed El-Dweik, Lincoln Univ. (USA); Mahmoud F. Almasri, Univ. of Missouri-Columbia (USA) [8369-25]
- 4:10 pm: **Comparison of phage-based magnetoelastic biosensors with TaqMan-based quantitative real-time PCR for the detection of Salmonella Typhimurium directly grown on tomato surfaces**, Mi-Kyung Park, Suiqiong Li, Shin Horikawa, Yating Chai, H. Clyde Wikle III, Bryan A. Chin, Auburn Univ. (USA) [8369-26]
- 4:30 pm: **Optimization of blocking of nonspecific binding on phage-based magnetoelastic biosensors**, Wen Shen, Mi-Kyung Park, Suiqiong Li, Shin Horikawa, Yating Chai, Leslie C. Mathison, Valery A. Petrenko, Bryan A. Chin, Auburn Univ. (USA) [8369-27]

Courses of Related Interest

- SC194 **Multispectral and Hyperspectral Image Sensors** (Lomheim) Tuesday, 1:30 to 5:30 pm
 - SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm
 - SC995 **Target Detection Algorithms for Hyperspectral Imagery** (Nasrabadi) Thursday, 8:30 am to 5:30 pm
 - SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm
- See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Fiber Optic Sensors and Applications IX

Conference Chairs: Henry H. Du, Stevens Institute of Technology (USA); Gary Pickrell, Virginia Polytechnic Institute and State Univ. (USA); Eric Udd, Columbia Gorge Research (USA)

Conference Co-Chairs: Jerry J. Benterou, Lawrence Livermore National Lab. (USA); Alexis Mendez, MCH Engineering LLC (USA); Stephen J. Mihailov, Communications Research Ctr. Canada (Canada); Anbo Wang, Virginia Polytechnic Institute and State Univ. (USA)

Program Committee: Christopher S. Baldwin, Aither Engineering, Inc. (USA); Ole Bang, Technical Univ. of Denmark (Denmark); Eric A. Bergles, BaySpec, Inc. (USA); Jeff Bush, Optiphase, Inc. (USA); Kevin Peng Chen, Univ. of Pittsburgh (USA); Brian Culshaw, Univ. of Strathclyde (United Kingdom); Abdessama Elyamani, Northrop Grumman Navigation Systems (USA); Yoel Fink, Massachusetts Institute of Technology (USA); Eric Lee Goldner, US Sensor Systems, Inc. (USA); Tom W. Graver, Micron Optics, Inc. (USA); Ming Han, Univ. of Nebraska-Lincoln (USA); 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. (USA); Katerina Krebber, Bundesanstalt für Materialforschung und -prüfung (Germany); Steven T. Kreger, Luna Innovations Inc. (USA); David A. Krohn, Light Wave Venture Consulting, LLC (USA); Paul Lefebvre, LxDATA (Canada); Thomas D. Monte, KVH Industries, Inc. (USA); Glen A. Sanders, Honeywell Technology (USA); Dennis J. Trevor, OFS Labs. (USA); Xingwei Wang, Univ. of Massachusetts Lowell (USA); Reinhardt Willsch, Institut für Photonische Technologien e.V. (Germany); Younan Xia, Washington Univ. in St. Louis (USA); Hai Xiao, Missouri Univ. of Science and Technology (USA)

Thursday 26 April

SESSION 1

Room: Conv. Ctr. 321 Thurs. 8:00 to 8:40 am

Keynote

Session Chair: Henry H. Du, Stevens Institute of Technology (USA)

8:00 am: Photonic crystal fibers and applications in sensing, Brian J. Mangan, OFS Fitel (USA) [8370-01]

SESSION 2

Room: Conv. Ctr. 321 Thurs. 8:40 to 10:30 am

Sensor Design and Modeling

Session Chair: Henry H. Du, Stevens Institute of Technology (USA)

8:40 am: Long-period gratings in photonic crystal fibers operating near the phase-matching turning point for evanescent chemical and biochemical sensing (Invited Paper), Jiri Kanka, Institute of Photonics and Electronics of the ASCR, v.v.i. (Czech Republic) [8370-02]

9:10 am: Modal reduction in 6-rod bundled single-crystal sapphire photonic crystal fibers, Neal T. Pfeifferberger, Gary Pickrell, Virginia Polytechnic Institute and State Univ. (USA) [8370-03]

9:30 am: Computational design of a strain fiber optic sensor, Andrés Yarce Botero, Univ. EAFIT (Colombia) [8370-04]

9:50 am: Modeling of low-finesse, extrinsic fiber optic Fabry-Perot whitelight interferometers, Cheng Ma, Anbo Wang, Virginia Polytechnic Institute and State Univ. (USA) [8370-05]

10:10 am: Computational design of a fiber optic temperature sensor, Damian Campo, Univ. EAFIT (Colombia) [8370-06]

Coffee Break 10:30 to 11:00 am

SESSION 3

Room: Conv. Ctr. 321 Thurs. 11:00 am to 12:10 pm

Novel Sensing Devices

Session Chair: Anbo Wang,

Virginia Polytechnic Institute and State Univ. (USA)

11:00 am: Temperature and pressure sensors based on chiral fibers (Invited Paper), Victor I. Kopp, Jongchul Park, Mitchell S. Wlodawski, Dan Neugroschl, Jonathan Singer, Azriel Z. Genack, Chiral Photonics, Inc. (USA) [8370-07]

11:30 am: Field testing the Raman gas composition sensor for gas turbine operation, Michael P. Buric, Benjamin T. Chorpening, Jessica C. Mullen, Joseph A. Ranalli, Steven D. Woodruff, National Energy Technology Lab. (USA) [8370-08]

11:50 am: Advanced fiber optic fluorescence turn-on molecular sensor for highly selective detection of copper in water, Yasser Chiniforooshan, Jianjun Ma, Wojtek J. Bock, Univ. du Québec en Outaouais (Canada); Wenhui Hao, Zhi Yuan Wang, Carleton Univ. (Canada) [8370-09]

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

SESSION 4

Room: Conv. Ctr. 321 Thurs. 1:30 to 3:10 pm

Photonic Crystal Fiber Sensors

Session Chair: Gary Pickrell,

Virginia Polytechnic Institute and State Univ. (USA)

1:30 pm: Multimode interference as a tool for fiber sensing (Invited Paper), Susana F. Oliveira Silva, Orlando Frazão, L. A. Ferreira, Francisco M. Araújo, INESC Porto (Portugal); José L. Santos, Univ. do Porto (Portugal) [8370-10]

2:00 pm: Novel photonic crystal fiber optofluidic sensing platform enabled through layer-by-layer assembly of pH-responsive polyelectrolytes (Invited Paper), Fei Tian, Stevens Institute of Technology (USA); Jiri Kanka, Institute of Photonics and Electronics of the ASCR, v.v.i. (Czech Republic); Svetlana A. Sukhishvili, Henry H. Du, Stevens Institute of Technology (USA) [8370-11]

2:30 pm: Competitive Raman gain and signal attenuation in PCF: an integrated theoretical and experimental study using SERS nanotags, Polina Pinkhasova, Stevens Institute of Technology (USA); Jiri Kanka, Institute of Photonics and Electronics of the ASCR, v.v.i. (Czech Republic); Svetlana A. Sukhishvili, Henry H. Du, Stevens Institute of Technology (USA) [8370-12]

2:50 pm: Long-period gratings in photonic crystal fiber for sensitive gas phase measurements, Fei Tian, Zonghu He, Stevens Institute of Technology (USA); Jiri Kanka, Institute of Photonics and Electronics of the ASCR, v.v.i. (Czech Republic); Henry H. Du, Stevens Institute of Technology (USA) [8370-13]

Coffee Break 3:10 to 3:40 pm

SESSION 5

Room: Conv. Ctr. 321 Thurs. 3:40 to 5:50 pm

Advanced Sensors for Energy Generation

Session Chair: Eric Udd, Columbia Gorge Research (USA)

- 3:40 pm: **Advanced Fiber Optical Sensor and Instrumentation for Power Generation Industrial Monitoring and Diagnostics** (*Invited Paper*), Hua Xia, General Electric Global Research (USA) [8370-14]
- 4:10 pm: **Distributed temperature sensing for an embedded turbine measurement application**, Yunmiao Wang, Jianmin Gong, Dorothy Y. Wang, Anbo Wang, Virginia Polytechnic Institute and State Univ. (USA) [8370-15]
- 4:30 pm: **Design validation of an air cooled turbo generator by using fibre optic sensors in a shop test**, Thomas Bosselmann, Michael Willsch, Michael Villnow, Sebastian Strack, Juergen R. Weidner, Vladimir Chernogorski, Siemens AG (Germany); Steve Lindholm, Eric Abromitis, Siemens Power Generation, Inc. (USA); Roland Roeding, Ulrich Schwanengel, Lothar Trefflich, Siemens AG (Germany) [8370-16]
- 4:50 pm: **Using IFPI sensors for multipoint temperature sensing inside gas turbines**, Tyler Shillig, Virginia Polytechnic Institute and State Univ. (USA) [8370-17]
- 5:10 pm: **Strain insensitive embeddable fiber-optic sapphire high-temperature thermometer**, Keith DePew, Bo Dong, Virginia Polytechnic Institute and State Univ. (USA) [8370-18]
- 5:30 pm: **Two-wavelength quadrature multipoint detection of partial discharge in power transformers using fiber Fabry-Perot acoustic sensors**, Bo Dong, Anbo Wang, Virginia Polytechnic Institute and State Univ. (USA) [8370-19]

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A 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.

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- Improving the in-flight security by employing seat occupancy sensors based on fiber Bragg grating technology**, Hongtao Zhang, Univ. of Massachusetts Lowell (USA); Pengfei Wang, Polytechnic Institute of New York Univ. (USA) [8370-30]
- Implement an adjustable delay time digital trigger for a NI data acquisition card in a high-speed demodulation system**, Hongtao Zhang, Univ. of Massachusetts Lowell (USA); Lingling Fan, Stevens Institute of Technology (USA); Pengfei Wang, Polytechnic Institute of New York Univ. (USA); Seong-Wook Park, Stevens Institute of Technology (USA) [8370-31]
- Sound detection monitoring in the transformer oil using fiber optic sensor**, Jongkil Lee, Andong National Univ. (Korea, Republic of) [8370-32]
- Ultra long distance distributed fiber-optic system for intrusion detection**, Dongsheng Tu, Ningbo Nuoke Electronic Technology Development Co., Ltd. (China); Min Zhang, Tsinghua Univ. (China); Qilin Zou, Zhaogong Jiang, Ningbo Nuoke Electronic Technology Development Co., Ltd. (China); Shangran Xie, Tsinghua Univ. (China); Shangjin Ren, Ningbo Nuoke Electronic Technology Development Co., Ltd. (China) [8370-33]

Friday 27 April

SESSION 6

Room: Conv. Ctr. 321 Fri. 8:50 to 10:00 am

Fiber Bragg Grating Sensors

Session Chair: Alexis Mendez, MCH Engineering LLC (USA)

- 8:50 am: **Improvements to high-speed monitoring of events in extreme environments using fiber Bragg grating sensors** (*Invited Paper*), Eric Udd, Columbia Gorge Research (USA); Jerry J. Benterou, Chadd M. May, Jose O. Sinibaldi, Lawrence Livermore National Lab. (USA) [8370-20]
- 9:20 am: **Ultrasonic detection based on pi-phase shifted fiber Bragg grating**, Ming Han, Tom Fink, Qi Zhang, Wayne Ahrens, Fawen Guo, Univ. of Nebraska-Lincoln (USA) [8370-22]
- 9:40 am: **A design of low power consumption and high speed WDM-to-OTDM waveband conversion system for the future optical sensing networks**, Tianxin Yang, Yu Peng, Dongfang Jia, Zhaoying Wang, Mei Sang, Tianjin Univ. (China) [8370-23]
- Coffee Break 10:00 to 10:30 am

SESSION 7

Room: Conv. Ctr. 321 Fri. 10:30 am to 12:30 pm

Advanced Interferometric Sensors

Session Chair: Jerry J. Benterou, Lawrence Livermore National Lab. (USA)

- 10:30 am: **Specialty fiber design for commercial, intrinsic fiber sensors**, Christopher Emslie, Fibercore Ltd. (United Kingdom) [8370-34]
- 10:50 am: **Performance limitations of a white light extrinsic Fabry-Perot interferometric displacement sensor**, Erik A. Moro, Michael D. Todd, Univ. of California, San Diego (USA); Anthony Puckett, Los Alamos National Lab. (USA) [8370-25]
- 11:10 am: **Distributed sensing of vibration, temperature, and pressure using fiber optics**, Peter Kung, QPS Photonics Inc. (Canada) [8370-26]
- 11:30 am: **Mach-Zehnder interferometer for movement monitoring**, Vladimir Vasinek, Jakub Cubik, Stanislav Kepak, Jan Dorcicak, Jan Latal, Petr Koudelka, Technical Univ. of Ostrava (Czech Republic) [8370-27]
- 11:50 am: **Fiber Fizeau interferometer for remote passive sensing**, Jeff Bush, Kwang Suh, Optiphase, Inc. (USA) [8370-28]
- 12:10 pm: **Interferometric polymer optical sensor for intravascular optoacoustic imaging**, Daniel C. Gallego, Univ. Carlos III de Madrid (Spain); Meng Wang, Univ. of Oulu (Finland); Jussi Hiltunen, VTT Technical Research Ctr. of Finland (Finland); Matti Kinnunen, Risto Myllyla, Univ. of Oulu (Finland); Horacio R. Lamela Rivera, Univ. Carlos III de Madrid (Spain) [8370-29]

Courses of Related Interest

- SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm
 - SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm
- See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Sensing Technologies for Global Health, Military Medicine, Disaster Response, and Environmental Monitoring II

Conference Chairs: **Sárka O. Southern**, Gaia Medical Institute (USA); **Arend H. J. Kolk**, Univ. van Amsterdam (Netherlands); **Kevin N. Montgomery**, U.S. Army Telemedicine and Advanced Technology Research Ctr. (USA) and Stanford Univ. (USA); **Carl W. Taylor**, National Ctr. for Disaster Medical Response, Univ. of South Alabama (USA)

Program Committee: **Mark J. Buller**, U.S. Army Research Institute of Environmental Medicine (USA); **Samuel N. Cheuvront**, U.S. Army Research Institute of Environmental Medicine (USA); **James B. Delehanty III**, U.S. Naval Research Lab. (USA); **Theresa G. Evans-Nguyen**, Draper Lab. (USA); **Konrad Faulstich**, Qiangen, Inc. (Germany); **Marjorie J. Greene**, CNA Corp. (USA); **Peter Kiesel**, Palo Alto Research Center, Inc. (USA); **Paul D. LaBarre**, PATH (USA); **Gerald Lilienthal**, The Boeing Co. (USA); **Baochuan Lin**, U.S. Naval Research Lab. (USA); **Igor L. Medintz**, U.S. Naval Research Lab. (USA); **Christopher Myers**, Naval Health Research Ctr. (USA); **Richard M. Ozanich**, Pacific Northwest National Lab. (USA); **Lada Rasochova**, Univ. of California, San Diego (USA); **Steven A. Ripp**, The Univ. of Tennessee (USA); **Albert Skip Rizzo III**, The Univ. of Southern California (USA); **Kim E. Sapsford**, U.S. Food and Drug Administration (USA); **Kevin Wang**, Banyan Biomarkers, Inc. (USA); **David Wolf**, Radiation Monitoring Devices, Inc. (USA); **Aurel Ymeti**, Ostendum R&D BV (Netherlands)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 324 Mon. 8:30 am to 12:00 pm

Global Health I:

Telemedicine and Point-of-Care Diagnostics

Session Chairs: **Aydogan Ozcan**, Univ. of California, Los Angeles (USA); **Brendan J. O'Farrell**, Diagnostic Consulting Network (USA)

8:30 am: **New imaging and sensing architectures for telemedicine and global healthcare** (*Invited Paper*), Aydogan Ozcan, Univ. of California, Los Angeles (USA) [8371A-01]

9:20 am: **Lab-on-a-cellphone: emerging platform for telemedicine global health**, Onur Mudanyali, Derek Tseng, Cetin Oztoprak, Serhan O. Isikman, Ikbal Sencan, Oguzhan Yaglidere, Aydogan Ozcan, Univ. of California, Los Angeles (USA) [8371A-02]

9:40 am: **On-chip blood analysis using lensless microscopy**, Serhan O. Isikman, Sungkyu Seo, Ikbal Sencan, Onur Mudanyali, Ting-Wei Su, Anthony Erlinger, Aydogan Ozcan, Univ. of California, Los Angeles (USA) [8371A-03]

10:00 am: **Field-portable fertility test using lensless microscopy on a chip**, Ting-Wei Su, Anthony Erlinger, Derek Tseng, Aydogan Ozcan, Univ. of California, Los Angeles (USA) [8371A-04]

Coffee Break 10:20 to 10:50 am

10:50 am: **Recent advances in the use of laser-induced breakdown spectroscopy (LIBS) as a rapid point-of-care pathogen diagnostic**, Steven J. Rehse, Univ. of Windsor (Canada); Andrzej W. Miziolek, US Army Research Lab. (USA) [8371A-05]

11:10 am: **Commercial development of high sensitivity quantitative rapid immunoassay systems for detection of biological agents** (*Invited Paper*), Brendan J. O'Farrell, Diagnostic Consulting Network (USA) [8371A-09]

11:40 am: **e-nanoflex point-of-care sensor system: smartphone-based roaming health monitor**, Vijay K. Varadan, Univ. of Arkansas (USA) .. [8371A-06]

Lunch Break 12:00 to 1:00 pm

SESSION 2

Room: Conv. Ctr. 324 Mon. 1:00 to 4:40 pm

Global Health II:

New Technologies for Point-of-Care Diagnostics

Session Chairs: **Arend H. J. Kolk**, Univ. van Amsterdam (Netherlands); **Joan Jackman**, Johns Hopkins Univ. Applied Physics Lab. (USA)

1:00 pm: **On-demand molecular diagnostic systems for tuberculosis: from inception to clinical impact** (*Invited Paper*), David Alland, Univ. of Medicine & Dentistry of New Jersey (USA) [8371A-10]

1:30 pm: **Breath-based biomarkers for tuberculosis**, Arend H. J. Kolk, Univ. van Amsterdam (Netherlands); Joep J.B. N. van Berkel, Maastricht Univ. (Netherlands); Mareli M. Claassens, Liz Walters, Stellenbosch Univ. (South Africa); Sjoukje Kuijper, Univ. van Amsterdam (Netherlands); Jan W. Dallinga, Fredrik-Jan Van Schooten, Maastricht Univ. (Netherlands) [8371A-11]

1:50 pm: **Challenges in point-of-care diagnostics in infectious disease** (*Invited Paper*), Joan Jackman, Johns Hopkins Univ. Applied Physics Lab. (USA) [8371A-71]

2:20 pm: **Rapid HIV tests for developing countries: the challenge of false-negative tests**, Ram Yogeve, Children's Memorial Hospital (USA) [8371A-13]

2:40 pm: **Simple and affordable point-of-care HIV staging enabled by controlled reagent release from gelatin**, Markus Beck, Niels van der Velde, Silvia Brockhuis, Dorothee Wasserberg, Leon W. M. M. Terstappen, Univ. Twente (Netherlands) [8371A-16]

Coffee Break 3:00 to 3:20 pm

3:20 pm: **Therapeutic monitoring of HIV/AIDS using saliva-based biomarkers**, Sárka O. Southern, Gaia Medical Institute (USA) [8371A-74]

3:40 pm: **Hepcidin: new biomarker for global health diagnostics of anemia and infection**, Mark Westerman, Intrinsic LifeSciences, LLC (USA) ... [8371A-17]

4:00 pm: **Enzymatic glucose detection using ZnO nanorods modified gate graphene transistor**, Sheng Chun Hung, C. W. Chen, National Central Univ. (Taiwan); Y. C. Lai, B. S. Wu, National Chiao Tung Univ. (Taiwan); Y. H. Chien, Y. P. Huang, National Central Univ. (Taiwan); G. C. Chi, National Chiao Tung Univ. (Taiwan); F. Ren, S. J. Pearton, Univ. of Florida (USA) [8371A-18]

4:20 pm: **Mathematical model for Dengue with three states of infection**, Juan F. Ospina, Univ. EAFIT (Colombia) [8371A-39]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 3

Room: Conv. Ctr. 324 Tues. 8:30 am to 12:30 pm

Military Medicine I: Traumatic Brain Injury and PTSD

Session Chairs: **David O. Okonkwo**, Univ. of Pittsburgh Medical Ctr. (USA); **Christian Macedonia**, Telemedicine and Advanced Technology Research Ctr. (USA)

8:30 am: **DARPA challenge: developing new technologies for brain and spinal injuries** (*Invited Paper*), Christian Macedonia, Defense Advanced Research Projects Agency (USA); Geoffrey S. F. Ling M.D., Uniformed Services Univ. of the Health Sciences (USA); Monica Zamisch, Science and Technology Associates, Inc. (USA); Jack W. Judy, Defense Advanced Research Projects Agency (USA) and Univ. of California, Los Angeles (USA) [8371A-19]

9:00 am: **Clinical white matter damage detection in military and civilian TBI**, David O. Okonkwo, Univ. of Pittsburgh Medical Ctr. (USA) [8371A-20]

9:20 am: **Brain tissue mapping and neuroprosthetic devices**, William Shain, Seattle Children's Research Institute (USA); Badrinath Roysam, Univ. of Houston (USA) [8371A-21]

9:40 am: **EYE-TRAC: monitoring attention and utility for mTBI**, Jamshid Ghajar, Jun Maruta, Jianliang Tong, Zarah Iqbal, Alison Schonberger, Brain Trauma Foundation (USA) [8371A-69]

10:00 am: **High-resolution brain scanning technology for advanced TBI diagnostics**, Julie Onton, Univ. of California, San Diego (USA) [8371A-22]

Coffee Break 10:20 to 10:50 am

10:50 am: **Biomarkers for diagnostics of traumatic brain injury**, Kevin Wang, Univ. of Florida, McKnight Brain Institute (USA) [8371A-23]

11:10 am: **Saliva biomarkers for noninvasive diagnostics: applications for TBI, PTSD and environmental medicine**, Sárka O. Southern, Gaia Medical Institute (USA) [8371A-24]

11:30 am: **Handheld device for rapid TBI diagnostics**, Sai Kumar, SFC-Fluidics (USA) [8371A-25]

11:50 am: **Perspectives on mTBI and PTSD diagnostics in the Navy**, Robert N. McLay, Naval Medical Ctr. San Diego (USA) [8371A-26]

12:10 pm: **Emerging treatments for PTSD based on virtual reality software**, Thomas Talbot, The Univ. of Southern California (USA) [8371A-27]

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

SESSION 4

Room: Conv. Ctr. 324 Tues. 1:30 to 6:00 pm

Military Medicine II: Critical Care, Robotics and Sensing

Session Chairs: **Sylvain Cardin**, U.S. Army Medical Research and Materiel Command (USA); **Chris Taitt**, U.S. Naval Research Lab. (USA)

1:30 pm: **TATRC challenge: developing new technologies for combat casualty care** (*Invited Paper*), Sylvain Cardin, U.S. Army Medical Research and Materiel Command (USA) [8371A-28]

2:00 pm: **Improving pain care in wounded soldiers**, Steven P. Cohen M.D., The Johns Hopkins Hospital (USA); Connie Kurihara, David Jamison, Scott Griffith, Walter Reed National Military Medical Ctr. (USA) [8371A-70]

2:20 pm: **Scar-free skin regeneration: new technology for burn treatment**, Sharon Gerecht, Johns Hopkins Univ. (USA) [8371A-32]

2:40 pm: **Stem cell engineering for tissue repair: new approach to TBI treatment**, Ning Zhang, Clemson Univ. (USA) [8371A-33]

3:00 pm: **Decision support systems for robotic surgery and acute care**, Peter Kazanzides, Johns Hopkins Univ. (USA) [8371A-72]

Coffee Break 3:20 to 3:50 pm

3:50 pm: **Antimicrobial resistance determinant microarray for analysis of multi-drug resistant isolates** (*Invited Paper*), Chris R. Taitt, Tomasz A. Leski, Gary J. Vora, U.S. Naval Research Lab. (USA); Brent House, Matilda Nicklasson, Guillermo Pimentel, Naval Medical Research Unit-3 (Egypt); Daniel V. Zurawski, Benjamin Kirkup, Walter Reed Army Institute of Research (USA); David W. Craft, Walter Reed Army Institute of Research (Retired) (USA); Emil Lesho, Paige Waterman, Walter Reed Army Institute of Research (USA) [8371A-35]

4:20 pm: **Field-expedient health assessment using a rapid biomarker test**, Mark Westerman, Intrinsic LifeSciences, LLC (USA) [8371A-36]

4:40 pm: **A field-deployable device for the rapid detection of cyanide poisoning in whole blood**, Hans R. Boehringer, Winnie Tong, Roy Chung, Diagnostic Consulting Network (USA); Gerry R. Boss, Univ. of California, San Diego (USA); Brendan J. O'Farrell, Diagnostic Consulting Network (USA) [8371A-73]

5:00 pm: **Nanosensing platforms: physics, technology and applications**, Edwin Carlen, University of Twente (Netherlands) [8371A-38]

5:20 pm: **Exploitation of pulse and respiration signals from the SimMan3GTM patient simulator using a laser Doppler vibrometer (LDV)**, Kenneth A. Byrd, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8371A-31]

5:40 pm: **3D medicine: streaming video-based 3D reconstruction method compatible with existing monoscopic and stereoscopic endoscopy systems**, Henri Bourma, Wannes van der Mark, TNO Defence, Security and Safety (Netherlands); Pieter Eendebak, TNO Defence, Security and Safety (Netherlands); Sander Landsmeer, Adam W. M. van Eekeren, Frank B. ter Haar, Fokko P. Wieringa, TNO Defence, Security and Safety (Netherlands); Jean-Paul v. Basten M.D., Canisius Wilhelmina Hospital (Netherlands) [8371A-30]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

MiniMAX: miniature, mobile, agile, x-ray system, Scott Watson, Samuel Gonzales, Gwynneth A. Cunningham, Los Alamos National Lab. (USA) [8371A-07]

Impedance spectroscopy for the detection of unknown toxins, Brian Riggs, George Plopper, Theresa Phamduy, Rensselaer Polytechnic Institute (USA); Janet Paluh, Univ. at Albany (USA); David T. Corr, Douglas B. Chrisey, Rensselaer Polytechnic Institute (USA) [8371A-49]

GC-MS analysis of polybrominated diphenyl ethers in Lake Erie, Mary C. Vagula, Weslene Tallmadge, Marissa Vartak, Gannon Univ. (USA) [8371A-50]

Wireless data communication and power delivery through Faraday shielded metallic barriers for sealed sensing applications, Jonathan D. Ashdown, Rensselaer Polytechnic Institute (USA) [8371A-51]

Cost effective malaria risk control using remote sensing and environmental data, Md. Z. Rahman, LaGuardia Community College (USA); Leonid Roytman, Atiqur Rahman, The City College of New York (USA); Abdel Hamid Kadik, LaGuardia Community College (USA) [8371A-52]

Quantum model of a biological attack using MAPLE, Leidy L. Alzate, Univ. EAFIT (Colombia) [8371A-53]

Wednesday 25 April

SESSION 5

Room: Conv. Ctr. 324 Wed. 8:30 am to 12:50 pm

Environmental Monitoring and Sensing Platforms

Session Chairs: Shadrian B. Strong,

Johns Hopkins Univ. Applied Physics Lab. (USA);

Robert E. Erlandson, Johns Hopkins Univ. Applied Physics Lab. (USA)

8:30 am: **The global assimilation of information for action (GAIA) initiative: understanding the impact of climate change on national security and public health** (*Invited Paper*), Shadrian B. Strong, Larry J. Paxton, Maegen Nix, The Johns Hopkins Univ. Applied Physics Lab. (USA); William H. Swartz, The Johns Hopkins Univ. Applied Physics Lab (USA); Michele B. Weiss, Robert Schaefer, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8371A-40]

9:00 am: **An overview of suite for automated global electronic biosurveillance (SAGES)**, Sheri Lewis, Johns Hopkins Univ. Applied Physics Lab. (USA) [8371A-65]

9:20 am: **Chemical and biological sensing needs for health effect studies**, Patrick N. Breyse, Johns Hopkins Univ. Bloomberg School of Public Health (USA) [8371A-66]

9:40 am: **Direct colorimetric detection of chemical warfare agents in both vapor and aerosol phases**, Manal Beshay, Intelligent Optical Systems, Inc. (USA) [8371A-08]

10:00 am: **Remote detection of human toxicants in real-time using a human-optimized, bioluminescent bacterial luciferase gene cassette bioreporter**, Dan M. Close, The Univ. of Tennessee (USA) and 490 BioTech, Inc. (USA); Steven A. Ripp, Stacey S. Patterson, Gary S. Saylor, The Univ. of Tennessee (USA) [8371A-37]

Coffee Break 10:20 to 10:50 am

10:50 am: **Real-time global monitoring of volcanic ash using hosted sensors on the Iridium NEXT constellation**, Robert E. Erlandson, Lars P. Dyrud, Charles A. Hibbitts, C. K. Kumar, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8371A-41]

11:10 am: **Sensing and modeling urban boundary layer dynamics to better understand air quality health risks during heat waves**, Mark F. Arend, The City College of New York (USA); Julie Pullen, Philip Orton, Stevens Institute of Technology (USA); Abdul Jalloh, Fred Moshary, The City College of New York (USA) [8371A-43]

11:30 am: **Analytical determination and detection of odor signatures**, Ryan M. Kramer, Air Force Research Lab. (USA) [8371A-44]

11:50 am: **Analysis of carbon soil content by using tagged neutron activation**, Jasmina Obhodas, Darovin Sudac, Institut Ruder Boškovic (Croatia); Vladivoj Valkovic, A.C.T. d.o.o. (Croatia) [8371A-46]

12:10 pm: **Modeling distributed feedback semiconductor lasers for carbon dioxide gas sensing**, Meng-Mu Shih, Univ. of Florida (USA) [8371A-47]

12:30 pm: **Millimeter wave I-Q standoff biosensor**, Shaolin Liao, Sasan Bakhtiari, Thomas W. Elmer, Sr., Apostolos Paul C. Raptis, Argonne National Lab. (USA) [8371A-48]

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500 Companies

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Tuesday · 10:00 am to 5:00 pm
Wednesday · 10:00 am to 5:00 pm
Thursday · 10:00 am to 2:00 pm

Courses of Related Interest

- SC194 **Multispectral and Hyperspectral Image Sensors** (Lomheim) Tuesday, 1:30 to 5:30 pm
- SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm
- SC719 **Chemical & Biological Detection: Overview of Point and Standoff Sensing Technologies** (Gardner, Popa) Monday, 8:30 am to 5:30 pm
- SC995 **Target Detection Algorithms for Hyperspectral Imagery** (Nasrabadi) Thursday, 8:30 am to 5:30 pm
- SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Biometric Technology for Human Identification IX

Conference Chairs: **B. V. K. Vijaya Kumar**, Carnegie Mellon Univ. (USA); **Salil Prabhakar**, Consultant (USA); **Arun A. Ross**, West Virginia Univ. (USA)

Program Committee: **George Bebis**, Univ. of Nevada, Reno (USA); **Thirimachos Bourlai**, West Virginia Univ. (USA); **Julien Bringer**, Morpho (France); **Mark Burge**, The MITRE Corp. (USA); **Bernadette Dorizzi**, TELECOM & Management SudParis (France); **Eliza Yingzi Du**, Indiana Univ.-Purdue Univ. Indianapolis (USA); **Jianjiang Feng**, Tsinghua Univ. (); **Julian Fierrez**, Univ. Autónoma de Madrid (Spain); **Patrick J. Flynn**, Univ. of Notre Dame (USA); **Venu Govindaraju**, Univ. at Buffalo (USA); **John M. Irvine**, Draper Lab. (USA); **Anil K. Jain**, Michigan State Univ. (USA); **Sabah A. Jassim**, The Univ. of Buckingham (United Kingdom); **Ioannis A. Kakadiaris**, Univ. of Houston (USA); **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. (USA); **Karthik Nandakumar**, Institute for Infocomm Research (Singapore); **Karl Ricanek, Jr.**, Univ. of North Carolina at Wilmington (USA); **Marios Savvides**, Carnegie Mellon Univ. (USA); **Michael E. Schuckers**, St. Lawrence Univ. (USA); **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. (USA); **Pong C. Yuen**, Hong Kong Baptist Univ. (Hong Kong, China)

Monday 23 April

SESSION 6

Room: Conv. Ctr. 319 Mon. 8:30 to 10:10 am

Heterogeneous Face Recognition

8:30 am: **A study on using middle-wave infrared images for face recognition**, Thirimachos Bourlai, Arun A. Ross, Cunjian Chen, Lawrence A. Hornak, West Virginia Univ. (USA) [8371B-54]

8:50 am: **Thermal to visible face recognition**, Jonghyun Choi, Univ. of Maryland, College Park (USA); Shuowen Hu, S. Susan Young, U.S. Army Research Lab. (USA); Larry S. Davis, Univ. of Maryland, College Park (USA) [8371B-55]

9:10 am: **Face recognition in the virtual world: recognizing avatar faces**, Roman V. Yampolskiy, Univ. of Louisville (USA); Brendan Klare, Anil K. Jain, Michigan State Univ. (USA) [8371B-56]

9:30 am: **Dictionary-based methods for face and iris recognition** (*Invited Paper*), Rama Chellappa, Univ. of Maryland, College Park (USA) [8371B-57]

Coffee Break 10:10 to 10:40 am

SESSION 7

Room: Conv. Ctr. 319 Mon. 10:40 to 11:40 am

Biometric Sensor Design

10:40 am: **Full-hand, 3D, non-contact scanner using sub-window-based, structured-light-illumination technique**, Veeraganesh Yalla, Flashscan3D LLC (USA); Laurence G. Hassebrook, Univ. of Kentucky (USA); Ray Daley, Colby Boles, Mike Troy, Flashscan3D LLC (USA) [8371B-58]

11:00 am: **Relaxing the constraints on image capture for iris recognition systems**, Peter A. Smith, TASC, Inc. (USA); John M. Rickman, TASC, Inc (USA) [8371B-59]

11:20 am: **Design and implementation of a contactless, multiple-hand-feature acquisition system**, Qiushi Zhao, Harbin Institute of Technology (China) and The Hong Kong Polytechnic Univ. (Hong Kong, China); Wei Bu, Xiangqian Wu, Harbin Institute of Technology (China); David Zhang, The Hong Kong Polytechnic Univ. (Hong Kong, China) [8371B-60]

Lunch Break 11:40 am to 1:00 pm

SESSION 8

Room: Conv. Ctr. 319 Mon. 1:00 to 2:40 pm

Novel Biometric Cues

1:00 pm: **3D face recognition opportunities and challenges** (*Invited Paper*), Ioannis A. Kakadiaris, Univ. of Houston (USA) [8371B-61]

1:40 pm: **Gait identification from invisible shadows**, Yumi Iwashita, Kyushu Univ. (Japan) and Jet Propulsion Lab. (USA); Koji Uchino, Ryo Kurazume, Kyushu Univ. (Japan); Adrian Stoica, Jet Propulsion Lab. (USA) [8371B-62]

2:00 pm: **Biometrics via IR spectroscopy of the epidermis: potential and difficulties**, David M. Mackie, U.S. Army Research Lab. (USA) [8371B-63]

2:20 pm: **Fusion of footsteps and face biometrics on an unsupervised and uncontrolled environment**, Ruben Vera-Rodriguez, Pedro Tome, Julian Fierrez, Javier Ortega-Garcia, Univ. Autónoma de Madrid (Spain) [8371B-64]

SESSION 9

Room: Conv. Ctr. 319 Mon. 2:40 to 4:45 pm

Ocular and Vascular Biometrics

2:40 pm: **Matching challenging ocular images** (*Invited Paper*), B. V. K. Vijaya Kumar, Carnegie Mellon Univ. (USA) [8371B-65]

Coffee Break 3:20 to 3:45 pm

3:45 pm: **A study on quality adjusted impact of time lapse on iris recognition**, Nadezhda A. Sazonova, The Univ. of Alabama (USA); Fang Hua, Clarkson Univ. (USA); Xuan Liu, Univ. of Florida (USA); Jeremiah J. Remus, Clarkson Univ. (USA); Arun A. Ross, Lawrence A. Hornak, West Virginia Univ. (USA); Stephanie Schuckers, Clarkson Univ. (USA) [8371B-66]

4:05 pm: **CUE: counterfeit-resistant usable eye-based authentication via oculomotor plant characteristics and complex eye movement patterns**, Oleg V. Komogortsev, Alex Karpov, Corey Holland, Texas State Univ. San Marcos (USA) [8371B-67]

4:25 pm: **Multiple hand vein recognition based on orientation of LBP**, Wei Bu, Xiangqian Wu, Enying Gao, Kuanquan Wang, Harbin Institute of Technology (China) [8371B-68]

Ocean Sensing and Monitoring IV

Conference Chairs: **Weilin Will Hou**, U.S. Naval Research Lab. (USA); **Robert Arnone**, U.S. Naval Research Lab. (USA)

Program Committee: **Todd E. Bowers**, Naval Oceanographic Office (USA); **Kendall L. Carder**, SRI International (USA); **James H. Churnside**, National Oceanic and Atmospheric Administration (USA); **Percy L. Donaghay**, The Univ. of Rhode Island (USA); **Linda J. Mullen**, Naval Air Systems Command (USA); **Mitchell A. Roffer**, Roffer's Ocean Fishing Forecasting Service, Inc. (USA); **Jon Schoonmaker**, Advanced Coherent Technologies LLC (USA); **Charles Trees**, NATO Undersea Research Ctr. (Italy); **Michael S. Twardowski**, WET Labs., Inc. (USA); **Alan Weidemann**, U.S. Naval Research Lab. (USA); **Sarah Woods**, U.S. Naval Research Lab. (USA)

Tuesday 24 April

SESSION 1

Room: Conv. Ctr. 322 Tues. 1:30 to 5:00 pm

Imaging the Ocean

Session Chairs: **Linda J. Mullen**, Naval Air Systems Command (USA); **Jon Schoonmaker**, Advanced Coherent Technologies LLC (USA)

1:30 pm: **Modular multichannel imaging system for littoral observation and target detection** (*Invited Paper*), Jon Schoonmaker, Cynthia Boucher, Yuliya Podobna, Steven Saggese, Advanced Coherent Technologies LLC (USA) [8372-01]

2:00 pm: **Compact optical system for imaging underwater and through the air/sea interface**, Derek M. Alley, Linda J. Mullen, Alan Laux, Naval Air Systems Command (USA); Walton E. McBride III, U.S. Naval Research Lab. (USA) [8372-02]

2:20 pm: **Scattered photons as useable signal for underwater imaging**, Walton E. McBride III, U.S. Naval Research Lab. (USA) [8372-03]

2:40 pm: **In-situ digital holography and adaptive sampling enable the study of the interactions of particles, organisms and bubbles within their natural environment**, Siddharth Talapatra, The Johns Hopkins Univ. (USA); James M. Sullivan, WET Labs., Inc. (USA); Joseph Katz, The Johns Hopkins Univ. (USA); Michael S. Twardowski, WET Labs., Inc. (USA); Percy L. Donaghay, The Univ. of Rhode Island (USA); Jiarong Hong, The Johns Hopkins Univ. (USA); Jan Rines, Malcolm N. McFarland, The Univ. of Rhode Island (USA); Aditya Nayak, Cao Zhang, The Johns Hopkins Univ. (USA) [8372-04]

Coffee/Exhibition Break 3:00 to 3:40 pm

3:40 pm: **Bahamas optical turbulence exercise (BOTEX)**, Weilin W. Hou, Ewa Jorosz, Sarah Woods, U.S. Naval Research Lab. (USA) [8372-05]

4:00 pm: **The spatial and temporal structure of thermal fluctuations associated with a vertical turbulent jet impinging a water surface: laboratory experiments and field observations**, K. Peter Judd, Ivan Savelyev, Geoffrey B. Smith, George O. Marmorino, U.S. Naval Research Lab. (USA) [8372-07]

4:20 pm: **An optically remote powered subsea video monitoring system**, Fat Kit Lau, Brian G. Stewart, Glasgow Caledonian Univ. (United Kingdom); Danny McStay, FMC Technologies Ltd. (United Kingdom) [8372-08]

4:40 pm: **Integration of SAR and AIS for ship detection and identification**, Chan-Su Yang, Tae-Ho Kim, Eun Kyung Oh, Korea Ocean Research & Development Institute (Korea, Republic of) [8372-09]

Wednesday 25 April

SESSION 2

Room: Conv. Ctr. 322 Wed. 8:00 to 9:00 am

Oil Spill Detection

Session Chair: **Mitchell A. Roffer**, Roffer's Ocean Fishing Forecasting Service, Inc. (USA)

8:00 am: **Development of a fluorescence polarization submersible instrument for the detection of submerged heavy oil spill**, Job Bello, Anton G. Smirnov, Patrick Toomey, EIC Labs., Inc. (USA) [8372-10]

8:20 am: **Introduction of oil spill monitoring and response support system using satellite remote sensing**, Tae-ho Kim, Eun Kyung Oh, Chan-Su Yang, Korea Ocean Research & Development Institute (Korea, Republic of) . . . [8372-11]

8:40 am: **Fingerprinting of crude oil using fluorescence spectroscopy**, A. Sheila Holmes-Smith, Mahesh Uttamial, Donald M. Hepburn, Glasgow Caledonian Univ. (United Kingdom); Alan Graham, David Faichnie, FMC Technologies Ltd. (United Kingdom) [8372-12]

SESSION 3

Room: Conv. Ctr. 322 Wed. 9:00 am to 12:30 pm

Remote Sensing of the Oceans: NPP VIIRS I

Session Chairs: **Changyong Cao**, National Oceanic and Atmospheric Administration (USA); **Robert Arnone**, U.S. Naval Research Lab. (USA)

9:00 am: **Application of laser-source based calibration for VIIRS for ultra-high accuracy radiometric calibration and some considerations on uses of those calibrations for ocean color studies** (*Invited Paper*), Bruce Guenther, Univ. of Maryland, Baltimore County (USA) [8372-13]

9:30 am: **Early results from NPP VIIRS on-orbit calibration** (*Invited Paper*), Xiaoxiong Xiong, NASA Goddard Space Flight Ctr. (USA); Changyong Cao, National Oceanic and Atmospheric Administration (USA); Frank DeLuccia, The Aerospace Corp. (USA); Bruce Guenther, Univ. of Maryland, Baltimore County (USA); Jim Butler, NASA Goddard Space Flight Ctr. (USA) [8372-14]

Coffee Break 10:00 to 10:30 am

10:30 am: **Validation of ocean color on VIIRS** (*Invited Paper*), Robert Arnone, U.S. Naval Research Lab. (USA) [8372-15]

11:00 am: **Initial results of NPP VIIRS SST processing at NAVOCEANO**, Bruce McKenzie, U.S. Navy (USA); Douglas A. May, U.S. Naval Research Lab. (USA); Keith D. Willis, Naval Oceanographic Office (USA); Jean-Francois P. Cayula, QinetiQ North America (USA) [8372-16]

11:20 am: **Monitoring of IR clear-sky radiances over oceans for SST (MICROS): readiness for NPP/VIIRS**, Xingming Liang, NOAA/NESDIS (USA) and Cooperative Institute for Research in the Atmosphere (USA); Alexander Ignatov, NOAA/NESDIS (USA); Korak Saha, NOAA/NESDIS (USA) and Cooperative Institute for Research in the Atmosphere (USA) [8372-17]

11:40 am: **Automated ocean color product validation for the Southern California Bight** (*Invited Paper*), Curtiss O. Davis, Nicholas Tufflaro, Oregon State Univ. (USA); Robert Arnone, U.S. Naval Research Lab. (USA); Burt Jones, The Univ. of Southern California (USA) [8372-18]

12:10 pm: **A methodology for calibration of hyperspectral and multispectral satellite data in coastal areas**, Giuliana Pennucci, NATO Undersea Research Ctr. (Italy); Giulietta S. Fargion, San Diego State Univ. (USA); Alberto Alvarez, Charles Trees, NATO Undersea Research Ctr. (Italy); Robert Arnone, U.S. Naval Research Lab. (USA) [8372-19]

Lunch/Exhibition Break 12:30 to 1:50 pm

SESSION 4

Room: Conv. Ctr. 322 Wed. 1:50 to 2:30 pm

Remote Sensing of the Oceans: NPP VIIRS II

Session Chairs: **Giulietta S. Fargion**, San Diego State Univ. (USA);
Robert Arnone, U.S. Naval Research Lab. (USA)

1:50 pm: **Selecting a first-guess SST as input to ACSP0**, Korak Saha, NOAA/NESDIS (USA) and Cooperative Institute for Research in the Atmosphere (USA); Alexander Ignatov, NOAA/NESDIS (USA); XingMing Liang, NOAA/NESDIS (USA) and Cooperative Institute for Research in the Atmosphere (USA); Prasanjit Dash, NOAA/NESDIS (USA) and Cooperative Institute for Research in the Atmospheres (USA) [8372-20]

2:10 pm: **Evaluation of atmospheric correction procedures for ocean color data processing using hyper- and multi-spectral radiometric measurements from the Long Island Sound Coastal Observatory**, Samir A. Ahmed, Alexander Gilerson, The City College of New York (USA); Tristan Harmel, Observatoire Océanologique de Villefranche sur Mer (France); Soe Hlaing, Alberto Tonizzo, The City College of New York (USA); Alan Weidemann, Robert Arnone, U.S. Naval Research Lab. (USA) [8372-21]

SESSION 5

Room: Conv. Ctr. 322 Wed. 2:30 to 6:00 pm

Lidar on Ocean Processes

Session Chairs: **Charles Trees**,
NATO Undersea Research Ctr. (Italy); **James H. Churnside**,
National Oceanic and Atmospheric Administration (USA)

2:30 pm: **Airborne lidar as a tool for estimating inherent optical properties (Invited Paper)**, Charles Trees, NATO Undersea Research Ctr. (Italy); Robert Arnone, U.S. Naval Research Lab. (USA) [8372-22]

3:00 pm: **Probing the subsurface ocean processes using ocean lidars**, Robert Arnone, Sergio deRada, Sherwin D. Ladner, U.S. Naval Research Lab. (USA); Charles Trees, NATO Undersea Research Ctr. (Italy) [8372-23]

Coffee/Exhibition Break 3:20 to 4:10 pm

4:10 pm: **Airborne lidar sensing of internal waves in a shallow fjord (Invited Paper)**, James H. Churnside, National Oceanic and Atmospheric Administration (USA); Richard D. Marchbanks, Cooperative Institute for Research in the Environmental Sciences (USA); Jennifer H. Lee, National Oceanic and Atmospheric Administration (USA); Joseph A. Shaw, Montana State Univ. (USA); Alan Weidemann, U.S. Naval Research Lab. (USA); Percy L. Donaghay, The Univ. of Rhode Island (USA) [8372-24]

4:40 pm: **Remote sensing of sound speed in the ocean via Brillouin scattering**, Edward S. Fry, Texas A&M Univ. (USA) [8372-25]

5:00 pm: **Multichannel deconvolution for underwater synchronous scan lidar image enhancement**, Bing Ouyang, Fraser R. Dalgleish, Frank M. Caimi, Florida Atlantic Univ. (USA); Anni K. Vuorenkoski, Harbor Branch Oceanographic Institute (USA); Thomas E. Giddings, Joseph Shirron, Metron, Inc. (USA) [8372-26]

5:20 pm: **A modulated-pulse laser for underwater detection, ranging, imaging, and communications**, Brandon Cochenour, Linda J. Mullen, Naval Air Systems Command (USA) [8372-27]

5:40 pm: **Polarization techniques for the retrieval of water parameters from above and below water polarimetric observations**, Alexander Gilerson, Amir Ibrahim, The City College of New York (USA); Tristan Harmel, Observatoire Océanologique de Villefranche sur Mer (France); Alberto Tonizzo, Samir A. Ahmed, The City College of New York (USA) [8372-28]

Thursday 26 April

SESSION 6

Room: Conv. Ctr. 322 Thurs. 8:00 to 10:10 am

Remote and In Situ Sensing of the Oceans I

Session Chairs: **Michael Twardowski**, WET Labs., Inc. (USA);
Todd E. Bowers, Naval Oceanographic Office (USA)

8:00 am: **Biological thin layers: history, ecological significance and consequences to oceanographic sensing systems (Invited Paper)**, James M. Sullivan, WET Labs, Inc. (USA) and The Univ. of Rhode Island (USA); Michael S. Twardowski, WET Labs., Inc. (USA); Percy L. Donaghay, Jan Rines, Malcolm N. McFarland, The Univ. of Rhode Island (USA); Siddharth Talapatra, Joseph Katz, The Johns Hopkins Univ. (USA); James H. Churnside, National Oceanic and Atmospheric Administration (USA); Alan Weidemann, U.S. Naval Research Lab. (USA) [8372-29]

8:30 am: **Development of new fusion products using satellite infrared, visible, synthetic aperture radar and altimetry data during the Deepwater Horizon oil spill in the Gulf of Mexico, 2010**, Mitchell A. Roffer, Gregory A. Gawlickowski, Mathew A. Upton, Roffer's Ocean Fishing Forecasting Service, Inc. (USA); Frank E. Muller-Karger, Univ. of South Florida (USA); Gustavo Goni, Joaquin Trinanes, National Oceanic and Atmospheric Administration (USA) [8372-30]

8:50 am: **Navy coastal environmental sensing**, Todd E. Bowers, Naval Oceanographic Office (USA) [8372-31]

9:10 am: **Tools required for ocean observing: the alliance for coastal technologies**, Mario N. Tamburri, Univ. of Maryland Ctr. for Environmental Science (USA) and Alliance for Coastal Technologies (USA) [8372-32]

9:30 am: **High resolution modeling using in-situ observations from sensor hosting and remote characterization (SHARC) solar and wave energy harvesting vehicle**, Stephen Lingsch, Naval Oceanographic Office (USA) [8372-33]

9:50 am: **Forecasting the ocean optical environment in support of Navy mine warfare operations**, Sherwin D. Ladner, Robert Arnone, Jason Jolliff, U.S. Naval Research Lab. (USA); Brandon Casey, QinetiQ Inc. (USA); Kenneth Matulewski, Naval Oceanographic Office (USA) [8372-34]

Coffee Break 10:10 to 10:40 am

SESSION 7

Room: Conv. Ctr. 322 Thurs. 10:40 am to 12:00 pm

Remote and In Situ Sensing of the Oceans II

Session Chairs: **Percy L. Donaghay**, The Univ. of Rhode Island (USA);
Michael Twardowski, WET Labs., Inc. (USA)

10:40 am: **Cross-calibrating Landsat 7 with Terra/MODIS over dark waters**, Nima Pahlevan, Nina G. Raqueno, John R. Schott, Rochester Institute of Technology (USA) [8372-35]

11:00 am: **Over-water atmospheric correction techniques for Landsat's new OLI sensor**, Aaron D. Gerace, John R. Schott, Rochester Institute of Technology (USA) [8372-36]

11:20 am: **Scanning flow cytometry reveals importance of scatter by large marine phytoplankton**, Malcolm N. McFarland, Jan Rines, Percy L. Donaghay, The Univ. of Rhode Island (USA); James M. Sullivan, WET Labs, Inc. (USA) [8372-37]

11:40 am: **Low-cost, fluorescence-based microfluidic sensor for measurements of pCO₂ in seawater**, Xudong Ge, Robert Henderson, Yordan V. Kostov, Govind Rao, Univ. of Maryland, Baltimore County (USA) [8372-38]

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

SESSION 8

Room: Conv. Ctr. 322 Thurs. 1:40 to 4:30 pm

Remote and In Situ Sensing of the Oceans III

Session Chairs: **Weilin Will Hou**, U.S. Naval Research Lab. (USA);
Alan Weidemann, U.S. Naval Research Lab. (USA)

1:40 pm: **Stability augmentation and mosaic method of forward-scan sonar images**, Shaorong Xie, Jun Luo, Jinbo Chen, Yuanyu XU, Shanghai Univ. (China) [8372-39]

2:00 pm: **Sonar watermark embedding and detection: a sea trial report**, Bijan G. Mobasser, Villanova Univ. (USA); Nagarjun Chakilam, The MathWorks, Inc. (USA); Robert S. Lynch, Naval Undersea Warfare Ctr. (USA) [8372-40]

2:20 pm: **Comparison of sea-level measurements using microwave radar and subsurface pressure gauge deployed in Mandovi estuary in Goa, central west coast of India**, Prakash Mehra, Yogesh Agarvadekar, Ryan Luis, Lalsab Nadaf, National Institute of Oceanography (India) [8372-42]

2:40 pm: **Study of wind speed attenuation at Kavaratti Island using land-based, offshore, and satellite measurements**, Antony Joseph, National Institute of Oceanography (India); Pradhan Rivonkar, Systems Electronics (India); T. M. Balakrishnan Nair, Indian National Ctr. for Ocean Information Services (India) [8372-43]

Coffee Break 3:00 to 3:30 pm

3:30 pm: **Statistical modeling of tropical cyclones' longevity after landfall in Australia**, Kamal K. Saha, Saleh A. Wasimi, Central Queensland Univ., Rockhampton (Australia) [8372-44]

3:50 pm: **Underwater text messaging and locating system for a network of divers**, Ranga Narayanaswami, Scientific Systems Co., Inc. (USA); Milica Stojanovic, Northeastern Univ. (USA); Carlos Gutierrez, Scientific Systems Co., Inc. (USA) [8372-45]

4:10 pm: **Hawaiian sun in New Hampshire waters: a simulation of natural environmental settings**, Shachak Pe'eri, Glenn T. Shwaery, The Univ. of New Hampshire (USA) [8372-41]

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Underwater laser range finder, Alan Laux, Linda J. Mullen, Naval Air Systems Command (USA); Paul Perez, Clarkson Univ. (USA); Eleonora P. Zege, B.I. Stepanov Institute of Physics (Belarus) [8372-46]

Microscope for researching underwater objects, Alexey D. Frolov, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation); Olga A. Vinogradova, Dmitry N. Frolov, Labor-Microscopes (Russian Federation) [8372-47]

Development of a low cost unmanned surface vehicle for military applications, Arturo E. Cadena, Jr., Ecuadorian Navy (Ecuador) [8372-48]

Courses of Related Interest

SC1077 **Introduction to Optical Oceanography** (Hou) Monday, 1:30 to 5:30 pm

SC194 **Multispectral and Hyperspectral Image Sensors** (Lomheim) Tuesday, 1:30 to 5:30 pm

SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm

SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours



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Micro- and Nanotechnology Sensors, Systems, and Applications IV

Conference Chairs: **Thomas George**, Zyomed Corp. (USA); **M. Saif Islam**, Univ. of California, Davis (USA); **Achyut Dutta**, Banphil Photonics, Inc. (USA)

Program Committee: **Scott D. Collins**, Univ. of Maine (USA); **Nibir K. Dhar**, Defense Advanced Research Projects Agency (USA); **Ernest J. Garcia**, Sandia National Labs. (USA); **Joan A. Hoffmann**, The Johns Hopkins Univ. Applied Physics Lab. (USA); **Mogens H. Jakobsen**, Technical Univ. of Denmark (Denmark); **Shanalyn A. Kemme**, Sandia National Labs. (USA); **Christopher M. Kroninger**, U.S. Army Research Lab. (USA); **Ryan P. Lu**, Space and Naval Warfare Systems Command (USA); **Joseph N. Mait**, U.S. Army Research Lab. (USA); **Michael C. McAlpine**, Princeton Univ. (USA); **William D. Nothwang**, U.S. Army Research Lab. (USA); **Robert Osiander**, The Johns Hopkins Univ. Applied Physics Lab. (USA); **Nezih Pala**, Florida International Univ. (USA); **Stergios J. Papadakis**, The Johns Hopkins Univ. Applied Physics Lab. (USA); **Michael T. Postek**, National Institute of Standards and Technology (USA); **Michael K. Rafailov**, The Reger Group (USA); **Noriko Satake**, UC Davis Medical Ctr. (USA); **Andre U. Sokolnikov**, Visual Solutions and Applications (USA); **Kyung-Ah Son**, Jet Propulsion Lab. (USA); **Thomas G. Thundat**, Univ. of Alberta (Canada); **Morgana Trexler**, The Johns Hopkins Univ. Applied Physics Lab. (USA); **Christopher C. Wilcox**, U.S. Naval Research Lab. (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 317 Mon. 8:00 to 11:50 am

Mesodynamic Architectures I

Session Chair: **Ryan P. Lu**,

Space and Naval Warfare Systems Command (USA)

- 8:00 am: **MesoDynamic Architectures (Meso) Program** (*Keynote Presentation*), Jeffrey Rogers, Defense Advanced Research Projects Agency (USA) ... [8373-01]
- 8:30 am: **Electrochemical quantum tunneling for electronic detection and characterization of biological toxins** (*Invited Paper*), Chaitanya Gupta, Ross Walker, Rishi Gharapuray, Max Shulaker, Zhiyong Zhang, Mehdi Javanmard, Ronald W. Davis, Boris Murmann, Roger T. Howe, Stanford Univ. (USA) [8373-02]
- 8:50 am: **Piezoelectronics: a novel, high-performance, low-power computer switching technology** (*Invited Paper*), Dennis M. Newns, Glenn J. Martyna, Bruce G. Elmegreen, Xiao-Hu Liu, Thomas N. Theis, IBM Thomas J. Watson Research Ctr. (USA) [8373-03]
- 9:10 am: **Communication and navigation applications of nonlinear micro/nanoscale resonator oscillators** (*Invited Paper*), Jon Lovseth, Ted Hoffmann, Sai Kalyanaraman, Andrew Reichenauer, Vadim Olen, Dennis Hrcirik, Rockwell Collins, Inc. (USA) [8373-04]
- 9:30 am: **Dynamics-enabled quartz reference oscillators** (*Invited Paper*), David Chang, Harris P. Moyer, Randall L. Kubena, Richard J. Joyce, Deborah J. Kirby, Peter D. Brewer, Hung Nguyen, Frederic P. Stratton, HRL Labs., LLC (USA) [8373-05]
- 9:50 am: **Topological surface state: science and potential applications** (*Invited Paper*), Ali Yazdani, Princeton Univ. (USA) [8373-06]
- Coffee Break 10:10 to 10:30 am
- 10:30 am: **Coherent feedback control in nanophotonic circuits** (*Invited Paper*), Hideo Mabuchi, Stanford Univ. (USA) [8373-07]
- 10:50 am: **Topological materials and their applications in electronics** (*Invited Paper*), Shoucheng Zhang, Stanford Univ. (USA) [8373-08]
- 11:10 am: **Piezoelectric nonlinear nanomechanical temperature and acceleration insensitive clocks** (*Invited Paper*), Gianluca Piazza, Augusto Tazzoli, Matteo Rinaldi, Jeronimo Segovia, Cristian Cassella, Brian Otis, Janlei Shi, Kimberly L. Turner, Chris Burgner, Kamala McNaul, Valeriy Felmetzger, Dave Bail, Univ. of Pennsylvania (USA) [8373-09]
- 11:30 am: **Topological insulator coherent energy devices** (*Invited Paper*), Yong P. Chen, Purdue Univ. (USA) [8373-10]
- Lunch Break 11:50 am to 12:50 pm

SESSION 2

Room: Conv. Ctr. 317 Mon. 12:50 to 2:10 pm

Mesodynamic Architectures II

Session Chair: **Ryan P. Lu**,

Space and Naval Warfare Systems Command (USA)

- 12:50 pm: **Coherent wavelength translation with optomechanics** (*Invited Paper*), Oskar J. Painter, California Institute of Technology (USA) [8373-11]
- 1:10 pm: **Information transduction based on magnons** (*Invited Paper*), Hong Tang, Yale Univ. (USA) [8373-12]
- 1:30 pm: **Stimulated Mach-wave phonon emission: toward broadband phonon emitters and phonon lasers** (*Invited Paper*), Peter T. Rakich, Charles M. Reinke, Ryan M. Camacho, Paul Davids, Ihab El-kady, Roy H. Olsson III, Darren W. Branch, Robert L. Jarecki, Sandia National Labs. (USA); Zheng Wang, Massachusetts Institute of Technology (USA) [8373-13]
- 1:50 pm: **Nonlinear nanoelectromechanical systems** (*Invited Paper*), Michael L. Roukes, California Institute of Technology (USA) [8373-14]

SESSION 3

Room: Conv. Ctr. 317 Mon. 2:10 to 4:20 pm

Novel Micro/Nano Approaches for Radiation Sensors and Materials

Session Chair: **Joan A. Hoffmann**,

The Johns Hopkins Univ. Applied Physics Lab. (USA)

- 2:10 pm: **Basic research interests in nanoscale radiation sensing** (*Keynote Presentation*), Calvin Shipbaugh, Defense Threat Reduction Agency (USA) [8373-15]
- 2:40 pm: **Graphene for radiation sensing and rad-hard electronics** (*Invited Paper*), Yong P. Chen, Purdue Univ. (USA) [8373-16]
- Coffee Break 3:00 to 3:20 pm
- 3:20 pm: **Microstructured semiconductor neutron detectors** (*Invited Paper*), Douglas S. McGregor, Steven L. Bellinger, Brian Cooper, Ryan G. Fronk, Timothy J. Sobering, J. Kenneth Shultis, Kansas State Univ. (USA) [8373-17]
- 3:40 pm: **Investigation of graphene-based nanoscale radiation sensitive materials** (*Invited Paper*), Joshua Robinson, Maxwell Wetherington, Michael LaBella, Michael Bresnehan, Zachary Hughes, David W. Snyder, The Pennsylvania State Univ. (USA) [8373-19]
- 4:00 pm: **Nanocomposites for radiation sensing** (*Invited Paper*), Brent K. Wagner, Zhitao Kang, Jason Nadler, Bernd Kahn, Robert Rosson, Georgia Tech Research Institute (USA) [8373-20]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

Introduction

Room: Conv. Ctr. 317 Tues. 7:55 to 8:00 am

SESSION 4

Room: Conv. Ctr. 317 Tues. 8:00 to 9:50 am

Scanning Microscopies for Micro- and Nanotechnology Applications

Note Room Change

Joint Session with Conference 8378

Session Chairs: **Michael T. Postek**, National Institute of Standards and Technology (USA); **Thomas George**, Zyomed Corp. (USA)

8:00 am: **Past, present, and future of BSE imaging in the SEM** (*Invited Paper*), Oliver C. Wells, Lynne M. Gignac, Michael S. Gordon, IBM Thomas J. Watson Research Ctr. (USA) [8378-01]

8:30 am: **Faults and foibles of quantitative EDS** (*Invited Paper*), Dale E. Newbury, National Institute of Standards and Technology (USA) [8378-02]

8:50 am: **Quantitative mechanical mapping at nanometer scale** (*Invited Paper*), Chanmin Su, Bruker Nano Inc. (USA) [8378-03]

9:10 am: **Nanoscale chemical composition mapping of polymers at 100nm spatial resolution with AFM-based IR spectroscopy** (*Invited Paper*), Kevin Kjoller, Craig B. Prater, Mike Lo, Anasys Instruments (USA); Alexandre Dazzi, Univ. of Paris-Sud-XI (France); Roshan Shetty, Anasys Instruments (USA) [8373-21]

9:30 am: **Does your SEM really tell the truth?** (*Invited Paper*), Michael T. Postek, National Institute of Standards and Technology (USA) [8378-04]

Coffee Break 9:50 to 10:20 am

SESSION 5

Room: Conv. Ctr. 317 Tues. 10:20 am to 12:10 pm

Micro- and Nanotechnology for Health Care

Session Chairs: **Noriko Satake**, UC Davis Medical Ctr. (USA); **Scott D. Collins**, Univ. of Maine (USA)

10:20 am: **A revolution in DNA sequencing technologies: beyond the \$1,000 genome** (*Keynote Presentation*), Jeffery A. Schloss, National Institutes of Health (USA) [8373-22]

10:50 am: **Molecular targeting in childhood malignancies using nanoparticles** (*Invited Paper*), Noriko Satake M.D., Elva Diaz, UC Davis Medical Ctr. (USA); Nitin Nitin, Univ. of California, Davis (USA); Jan Nolta, Kit S. Lam, UC Davis Medical Ctr. (USA) [8373-23]

11:10 am: **Solid state nanopore sensors for DNA analysis** (*Invited Paper*), Rashid Bashir, Univ. of Illinois at Urbana-Champaign (USA) [8373-24]

11:30 am: **Fabrication and characterization of a solid state nanopore with self-aligned carbon nanoelectrodes for molecular detection** (*Invited Paper*), Scott D. Collins, Patrick S. Spinney, Univ. of Maine (USA); David G. Howitt, Univ. of California, Davis (USA); Rosemary L. Smith, Univ. of Maine (USA) ... [8373-25]

11:50 am: **MRI-guided, ultrasound-mediated drug delivery to solid tumors: current problems** (*Invited Paper*), Natalya Rapoport, The Univ. of Utah (USA) [8373-26]

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

SESSION 6

Room: Conv. Ctr. 317 Tues. 1:10 to 3:00 pm

Beam Control Systems Using MEMS and Liquid Crystals

Session Chair: **Christopher C. Wilcox**, U.S. Naval Research Lab. (USA)

1:10 pm: **MEMS- and LC-adaptive optics at the Naval Research Laboratory** (*Keynote Presentation*), Sergio R. Restaino, Christopher C. Wilcox, Ty Martinez, Jonathan R. Andrews, Freddie Santiago, U.S. Naval Research Lab. (USA); Don M. Payne, Narrascope, Inc. (USA) [8373-27]

1:40 pm: **Closed-loop performance of an actuated deformable carbon fiber reinforced polymer mirror** (*Invited Paper*), Christopher C. Wilcox, U.S. Naval Research Lab. (USA); Matthew E. L. Jungwirth, David V. Wick, Michael S. Baker, Clinton G. Hobart, Sandia National Labs. (USA); Robert C. Romeo, Robert N. Martin, Composite Mirror Applications, Inc. (USA) [8373-28]

2:00 pm: **Theory and design of a MEMS-enabled diffraction limited adaptive optical zoom system** (*Invited Paper*), Matthew E. L. Jungwirth, College of Optical Sciences, The Univ. of Arizona (USA); David V. Wick, Sandia National Labs. (USA) [8373-29]

2:20 pm: **Unconventional adaptive optics at the University of Arizona** (*Invited Paper*), Michael Hart, Olivier Guyon, Johanan L. Codona, S. Mark Ammons, The Univ. of Arizona (USA) [8373-30]

2:40 pm: **Implementation of a phase-only, spatial-light modulator (SLM) for an atmospheric turbulence simulator at the short wavelength infrared (SWIR) regime** (*Invited Paper*), Carlos O. Font, Christopher C. Wilcox, Freddie Santiago, G. Charmaine Gilbreath, David Bonanno, U.S. Naval Research Lab. (USA) [8373-31]

Coffee Break 3:00 to 3:30 pm

SESSION 7

Room: Conv. Ctr. 317 Tues. 3:30 to 5:20 pm

Emerging Micro- and Nanotechnologies for Sensing in Challenging Environments

Session Chair: **Kyung-Ah Son**, HRL Labs., LLC (USA)

3:30 pm: **The process of developing an instrument: the JPL electronic nose** (*Keynote Presentation*), Margaret A. Ryan, Pacific Northwest National Lab. (USA) [8373-37]

4:00 pm: **Materials development for radiation detection** (*Invited Paper*), Chae Lee, Raytheon Co. (USA) [8373-33]

4:20 pm: **Electrochemical, high-temperature gas sensors** (*Invited Paper*), Bilge Saruhan-Brings, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) [8373-34]

4:40 pm: **Graphene-based chemical sensors** (*Invited Paper*), Nikhil A. Koratkar, Rensselaer Polytechnic Institute (USA) [8373-35]

5:00 pm: **Nano/bio-hybrids for all electronic chemical detection** (*Invited Paper*), A.T. Charlie Johnson, Univ. of Pennsylvania (USA) [8373-36]

Wednesday 25 April

SESSION 8

Room: Conv. Ctr. 317 Wed. 8:00 to 9:50 am

Nanotechnologies for Energy Generation and Storage

Note Room Change

Joint Session with Conference 8377

Session Chairs: **Michael C. McAlpine**, Princeton Univ. (USA);
Nezih Pala, Florida International Univ. (USA)

- 8:00 am: **Materials research at DARPA** (*Keynote Presentation*), Brian C. Holloway, Defense Advanced Research Projects Agency (USA) [8373-38]
- 8:30 am: **Light management on industrial-size c-Si solar cells by Si nanowires fabricated by electroless etching** (*Invited Paper*), Rasiit Turan, Mustafa Kulakci, Baris Ozdemir, Husnu E. Unalan, Middle East Technical Univ. (Turkey) . . . [8373-39]
- 8:50 am: **Tailoring absorption and emission properties in semiconductor nanowires with nanocavity plasmons for photovoltaic applications** (*Invited Paper*), Ritesh Agarwal, Univ. of Pennsylvania (USA) [8373-40]
- 9:10 am: **Multijunction nanowire solar cells based on III-V nanowire arrays synthesized using MOCVD** (*Invited Paper*), Chongwu Zhou, The Univ. of Southern California (USA) [8373-41]
- 9:30 am: **Silicon-based bulk nanostructured thermoelectric generators** (*Invited Paper*), Akram Boukai, Univ. of Michigan (USA) [8373-42]
- Coffee/Lunch/Exhibition Break 9:50 am to 1:00 pm

SESSION 9

Room: Conv. Ctr. 317 Wed. 1:00 to 2:50 pm

Systems Engineering for Microsystems: From Research to Applications

Session Chair: **Robert Osiander**, The Johns Hopkins Univ. Applied Physics Lab. (USA)

- 1:00 pm: **Applying systems engineering methodologies to the micro- and nanoscale realm** (*Keynote Presentation*), M. Ann Garrison-Darrin, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8373-43]
- 1:30 pm: **Leveraging scale effects to create next-generation photovoltaic systems through micro- and nanotechnologies** (*Invited Paper*), Gregory N. Nielson, Sandia National Labs. (USA) [8373-44]
- 1:50 pm: **Systems engineering at the nanoscale** (*Invited Paper*), Jason J. Benkoski, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8373-45]
- 2:10 pm: **Nano-infusion: a new technology platform** (*Invited Paper*), Terrence G. Vargo, Integument Technologies, Inc. (USA) [8373-46]
- 2:30 pm: **Electrofluidic systems for contrast management** (*Invited Paper*), Keith J. Rebello, Jeffrey Maranchi, Jason Tiffany, Christopher Brown, Adam Maisano, The Johns Hopkins Univ. Applied Physics Lab. (USA); Matthew Hagedon, Jason C. Heikenfeld, Univ. of Cincinnati (USA) [8373-47]
- Coffee Break 2:50 to 3:20 pm

SESSION 10

Room: Conv. Ctr. 317 Wed. 3:20 to 4:50 pm

Heterogeneous Integration of Multifunctional Materials, Devices, and Micro/Nanosystems

Session Chair: **M. Saif Islam**, Univ. of California, Davis (USA)

- 3:20 pm: **Heterogeneous integration of semiconductor materials: basic issues, current progress, and future prospects** (*Keynote Presentation*), Jerry M. Woodall, Purdue Univ. (USA) [8373-48]
- 3:50 pm: **Metamaterial sensors for infrared detection of molecular monolayers** (*Invited Paper*), Ertugrul Cubukcu, Univ. of Pennsylvania (USA) [8373-49]
- 4:10 pm: **Lensfree on-chip microscopy and tomography** (*Invited Paper*), Aydogan Ozcan, Univ. of California, Los Angeles (USA) [8373-50]
- 4:30 pm: **Printed assembly of micro/nanostructured semiconductor materials for photovoltaics and optoelectronics** (*Invited Paper*), Jongseung Yoon, The Univ. of Southern California (USA) [8373-51]

Thursday 26 April

SESSION 11

Room: Conv. Ctr. 317 Thurs. 8:00 to 9:40 am

MAST: Small-Scale Autonomous Platforms

Note Room Change

Joint Session with Conference 8387

Session Chair: **Christopher M. Kroninger**, U.S. Army Research Lab. (USA)

- 8:00 am: **Design and development of a revolutionary VTOL micro-air vehicle: the cyclocopter** (*Invited Paper*), Moble Benedict, Inderjit Chopra, Univ. of Maryland, College Park (USA) [8373-52]
- 8:20 am: **Millimeter-scale, piezoMEMS-enabled autonomous systems: system feasibility and mobility** (*Invited Paper*), Jeffrey S. Pulskamp, Ronald G. Polcawich, Gabriel L. Smith, Christopher M. Kroninger, U.S. Army Research Lab. (USA) [8373-53]
- 8:40 am: **Yaw feedback control of a bio-inspired flapping wing vehicle** (*Invited Paper*), Gregory Gremillion, James S. Humbert, Univ. of Maryland, College Park (USA); Paul D. Samuel, Daedalus Flight Systems, LLC (USA) [8373-54]
- 9:00 am: **Maneuverability and mobility in palm-sized, legged robots** (*Invited Paper*), Nicholas J. Kohut, Paul Birkmeyer, Kevin C. Peterson, Andrew O. Pullin, Ronald S. Fearing, Univ. of California, Berkeley (USA) [8373-55]
- 9:20 am: **Challenges for micro-scale, flapping-wing, micro air vehicles** (*Invited Paper*), Robert J. Wood, Benjamin Finio, Michael Karpelson, Nestor O. Perez Arancibia, Pratheev Sreetharan, John P. Whitney, Harvard Univ. (USA) [8373-56]
- Coffee Break 9:40 to 10:20 am

SESSION 12

Room: Conv. Ctr. 317 Thurs. 10:20 to 11:50 am

MAST: Sensors for Small-Scale Autonomous Platforms

Note Room Change

Joint Session with Conference 8387

Session Chair: **William D. Nothwang**, U.S. Army Research Lab. (USA)

- 10:20 am: **Biologically inspired, haltere, angular-rate sensors for micro-autonomous systems** (*Invited Paper*), Gabriel L. Smith, William D. Nothwang, Brian E. Schuster, Sarah S. Bedair, Christopher D. Meyer, Jeffrey S. Pulskamp, Ronald G. Polcawich, U.S. Army Research Lab. (USA) [8373-57]
- 10:40 am: **Hair-based sensors for micro-autonomous systems** (*Invited Paper*), Mahdi M. Sadeghi, Rebecca L. Peterson, Khalil Najafi, Univ. of Michigan (USA) [8373-58]
- 11:00 am: **Gallium nitride micromechanical resonators for IR detection** (*Invited Paper*), Mina Rais-Zadeh, Univ. of Michigan (USA) [8373-59]
- 11:20 am: **Micromachined low-mass RF front-end for beam steering radar** (*Invited Paper*), Mehrnoosh Vahidpour, Meysam Moallem, Jack R. East, Kamal Sarabandi, Univ. of Michigan (USA) [8373-60]
- 11:40 am: **A programmable palm-size gas analyzer for use in micro-autonomous systems** (*Invited Paper*), Robert J. M. Gordonker, Kensall D. Wise, Univ. of Michigan (USA) [8373-61]
- Lunch/Exhibition Break 12:00 to 1:00 am

SESSION 13

Room: Conv. Ctr. 317 Thurs. 1:00 to 2:50 pm

Nanomaterials for Armor Applications

Session Chair: Morgana Trexler,
The Johns Hopkins Univ. Applied Physics Lab. (USA)

1:00 pm: **Armor nanomaterials: hype, facts, and future** (*Keynote Presentation*), Michael C. Maher, Defense Advanced Research Projects Agency (USA) [8373-62]

1:30 pm: **Designer materials for a secure future** (*Invited Paper*), Nitin P. Daphalapurkar, Kaliat T. Ramesh, The Johns Hopkins Univ. (USA) [8373-63]

1:50 pm: **Carbon nanotube composite armor** (*Invited Paper*), David S. Lashmore, Nanocomp Technologies Inc. (USA) [8373-64]

2:10 pm: **Multiscale modeling of high-strength fibers and fabrics** (*Invited Paper*), John A. Thomas, Michael Boyle, Matthew Shanaman, Xiomara Calderon-Colon, Erin LaBarre, Jason Tiffany, Morgana Trexler, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8373-65]

2:30 pm: **Strategic maturation of technology and manufacturing readiness for nanomaterials production** (*Invited Paper*), Robert H. Carter, Ernest Chin, U.S. Army Research Lab. (USA) [8373-66]

Coffee Break 2:50 to 3:20 pm

SESSION 14

Room: Conv. Ctr. 317 Thurs. 3:20 to 5:10 pm

New Boundaries and Frontiers for MEMS

Session Chairs: Ernest J. Garcia, Sandia National Labs. (USA);
Victor M. Castaño, Univ. Nacional Autónoma de México (Mexico)

3:20 pm: **Emerging nanomaterials for gamma and neutron radiation detection** (*Keynote Presentation*), Marek Osiniski, The Univ. of New Mexico (USA) . [8373-67]

3:50 pm: **SnO₂-based memristors and the potential synergies of integrating memristors with MEMS** (*Invited Paper*), David Zubia, Sergio F. Almeida, Jonathan A. Cervantes, Arka Talukdar, Eric W. MacDonald, The Univ. of Texas at El Paso (USA); Jose Mireles, Jr., Univ. Autónoma de Ciudad Juarez (Mexico) [8373-68]

4:10 pm: **Engineered nanoparticles for improved vasoactive intestinal peptide (VIP) modulation of the immune response** (*Invited Paper*), David Pozo Perez, Ctr. Andaluz de Biología Molecular y Medicina Regenerativa (Spain) and Univ. de Málaga (Spain); Soledad Lopez-Enriquez, Rebecca Klippstein, Ctr. Andaluz de Biología Molecular y Medicina Regenerativa (Spain) [8373-69]

4:30 pm: **Microsystems: technology enabler for ...** (*Invited Paper*), Murat Okandan, Sandia National Labs. (USA) [8373-70]

4:50 pm: **Nanogold as NEMS platform: past, present, and future** (*Invited Paper*), Victor M. Castaño, Univ. Nacional Autónoma de México (Mexico) [8373-71]

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Very sensitive nanocomposite UV photodetector with performance superior to inorganic photodetectors, Jinsong Huang, Univ. of Nebraska-Lincoln (USA) [8373-92]

A self-calibrating, bi-axial piezoelectric MEMS tilt sensor, Paul Moubarak, Danielle Barsky, Pinhas Ben-Tzvi, Mona Zaghoul, The George Washington Univ. (USA) [8373-93]

Lens-free, near-infrared (NIR) imaging using structured substrates and compressive sensing, Bahar Khademhosseini, Gabriel Biener, Ikbal Sencan, Aydogan Ozcan, Univ. of California, Los Angeles (USA) [8373-95]

Reliable SERS substrates by controlled assembly of nanoparticles, Oded Rabin, Univ. of Maryland, College Park (USA) [8373-97]

IR microscopy using external-cavity, quantum-cascade lasers, Robert J. Shine, Jr., Miles J. Weida, Peter R. Buerki, Timothy Day, Daylight Solutions Inc. (USA) [8373-100]

Relation between charge on free electrodes and the response of electrostatic MEMS actuators and sensors, Sudarshan R. Nelatury, Dipu Onipede, Jr., Penn State Erie, The Behrend College (USA); Robert A. Gray, Penn State Harrisburg (USA) [8373-101]

Ultrafast bangap photonics and low-observable problem, Michael K. Rafailov, Univ. for Optical Sciences (USA) [8373-103]

Bragg reflectors for large optical aperture MEMS Fabry-Perot interferometers, Anna Rissanen, Rami Mannila, Jarkko E. Anttila, VTT Technical Research Ctr. of Finland (Finland) [8373-104]

Sensitive detection of multivalent ions via DNA bridge: toward SWNT-based optical sensors, Tetyana Ignatova, Slava V. Rotkin, Lehigh Univ. (USA) [8373-105]

Near-field thermal properties of nanocarbons, Slava V. Rotkin, Lehigh Univ. (USA); Alexey G. Petrov, Ioffe Physico-Technical Institute (Russian Federation) [8373-106]

Sensing trace amounts of Nitroaromatic explosives using nanowire-nanocluster hybrids, Geetha S. Aluri, George Mason Univ. (USA); Abhishek Motayed, Univ. of Maryland, College Park (USA); Albert V. Davydov, Vladimir Oleshko, Kris A. Bertness, Norman A. Sanford, National Institute of Standards and Technology (USA); Mulpuri V. Rao, George Mason Univ. (USA) [8373-107]

Fabrication of vertically aligned GaN core-shell nanostructures for sensing applications, Dipak Paramanik, Geetha S. Aluri, Sergiy Krylyuk, Abhishek Motayed, National Institute of Standards and Technology (USA); Matthew King, Sean McLaughlin, Shalini Gupta, Herlan Cramer, Northrop Grumman Electronic Systems (USA); Albert V. Davydov, Babak Nikoobakht, National Institute of Standards and Technology (USA) [8373-108]

Development of nanostructure-based antireflection coatings for EO/IR sensor applications, Ashok K. Sood, Roger E. Welsler, Magnolia Solar, Inc. (USA); E. Fred Schubert, Rensselaer Polytechnic Institute (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA); Priyalal S. Wijewarnasuriya, U.S. Army Research Lab. (USA) [8373-109]

IonCCD as an alternative pixelated anode for direct MCP readout in imaging and spectroscopy, Omar Hadjar, OI Analytical (USA) [8373-110]

Multifrequency and broadband optical antennas, Hualiang Zhang, J. Ding, Yuankun Lin, Univ. of North Texas (USA) [8373-111]

High-resolution digital spectrometers-on-chip, Christophe Peroz, Abeam Technologies (USA); Alexey Bugrov, Nano-Optic Devices (USA); Cosimo Calo, Lawrence Berkeley National Lab. (USA); Alexander Goltsov, Nano-Optic Devices (USA); Scott D. Dhuey, Lawrence Berkeley National Lab. (USA); Igor A. Ivonin, Alexander Koshelev, Pavel Sasorov, Nano-Optic Devices (USA); Stefano Cabrini, Lawrence Berkeley National Lab. (USA); Sergey Babin, Abeam Technologies (USA); Vladimir V. Yankov, Nano-Optic Devices (USA) [8373-112]

Selective immobilization of proteins on semiconductor nanowires and thin films for biosensor development, Elissa H. Williams, George Mason Univ. (USA) and National Institute of Standards and Technology (USA); Albert V. Davydov, National Institute of Standards and Technology (USA); Sergiy Krylyuk, National Institute of Standards and Technology (USA) and Univ. of Maryland (USA); Abhishek Motayed, Lee J. Richter, Gheorghe Stan, Rebecca A. P. Zangmeister, Nancy Lin, Kristen Steffens, Kristine A. Bertness, National Institute of Standards and Technology (USA); Yaroslav Koshka, Mississippi State Univ. (USA); Vladimir Oleshko, National Institute of Standards and Technology (USA); John A. Schreifels, Mulpuri V. Rao, George Mason Univ. (USA) [8373-113]

Friday 27 April

SESSION 15

Room: Conv. Ctr. 317 Fri. 8:00 to 9:50 am

Applications of Nanomaterials for Surface Enhanced RAMAN Spectroscopy (SERS)

Session Chair: Stergios J. Papadakis,

The Johns Hopkins Univ. Applied Physics Lab. (USA)

- 8:00 am: **Target-specific sensing using SERS** (*Keynote Presentation*), Martin Moskovits, Nam Hoon Kim, Univ. of California, Santa Barbara (USA) [8373-72]
- 8:30 am: **Standard method for characterizing SERS substrates** (*Invited Paper*), Steven D. Christesen, Jason A. Guicheteau, Augustus W. Fountain III, U.S. Army Edgewood Chemical Biological Ctr. (USA) [8373-73]
- 8:50 am: **Controlling the synthesis and assembly of silver nanocrystals for ultrasensitive detection by SERS** (*Invited Paper*), Younan Xia, Washington Univ. in St. Louis (USA) [8373-74]
- 9:10 am: **Evaluation of SERS substrates for chemical agent detection** (*Invited Paper*), Stuart R. Farquharson, Real-Time Analyzers, Inc. (USA) [8373-75]
- 9:30 am: **Nanowire-based surface-enhanced Raman spectroscopy (SERS) for chemical warfare simulants** (*Invited Paper*), Joan A. Hoffmann, Joseph A. Miragliotta, The Johns Hopkins Univ. Applied Physics Lab. (USA); Jay Wang, Pawan Tyagi, The Johns Hopkins Univ. (USA); Stergios J. Papadakis, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8373-76]
- Coffee Break 9:50 to 10:20 am

SESSION 16

Room: Conv. Ctr. 317 Fri. 10:20 am to 12:10 pm

Metamaterials, Graphene, Compound Semiconductors for Thz Technology Applications

Session Chair: Andre U. Sokolnikov,
Visual Solutions and Applications (USA)

- 10:20 am: **Nanomaterials and future aerospace technologies: challenges and opportunities** (*Keynote Presentation*), Richard Vaia, Air Force Research Lab. (USA) [8373-77]
- 10:50 am: **Infrared imaging system using nanocarbon materials** (*Invited Paper*), Ning Xi, Michigan State Univ. (USA) [8373-78]
- 11:10 am: **Identification of nanoscale films for THz sensing** (*Invited Paper*), Gamani Karunasiri, Fabio Alves, Dragoslav Grbovic, Brian Kearney, Naval Postgraduate School (USA) [8373-79]
- 11:30 am: **InP- and graphene-based grating-gated transistors for tunable THz and mm-wave detection** (*Invited Paper*), Robert E. Peale, Nima Nader Esfahani, Christopher J. Fredricksen, Gautam Medhi, Univ. of Central Florida (USA); Justin W. Cleary, Air Force Research Lab. (USA); Walter R. Buchwald, Solid State Scientific Corp. (USA); Joshua Hendrickson, Air Force Research Lab. (USA); Masahiro Ishigami, Michael S. Lodge, Ben D. Dawson, Univ. of Central Florida (USA) [8373-80]
- 11:50 am: **Population inversion and terahertz lasing in graphene** (*Invited Paper*), Vladimir V. Mitin, Univ. at Buffalo (USA); Victor Ryzhii, Maxim Ryzhii, Univ. of Aizu (Japan); Akira Satou, Taiichi Otsuji, Tohoku Univ. (Japan) [8373-81]
- Lunch Break 12:10 to 1:10 pm

SESSION 17

Room: Conv. Ctr. 317 Fri. 1:10 to 3:00 pm

Nanotechnology for Standoff Detection and Counterterrorism Operations I

Note Room Change

Joint Session with Conference 8358

Session Chairs: Michael K. Rafailov, The Reger Group (USA);
Thomas G. Thundat, Univ. of Alberta (Canada)

- 1:10 pm: **Phenomenology and system engineering of micro- and nano-antenna FPA sensors for detection of concealed weapons and improvised explosive devices** (*Keynote Presentation*), Roger Appleby, Queen's Univ. Belfast (United Kingdom) [8373-82]
- 1:40 pm: **Introducing sub-wavelength pixel THz camera for the understanding of close pixel-to-wavelength imaging challenges** (*Invited Paper*), Alain Bergeron, Linda Marchese, Denis G. Dufour, Martin Bolduc, Marc Terroux, Éric Savard, Bruno Tremblay, El -Hassane Oulachgar, Michel Doucet, Loïc Le Noc, Christine Alain, Hubert Jerominek, INO (Canada) [8373-83]
- 2:00 pm: **Optimal coherent control methods for explosives detection** (*Invited Paper*), David S. Moore, Shawn D. McGrane, Margo T. Greenfield, R. Jason Scharff, Los Alamos National Lab. (USA) [8373-84]
- 2:20 pm: **Photodetection with active optical antennas** (*Invited Paper*), Naomi J. Halas, Rice Univ. (USA) [8373-85]
- 2:40 pm: **Canadian approaches for chemical, biological and explosive standoff detection** (*Invited Paper*), Sylvain Désilets, Jean-Marc Thériault, Jean-Robert Simard, Defence Research and Development Canada, Valcartier (Canada) [8373-86]
- Coffee Break 3:00 to 3:30 pm

SESSION 18

Room: Conv. Ctr. 317 Fri. 3:30 to 5:20 pm

Nanotechnology for Standoff Detection and Counterterrorism Operations II

Note Room Change

Joint Session with Conference 8358

Session Chairs: Michael K. Rafailov, The Reger Group (USA);
Thomas G. Thundat, Univ. of Alberta (Canada);
Mogens H. Jakobsen, Technical Univ. of Denmark (Denmark)

- 3:30 pm: **QCL as a game changer in mid-IR standoff military applications** (*Keynote Presentation*), Chandra Kumar N. Patel, Pranalytica, Inc. (USA) [8373-87]
- 4:00 pm: **Standoff detection of explosive residues on unknown surfaces** (*Invited Paper*), Charles W. Van Neste, Xunchen Liu, Lana L. Norman, Manisha Gupta, Seonghwan Kim, Ying Y. Tsui, Thomas G. Thundat, Univ. of Alberta (Canada) [8373-88]
- 4:20 pm: **Broadband tunable external cavity quantum cascade lasers for standoff detection of explosives** (*Invited Paper*), Stefan Hugger, Frank Fuchs, Michel Kinzer, Quankui Yang, Wolfgang Bronner, Rolf Aidam, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany); Kai Degreif, Fraunhofer-Institut für Physikalische Messtechnik (Germany); Frank Schnürer, Fraunhofer-Institut für Chemische Technologie (Germany) [8373-89]
- 4:40 pm: **Infrared photothermal imaging for standoff detection applications** (*Invited Paper*), Christopher A. Kendziora, Robert Furstenberg, Michael R. Papantonakis, Viet Q. Nguyen, R. Andrew McGill, U.S. Naval Research Lab. (USA) [8373-90]
- 5:00 pm: **High-power, military ruggedized QCL-based laser systems** (*Invited Paper*), Eric B. Takeuchi, William B. Chapman, Timothy Day, David B. Arnone, Michael Pushkarsky, David B. Caffey, Michael B. Young, Daylight Solutions Inc. (USA) [8373-91]

Courses of Related Interest

- SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm
 - SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm
- See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Next-Generation Spectroscopic Technologies V

Conference Chairs: **Mark A. Druy**, Physical Sciences Inc. (USA); **Richard A. Crocombe**, Thermo Fisher Scientific Inc. (USA)

Program Committee: **John Marcell Dell**, The Univ. of Western Australia (Australia); **Richard D. Driver**, Headwall Photonics Inc. (USA); **Michael B. Frish**, Physical Sciences Inc. (USA); **David M. Haaland**, Spectral Resolutions (USA); **Frederick G. Haibach**, Block Engineering, LLC (USA); **Martin Kraft**, Carinthian Tech Research AG (Austria); **Jouko O. Malinen**, VTT Technical Research Ctr. of Finland (Finland); **Curtis A. Marcott**, Light Light Solutions, LLC (USA); **Ellen V. Miseo**, Analytical Answers, Inc. (USA); **David W. Schiering**, Smiths Detection (USA); **Eric B. Takeuchi**, Daylight Solutions Inc. (USA); **Christopher J. White**, Active Spectrum, Inc. (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 304 Mon. 8:30 to 10:10 am

Spectrometers in the Field

Session Chair: **Mark A. Druy**, Physical Sciences Inc. (USA)

8:30 am: **Progress in fieldable LIBS**, Andrzej W. Miziolek, U.S. Army Research Lab. (USA) [8374-01]

8:50 am: **Field-portable, time-resolved SORS sensor for the identification of concealed hazards**, Biju Cletus, Queensland Univ. of Technology (Australia) [8374-02]

9:10 am: **Miniature near-infrared (NIR) spectrometer engine for handheld applications**, Nada A. O'Brien, Don Friedrich, Charles A. Hulse, Fred Van Milligen, Marc Von Gunten, JDSU (USA) [8374-03]

9:30 am: **Recent developments toward low-cost, miniaturized spectrometers for field applications**, Dilusha K. Silva, Jarek Antoszewski, Thuyen Nguyen, John M. Dell, Lorenzo Faraone, The Univ. of Western Australia (Australia) [8374-04]

9:50 am: **Advances in handheld FT-IR instrumentation**, Josep Arnó, Len Cardillo, Max Frayer, Michael Frunzi, Paul Hetherington, Dustin Levy, Kyle Oberndorfer, Walter Perec, Terry Sauer, John T. Stein, Eric Zuidema, Smiths Detection (USA) [8374-05]

Coffee Break 10:10 to 10:40 am

SESSION 2

Room: Conv. Ctr. 304 Mon. 10:40 to 11:20 am

Enabling Technologies

Session Chair: **Eric B. Takeuchi**, Daylight Solutions Inc. (USA)

10:40 am: **Investigation of optically injected charge carrier dynamics with THz spectroscopy**, Thomas Arnold, Martin DeBiasio, Raimund Leitner, Carinthian Tech Research AG (Austria) [8374-06]

11:00 am: **Time-resolved absolute spectral analysis of IR countermeasure flares and its experimental validation by using an optical emission spectrometer with PbSe array detector**, Hyungwoo Lee, Changhoon Oh, Jae W. Hahn, Yonsei Univ. (Korea, Republic of) [8374-08]

Lunch Break 11:20 am to 1:00 pm

SESSION 3

Room: Conv. Ctr. 304 Mon. 1:00 to 2:40 pm

Imaging and Chemometrics I

Session Chair: **Ellen V. Miseo**, Analytical Answers, Inc. (USA)

1:00 pm: **Multi- and hyperspectral UAV imaging system for forest and agriculture applications**, Jussi H. Mäkynen, Heikki Saari, Christer Holmlund, Kai Ojala, Tapani Antila, VTT Technical Research Ctr. of Finland (Finland) .. [8374-09]

1:20 pm: **Simple XRD algorithm for direct determination of cotton cellulose crystallinity**, Yongliang Liu, Devron Thibodeaux, Gary Gamble, Philip Bauer, Agricultural Research Service (USA); Don VanDerveer, Clemson Univ. (USA) [8374-10]

1:40 pm: **A small, low-cost, hyperspectral imaging FTIR sensor design for standoff detection applications**, Thomas C. Gruber, Jr., Brad Moore, Brian Tercha, Ryan Bowe, MESH, Inc. (USA) [8374-11]

2:00 pm: **Video-rate chemical identification and visualization with snapshot hyperspectral imaging**, Andrew Bodkin, Bodkin Design & Engineering, LLC (USA); Andrew Sheinis, Univ. of Wisconsin-Madison (USA); Adam Norton, Norton Engineered Optics (USA); James T. Daly, Carson Roberts, Bodkin Design & Engineering, LLC (USA); Scott Beaven, Jeff Weinheimer, Space Computer Corp. (USA) [8374-12]

2:20 pm: **X-ray diffraction imaging and tomographic reconstruction**, Ke Chen, David Castanon, Boston Univ. (USA) [8374-13]

Coffee Break 2:40 to 3:20 pm

SESSION 4

Room: Conv. Ctr. 304 Mon. 3:20 to 4:20 pm

Imaging and Chemometrics II

Session Chair: **Richard A. Crocombe**, Thermo Fisher Scientific Inc. (USA)

3:20 pm: **Thermal hyperspectral chemical imaging**, Hannu Holma, Timo Hyvärinen, Antti-Jussi Mattila, Specim Spectral Imaging Ltd. (Finland) .. [8374-14]

3:40 pm: **Spectral imaging device based on a tuneable MEMS Fabry-Perot interferometer**, Jarkko E. Antila, VTT Technical Research Ctr. of Finland (Finland); Uula Kantojärvi, VTT Information Technology (Finland); Rami Mannila, Anna Rissanen, VTT Technical Research Ctr. of Finland (Finland) [8374-15]

4:00 pm: **High-resolution SWIR hyperspectral imaging: a new approach based on volume Bragg grating**, Sébastien Blais-Ouellette, Marc Verhaegen, Simon Lessard, Photon etc. Inc. (Canada) [8374-16]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 5

Room: Conv. Ctr. 304 Tues. 8:00 to 10:00 am

Laser-based and Cavity Ringdown Spectroscopy

Session Chair: Michael B. Frish, Physical Sciences Inc. (USA)

8:00 am: **Mid-IR interband cascade lasers operating with <30 mW of input power**, Jerry R. Meyer, William W. Bewley, Charles D. Merritt, Chul Soo Kim, Chadwick Canedy, Igor Vurgaftman, Joshua Abell, Mijin Kim, U.S. Naval Research Lab. (USA) [8374-17]

8:20 am: **Monolithic, integrated-optic TDLAS sensors and networks**, Michael B. Frish, Richard T. Wainner, Physical Sciences Inc. (USA) [8374-18]

8:40 am: **Recent advances in mid-IR external-cavity, quantum cascade laser performance**, Michael Radunsky, Michael Pushkarsky, Miles J. Weida, Edeline Forthingham, Daylight Solutions Inc. (USA); Jenny Pushkarskaya, Univ. of California, Berkeley (USA); Timothy Day, Daylight Solutions Inc. (USA) . . [8374-19]

9:00 am: **Monolithic, widely tunable quantum cascade laser**, Kevin M. Lascola, Richard P. Leavitt, John D. Bruno, John L. Bradshaw, John T. Pham, Frederick J. Towner, Maxion Technologies, Inc. (USA) [8374-20]

9:20 am: **High-performance interband cascade lasers emitting between 3.3 and 3.5 microns**, John D. Bruno, John L. Bradshaw, Kevin M. Lascola, Richard P. Leavitt, John T. Pham, Frederick J. Towner, Reshma A. Vohra, Maxion Technologies, Inc. (USA) [8374-21]

9:40 am: **Detection and quantification of explosives and CWAs using a handheld, widely tunable quantum cascade laser**, Erik R. Deutsch, Frederick G. Haibach, Alexander Mazurenko, Block Engineering, LLC (USA) [8374-22]

Coffee Break 10:00 to 10:30 am

SESSION 6

Room: Conv. Ctr. 304 Tues. 10:30 am to 12:30 pm

Raman, SERS, and Security Applications

Session Chair: David W. Schiering, Smiths Detection (USA)

10:30 am: **A time-resolved 128x128 SPAD camera for laser Raman spectroscopy**, Yuki Maruyama, Technische Univ. Delft (Netherlands); Jordana Blacksberg, Jet Propulsion Lab. (USA); George R. Rossman, California Institute of Technology (USA); Edoardo Charbon, Technische Univ. Delft (Netherlands) [8374-23]

10:50 am: **Identification of targets at remote distances with Raman spectroscopy**, Rick Cox, Brad Williams, Mark Harpster, DeltaNu (USA) [8374-24]

11:10 am: **Fiber-optic Raman probe based on single-crystal sapphire fiber**, Ming Han, Cody Raml, Dennis R. Alexander, Xiangnan He, Yongfeng Lu, Univ. of Nebraska-Lincoln (USA) [8374-25]

11:30 am: **Portable Raman spectroscopy using retina-safe (1550 nm) laser excitation**, Stuart R. Farquharson, Real-Time Analyzers, Inc. (USA) . . . [8374-26]

11:50 am: **Fluorescence emission-excitation matrix and cavity ring-down spectroscopy of hydrocarbon oils and fuels**, Hengameh Omrani, Queen's Univ. (Canada) and GasTOPS Ltd. (Canada); Alexander E. Dudelzak, GasTOPS Ltd. (Canada) and Queen's Univ. (Canada); Hans-Peter Looock, Helen Waechter, Queen's Univ. (Canada) [8374-27]

12:10 pm: **Industrial Raman mapping spectroscopy for mining applications**, Martin De Biasio, Raimund Leitner, Thomas Arnold, Andreas Tortschanoff, Gerald McGunnigle, Carinthian Tech Research AG (Austria); Nina Fietz, Lars Weitkämper, RWTH Aachen (Germany); Dirk Baithasar, Volker Rehmann, TITECH GmbH (Germany) [8374-28]

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

SESSION 7

Room: Conv. Ctr. 304 Tues. 2:00 to 3:00 pm

Novel Spectrometers I

Session Chair: Richard A. Crocombe, Thermo Fisher Scientific Inc. (USA)

2:00 pm: **Pulsed and high-speed FTIR spectroscopy**, Sascha P. Heussler, National Univ. of Singapore (Singapore); Herbert O. Moser, Karlsruher Institut für Technologie (Germany); Shenbaga Manogara Pandian Kalaiselvi, Chenggen Quan, Cho Jui Tay, Mark Breeze, National Univ. of Singapore (Singapore) [8374-36]

2:20 pm: **High-speed resonant FTIR spectrometer**, Julia Rentz Dupuis, David Carlson, David J. Mansur, Scott P. Newbry, Robert Vaillancourt, James R. Engel, OPTRA, Inc. (USA); Bradley Engel, Nelson Air Corp. (USA) [8374-30]

2:40 pm: **A new high-resolution, high-throughput HyperFlux spectrometer: first experience as applied to Raman spectroscopy**, Brad Schmidt, Arjae Spectral Enterprises Ltd. (Canada); Jeffrey Meade, Bradford Behr, Aaron Weinroth, Arjae Spectral Enterprises, Inc. (USA) [8374-31]

Coffee/Exhibition Break 3:00 to 3:40 pm

SESSION 8

Room: Conv. Ctr. 304 Tues. 3:40 to 6:00 pm

Novel Spectrometers II

Session Chair: Frederick G. Haibach, Block Engineering, LLC (USA)

3:40 pm: **Realization of a hybrid-integrated MEMS scanning grating spectrometer**, Tino Pügner, Heinrich Grüger, Jens Knobbe, Harald Schenk, Fraunhofer-Institut für Photonische Mikrosysteme (Germany) [8374-32]

4:00 pm: **Widely tunable, Fabry-Perot-filter-based MWIR and LWIR microspectrometers**, Martin Ebermann, Norbert Neumann, InfraTec GmbH (Germany); Karla Hiller, Technische Univ. Chemnitz (Germany); Elvira Gittler, Jenoptik Optical Systems GmbH (Germany); Steffen Kurth, Fraunhofer-Institut für Elektronische Nanosysteme (Germany) [8374-33]

4:20 pm: **A compact optical spectrometer based on a single-grating Fresnel diffractive optical element**, Chuan Yang, Perry S. Edwards, Kebin Shi, Zhiwen Liu, The Pennsylvania State Univ. (USA) [8374-34]

4:40 pm: **Compact, low-cost waveguide-based optical spectrometer for detection of chemical/biological agents**, Brent C. Bergner, Spectrum Scientific, Inc. (USA); Pradeep Kumar, Wayne State Univ. (USA); David Cook, Spectrum Scientific, Inc (USA); Ivan Avrutsky, Wayne State Univ. (USA) [8374-35]

5:00 pm: **Fourier transform, infrared-phase-shift cavity-ring-down spectrometer**, Julia Rentz Dupuis, James R. Engel, OPTRA, Inc. (USA) [8374-29]

5:20 pm: **Characterization of materials using infrared photothermal microspectroscopy**, Robert Furstenberg, Christopher A. Kendziora, Michael R. Papantonakis, Viet Q. Nguyen, R. Andrew McGill, U.S. Naval Research Lab. (USA) [8374-37]

5:40 pm: **Micromechanical photothermal spectroscopy of trace gases**, Todd H. Stievater, Nicolas A. Papanicolaou, Robert Bass, William S. Rabinovich, R. Andrew McGill, U.S. Naval Research Lab. (USA) [8374-38]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Snapshot spectral imaging using optimised computer generated holograms, Martin De Biasio, Thomas Arnold, Raimund Leitner, Andreas Tortschanoff, Carinthian Tech Research AG (Austria) [8374-39]

NO and N₂O detection employing cavity enhanced technique, Jacek Wojtas, Robert Medrzycki, Beata Rutecka, Janusz Mikołajczyk, Mirosław Nowakowski, Dariusz Szabra, Magdalena Gutowska, Military Univ. of Technology (Poland); Tadeusz Stacewicz, Univ. of Warsaw (Poland); Zbigniew Bielecki, Military Univ. of Technology (Poland) [8374-40]

Advanced Photon Counting Techniques VI

Conference Chair: **Mark A. Itzler**, Princeton Lightwave, Inc. (USA)

Conference Co-Chair: **Joe C. Campbell**, Univ. of Virginia (USA)

Program Committee: **Gerald S. Buller**, Heriot-Watt Univ. (United Kingdom); **Sergio Cova**, Politecnico di Milano (Italy); **William H. Farr**, Jet Propulsion Lab. (USA); **Robert H. Hadfield**, Heriot-Watt Univ. (United Kingdom); **Majeed M. Hayat**, The Univ. of New Mexico (USA); **Michael A. Krainak**, NASA Goddard Space Flight Ctr. (USA); **Robert A. Lamb**, SELEX Galileo Ltd. (United Kingdom); **Alan L. Migdall**, National Institute of Standards and Technology (USA); **Michael Wahl**, PicoQuant GmbH (Germany); **Hugo Zbinden**, Univ. of Geneva (Switzerland); **K. Alex McIntosh**, MIT Lincoln Lab. (USA)

Wednesday 25 April

SESSION 1

Room: Conv. Ctr. 315 Wed. 8:20 to 10:00 am

Photon Counting for Quantum Information

Session Chair: **Mark A. Itzler**, Princeton Lightwave, Inc. (USA)

8:20 am: **What are single photons good for?** (*Invited Paper*), Hugo Zbinden, Univ. of Geneva (Switzerland) [8375-01]

8:45 am: **Novel photon detection technologies for quantum communications** (*Invited Paper*), Masahide Sasaki, National Institute of Information and Communications Technology (Japan) [8375-02]

9:10 am: **Quantum random number generators and their use in cryptography** (*Invited Paper*), Mario Stipcevic, Univ. of California, Santa Barbara (USA) and Rudjer Boskovic Institute (Croatia) [8375-03]

9:35 am: **Reliable source of conditional states by multiple-photon subtraction using hybrid photodetectors** (*Invited Paper*), Maria Bondani, Consiglio Nazionale delle Ricerche (Italy); Alessia Allevi, Univ. degli Studi dell'Insubria (Italy); Marco G. Genoni, Imperial College London (United Kingdom); Federica A. Beduini, ICFO - Institut de Ciències Fotòniques (Spain); Stefano Olivares, Univ. degli Studi di Trieste (Italy); Matteo G. Paris, Univ. degli Studi di Milano (Italy); Alessandra Andreoni, Univ. degli Studi dell'Insubria (Italy) [8375-04]

Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 315 Wed. 10:30 to 11:20 am

Single Photon Sources

Session Chair: **Michael Wahl**, PicoQuant GmbH (Germany)

10:30 am: **Near-unity efficiency, single-photon sources based on tapered photonic nanowires** (*Invited Paper*), Joël Bleuse, Mathieu Munsch, Julien Claudon, Commissariat à l'Énergie Atomique (France); Niels Gregersen, Jesper Mørk, Technical Univ. of Denmark (Denmark); Nitin S. Malik, Emmanuel Dupuy, Jean-Michel Gérard, Commissariat à l'Énergie Atomique (France) [8375-05]

10:55 am: **Efficient extraction, frequency conversion, and amplitude modulation of single photons from epitaxially grown quantum dots** (*Invited Paper*), Kartik Srinivasan, National Institute of Standards and Technology (USA) [8375-06]

SESSION 3

Room: Conv. Ctr. 315 Wed. 11:20 am to 12:25 pm

Applications of Photon Counting

Session Chair: **Michael Wahl**, PicoQuant GmbH (Germany)

11:20 am: **High-throughput, single-molecule analysis with a multipixel SPAD array** (*Invited Paper*), Antonino Ingarciola, Ryan A. Colyer, Ron R. Lin, Univ. of California, Los Angeles (USA); Francesco Panzeri, Angelo Gulinatti, Ivan Rech, Massimo Ghioni, Sergio Cova, Politecnico di Milano (Italy); Shimon Weiss, Xavier Michalet, Univ. of California, Los Angeles (USA) [8375-07]

11:45 am: **Functional analysis of fiber optic sensors using statistical photon counting: an automobile case study covered from quantum mechanics**, J. Alejandro Betancur Ramirez, Univ. EAFIT (Colombia) [8375-08]

12:05 pm: **Time-sequential binary sensing for high-dynamic range imaging**, Yue M. Lu, Harvard Univ. (USA) [8375-09]

Lunch/Exhibition Break 12:25 to 1:55 pm

SESSION 4

Room: Conv. Ctr. 315 Wed. 1:55 to 3:25 pm

Photon Counting Arrays for LIDAR Imaging

Session Chair: **K. Alex McIntosh**, MIT Lincoln Lab. (USA)

1:55 pm: **Photon counting laser radar** (*Invited Paper*), Dale G. Fried, MIT Lincoln Lab. (USA) [8375-10]

2:20 pm: **Photon counting lidar activities at FOI in Sweden** (*Invited Paper*), Ove Steinvall, Lars J. Sjöqvist, Markus Henriksson, Swedish Defence Research Agency (Sweden) [8375-11]

2:45 pm: **Geiger-mode APD camera system for single-photon 3D lidar imaging**, Mark Entwistle, Mark A. Itzler, Jim Chen, Mark Owens, Ketan M. Patel, Xudong Jiang, Krystyna Slomkowski, Sabbir Rangwala, Princeton Lightwave, Inc. (USA) [8375-12]

3:05 pm: **Low-power, 20 meter 3D ranging SPAD camera based on continuous-wave indirect time-of-flight**, Simone Bellisai, Luca Ferretti, Federica A. Villa, Politecnico di Milano (Italy); Simone Tisa, Micro Photon Devices S.r.l. (Italy); Alberto Tosi, Franco Zappa, Politecnico di Milano (Italy) [8375-13]

Coffee/Exhibition Break 3:25 to 4:25 pm

SESSION 5

Room: Conv. Ctr. 315 Wed. 4:25 to 6:00 pm

Multiphoton Coincidence Counting

Session Chair: **Alan L. Migdall**,

National Institute of Standards and Technology (USA)

4:25 pm: **An FPGA-based module for multiphoton coincidence counting** (*Invited Paper*), David A. Branning, Trinity College (USA); Mark Beck, Whitman College (USA) [8375-14]

4:50 pm: **Recent advances in high-speed electronics for TCSPC and coincidence counting** (*Invited Paper*), Gerald Kell, Daniel Schulz, Fachhochschule Brandenburg (Germany); Tino Roehlicke, Hans-Jürgen Rahn, Michael Wahl, PicoQuant GmbH (Germany) [8375-15]

5:15 pm: **Low-cost multichannel FPGA-based coincidence boards** (*Invited Paper*), Sergey Polyakov, Alan L. Migdall, National Institute of Standards and Technology (USA) [8375-16]

5:40 pm: **4-channel, 20ps-resolution, monolithic time-to-amplitude converter for multichannel TCSPC systems**, Matteo C. Crotti, Ivan Rech, Ivan Labanca, Massimo Ghioni, Politecnico di Milano (Italy) [8375-17]

Thursday 26 April

SESSION 6

Room: Conv. Ctr. 315 Thurs. 8:25 to 10:00 am

Superconducting Single Photon Detectors

Session Chair: **William H. Farr**, Jet Propulsion Lab. (USA)

8:25 am: **Superconducting nanowire single-photon detectors for optical communication and quantum information applications** (*Invited Paper*), Danna Rosenberg, Andrew J. Kerman, Eric A. Dauler, Si Pan, Richard J. Molnar, Jung U. Yoon, MIT Lincoln Lab. (USA) [8375-18]

8:50 am: **Enhancing the quantum efficiency of superconducting nanowire, single-photon detectors for near-infrared wavelengths** (*Invited Paper*), Sander N. Dorenbos, Pol Forn Diaz, Tomoko Fuse, Ad H. Verbruggen, Reinier W. Heeres, Eduard F. Driessen, Teun M. Klapwijk, Valery Zwiller, Technische Univ. Delft (Netherlands) [8375-20]

Conference 8375 · Room: Conv. Ctr. 315

9:15 am: **Fast path and polarisation manipulation of telecom wavelength single photons in waveguides using superconducting nanowire single-photon detectors** (*Invited Paper*), Chandra M. Natarajan, Heriot-Watt Univ. (United Kingdom) and Stanford Univ. (USA); Damien Bonneau, Mirko Lobino, Pisu Jiang, Univ. of Bristol (United Kingdom); Michael G. Tanner, Heriot-Watt Univ. (United Kingdom); Sander N. Dorenbos, Valery Zwiller, Technische Univ. Delft (Netherlands); Mark G. Thompson, Jeremy L. O'Brien, Univ. of Bristol (United Kingdom); Robert H. Hadfield, Heriot-Watt Univ. (United Kingdom) [8375-21]

9:40 am: **Toward linear optical detection with single-photon sensitivity at telecom wavelengths**, Saeedeh Jahanmirinejad, Andrea Fiore, Technische Univ. Eindhoven (Netherlands) [8375-22]

Coffee Break 10:00 to 10:30 am

SESSION 7

Room: Conv. Ctr. 315 Thurs. 10:30 am to 12:20 pm

Single Photon Avalanche Diodes

Session Chair: Joe C. Campbell, Univ. of Virginia (USA)

10:30 am: **Silicon, single-photon avalanche diodes for high-performance, parallel-photon timing** (*Invited Paper*), Angelo Gulinatti, Ivan Rech, Corrado Cammi, Ivan Labanca, Politecnico di Milano (Italy); Piera Maccagnani, Istituto per la Microelettronica e Microsistemi (Italy); Massimo Ghioni, Politecnico di Milano (Italy) and Micro Photon Devices (Italy) [8375-23]

10:55 am: **Distortions from multiphoton triggering in a single CMOS SPAD** (*Invited Paper*), Matthew W. Fishburn, Technische Univ. Delft (Netherlands); Edoardo Charbon, Technische Univ. Delft (Netherlands) and École Polytechnique Fédérale de Lausanne (Switzerland) [8375-24]

11:20 am: **High-detection efficiency and picosecond timing compact detector modules with red-enhanced SPADs**, Andrea Giudice, Georg Simmerle, Daniele Veronese, Roberto Biasi, Micro Photon Devices S.r.l. (Italy); Angelo Gulinatti, Ivan Rech, Politecnico di Milano (Italy); Massimo Ghioni, Politecnico di Milano (Italy) and Micro Photon Devices S.r.l. (Italy); Piera Maccagnani, Istituto per la Microelettronica e Microsistemi (Italy) [8375-25]

11:40 am: **A Ge-on-Si single-photon avalanche diode operating in Geiger mode at infrared wavelengths**, Mahdi Aminian, Sr., Ecole Polytechnique Fédérale de Lausanne (Switzerland); Amir Sammak, Sr., Lis K. Nanver, Technische Univ. Delft (Netherlands); Edoardo Charbon, Ecole Polytechnique Fédérale de Lausanne (Switzerland) and Technische Univ. Delft (Netherlands) [8375-26]

12:00 pm: **Development of small unit cell avalanche photodiodes for UV imaging applications**, Ashok K. Sood, Roger E. Welsler, Magnolia Optical Technologies, Inc. (USA); Russell D. Dupuis, Georgia Institute of Technology (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA); Fatemah S. Shahedipour-Sandvik, Univ. at Albany (USA) [8375-27]

Lunch/Exhibition Break 12:20 to 1:45 pm

SESSION 8

Room: Conv. Ctr. 315 Thurs. 1:45 to 3:10 pm

Solid State Photomultipliers and Novel SPDs

Session Chair: Michael A. Krainak, NASA Goddard Space Flight Ctr. (USA)

1:45 pm: **Probabilistic analysis of solid state photomultiplier performance** (*Invited Paper*), Sergey L. Vinogradov, P.N. Lebedev Physical Institute (Russian Federation) [8375-28]

2:10 pm: **Photon-number statistics and correlations with silicon photomultipliers**, Maria Bondani, Consiglio Nazionale delle Ricerche (Italy); Marco Ramilli, Univ. Hamburg (Germany); Alessia Allevi, Luca Nardo, Massimo Caccia, Alessandra Andreoni, Univ. degli Studi dell'Insubria (Italy) [8375-29]

2:30 pm: **InGaAs/InP negative-feedback avalanche diodes (NFADs) and solid state photomultipliers (SSPMs)**, Xudong Jiang, Mark A. Itzler, Krystyna Slomkowski, Princeton Lightwave, Inc. (USA) [8375-30]

2:50 pm: **Solution-processed, quantum-dot-gated, organic thin-film transistor for single-photon detection**, Jinsong Huang, Univ. of Nebraska-Lincoln (USA) [8375-32]

Coffee Break 3:10 to 3:40 pm

SESSION 9

Room: Conv. Ctr. 315 Thurs. 3:40 to 5:40 pm

High-Rate Photon Counting with APDs

Session Chair: Hugo Zbinden, Univ. of Geneva (Switzerland)

3:40 pm: **Readout circuitry for continuous high-rate photon detection with arrays of InP geiger-mode avalanche photodiodes** (*Invited Paper*), Jonathan Frechette, Peter Grossmann, David Busacker, George Jordy, Erik K. Duerr, K. Alex McIntosh, Douglas C. Oakley, Robert J. Bailey, Albert C. Ruff, Michael Brattain, Joseph E. Funk, Jason MacDonald, Simon Verghese, MIT Lincoln Lab. (USA) [8375-33]

4:05 pm: **High-speed CMOS time-domain single-photon counting for high-dynamic range and high sensitivity** (*Invited Paper*), Munir M. El-Desouki, King Abdulaziz City for Science & Technology (Saudi Arabia); Darek Palubiak, M. Jamal Deen, McMaster Univ. (Canada) [8375-34]

4:30 pm: **Linear photon-counting with HgCdTe APDs** (*Invited Paper*), Gautier Vojetta, Fabrice Guellec, Commissariat à l'Énergie Atomique (France); Philippe Feautrier, Institut de Planétologie et d'Astrophysique de Grenoble (France); Kevin Foubert, Johan Rothman, Commissariat à l'Énergie Atomique (France) [8375-35]

4:55 pm: **Avalanche discrimination and high-speed counting in periodically gated single-photon avalanche diodes** (*Invited Paper*), Alessandro Restelli, Joint Quantum Institute (USA); Joshua C. Bienfang, National Institute of Standards and Technology (USA) [8375-36]

5:20 pm: **Improved sinusoidal gating operation of InGaAs/InP single-photon avalanche diodes**, Zhiwen Lu, Univ. of Virginia (USA) [8375-37]

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A Thurs. 6:00 to 7:30 pm

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Measuring isomeric transitions in holmium-166 using a time-gated pmt, Stanley L. Henriquez, Marc S. Litz, James J. Carroll, U.S. Army Research Lab. (USA) [8375-38]

Picosecond-resolved FRET on non-amplified DNA for identifying individuals genetically susceptible to type 1 diabetes, Maria Bondani, Luca Nardo, Giovanna Tosi, Roberto Accolla, Alessandra Andreoni, Univ. degli Studi dell'Insubria (Italy) [8375-39]

Courses of Related Interest

SC278 **Infrared Detectors** (Dereniak) Monday, 8:30 am to 12:30 pm
See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Photonic Microdevices/Microstructures for Sensing IV

Conference Chairs: **Xudong Fan**, Univ. of Michigan (USA); **Hai Xiao**, Missouri Univ. of Science and Technology (USA); **Anbo Wang**, Virginia Polytechnic Institute and State Univ. (USA)

Program Committee: **Hatice Altug**, Boston Univ. (USA); **Junhang Dong**, Univ. of Cincinnati (USA); **Henry H. Du**, Stevens Institute of Technology (USA); **Erica Forzani**, Arizona State Univ. (USA); **Bai-Ou Guan**, Jinan Univ. (China); **Wei Jin**, The Hong Kong Polytechnic Univ. (Hong Kong, China); **Radislav A. Potyrailo**, GE Global Research (USA); **Stephen Schultz**, Brigham Young Univ. (USA); **Venkataraman S. Swaminathan**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Ian M. White**, Univ. of Maryland, College Park (USA); **Tian Yang**, Shanghai Jiao Tong Univ. (China); **Yibing Zhang**, ExxonMobil Research and Engineering Co. (USA); **Mohammed M. Zourob**, Institut National de la Recherche Scientifique (Canada)

Thursday 26 April

SESSION 1

Room: Conv. Ctr. 323 Thurs. 8:00 to 10:00 am

Photonic Micro-/Nanostructures for Sensing I

Session Chair: **Xudong Fan**, Univ. of Michigan (USA)

8:00 am: **Large-area and label-free plasmonic microarrays** (*Invited Paper*), Hatice Altug, Min A. Huang, Tsung-Yao Chang, Ahmet A. Yanik, Hsin-Yu Tsai, Peng Shi, Serap Aksu, Mehmet F. Yanik, Boston Univ. (USA) [8376-01]

8:40 am: **Thermally modulated nanotrampoline material as smart skin for gas molecular mass detection** (*Invited Paper*), Hua Xia, GE Global Research (USA) [8376-02]

9:20 am: **High-throughput nanostructured SERS substrates by self assembly**, Oded Rabin, Robert M. Briber, Seung Yong Lee, Wonjoo Lee, Univ. of Maryland, College Park (USA) [8376-03]

9:40 am: **Plasmonic enhancement of a whispering gallery-mode biosensor for single nanoparticle detection in aqueous solution**, Siyka I. Shopova, Raaj Rajmangal, Polytechnic Institute of New York Univ. (USA); Stephen Holler, Fordham Univ. (USA); Stephen Arnold, Polytechnic Institute of New York Univ. (USA) [8376-04]

Coffee Break 10:00 to 10:20 am

SESSION 2

Room: Conv. Ctr. 323 Thurs. 10:20 am to 12:00 pm

Photonic Micro-/Nanostructures for Sensing II

Session Chair: **Sharon M. Weiss**, Vanderbilt Univ. (USA)

10:20 am: **Surface-enhanced nanoplasmonic sensing and imaging of biomolecular processes** (*Invited Paper*), Donghyun Kim, Yonsei Univ. (Korea, Republic of) and Yonsei Institute of Medical Instruments Technology (Korea, Republic of) [8376-05]

11:00 am: **Sensitivity enhancement and detection-limit improvement in whispering gallery-mode-based biosensing** (*Invited Paper*), Yun-Feng Xiao, Bei-Bei Li, Peking Univ. (China) [8376-06]

11:40 am: **Multi-axis all dielectric electric field sensors**, Spencer Chadderdon, Daniel T. Perry, Jacob Van Wagoner, Brigham Young Univ. (USA); Wen C. Wang, Richard A. Forber, IPITEK, Inc. (USA); Richard Selfridge, Stephen Schultz, Brigham Young Univ. (USA) [8376-07]

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

SESSION 3

Room: Conv. Ctr. 323 Thurs. 1:20 to 3:20 pm

Photonic Micro-/Nanostructures for Sensing III

Session Chair: **Miao Yu**, Univ. of Maryland, College Park (USA)

1:20 pm: **Porous materials for optical detection of chemicals, biological molecules, and high-energy radiation** (*Invited Paper*), Sharon M. Weiss, Vanderbilt Univ. (USA) [8376-08]

2:00 pm: **Nanostructured photonic biosensors for medical diagnosis and analyzing cellular signals** (*Invited Paper*), Eiichi Tamiya, Osaka Univ. (Japan) [8376-09]

2:40 pm: **In vivo experiments of laser thermotherapy on liver tissue with FBG temperature distribution sensor**, Na Chen, Shaofeng Chen, Hongfei Zhu, Shupeng Liu, Zhenyi Chen, Fufei Pang, Tingyun Wang, Shanghai Univ. (China) [8376-10]

3:00 pm: **Highly sensitive detection of glucose concentration with optofluidics ring resonator**, Yunhan Luo, Jinan Univ. (China); Xudong Fan, Univ. of Michigan (USA) [8376-11]

Coffee Break 3:20 to 3:40 pm

SESSION 4

Room: Conv. Ctr. 323 Thurs. 3:40 to 5:40 pm

Photonic Micro-/Nanostructures for Sensing IV

Session Chairs: **Xudong Fan**, Univ. of Michigan (USA);

Ian M. White, Univ. of Maryland, College Park (USA)

3:40 pm: **Manipulation and sensing with surface plasmonic lens-based fiber optic tweezers** (*Invited Paper*), Miao Yu, Univ. of Maryland, College Park (USA); Yuxiang Liu, National Institute of Standards and Technology (USA) [8376-12]

4:20 pm: **Optical fiber sensor interrogation improved by active fiber loop** (*Invited Paper*), Tao Wei, Jie Huang, Xinwei Lan, Missouri Univ. of Science and Technology (USA); Qun Han, Missouri Univ. of Science and Technology (USA) and Tianjing Univ. (China); Hai Xiao, Missouri Univ. of Science and Technology (USA) [8376-13]

5:00 pm: **Interrogation of in-series double cladding fiber sensor for simultaneous refractive index and temperature measurement**, Bo Qi, Fufei Pang, Tingyun Wang, Na Chen, Sujuan Huang, Zhenyi Chen, Shanghai Univ. (China) [8376-14]

5:20 pm: **High-sensitivity electro-optic CO₂ gas sensing based on absorption spectroscopy**, Scott N. Zhang, Dorothy Y. Wang, Jianmin Gong, Virginia Polytechnic Institute and State Univ. (USA); Dian Fan, Wuhan Univ. of Technology (China); Bo Dong, Michael Fraser, Anbo Wang, Virginia Polytechnic Institute and State Univ. (USA) [8376-15]

POSTERS—THURSDAY

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Transformation optics designed general optical Luneburg lens with flattened shapes, Kris Ohlinger, Yuankun Lin, Hualiang Zhang, Univ. of North Texas (USA) [8376-26]

Friday 27 April

SESSION 5

Room: Conv. Ctr. 323 Fri. 8:20 to 10:00 am

Optical Sensor Fabrication

Session Chair: Donghyun Kim, Yonsei Univ. (Korea, Republic of)

8:20 am: **Photonic crystal electro-optic devices in engineered thin film lithium viobate substrates**, Vincent E. Stenger, SRICO Inc. (USA) [8376-16]

8:40 am: **3D soft waveguides: the ability of pegda gel to guide light**, Raquel Perez-Castillejos, Olga Ordeig, New Jersey Institute of Technology (USA) [8376-17]

9:00 am: **Cathodoluminescence of conducting gratings and implications for electron-beam investigations of nano-photonic devices**, Janardan Nath, Casey Schwarz, Robert E. Peale, Leonid Chernyak, Univ. of Central Florida (USA); Walter R. Buchwald, Solid State Scientific Corp. (USA) [8376-18]

9:20 am: **Characterizations of light coupling between side polished fiber and optofluidic ring resonator**, Yunhan Luo, Jinan Univ. (China); Xudong Fan, Univ. of Michigan (USA) [8376-19]

9:40 am: **Fiber Bragg gratings fabricated using a high-repetition rate femtosecond laser**, Amardeep Kaur, Tao Wei, Qun Han, Hai Xiao, Hai-Lung Tsai, Steve E. Watkins, Missouri Univ. of Science and Technology (USA) [8376-20]

Coffee Break 10:00 to 10:20 am

SESSION 6

Room: Conv. Ctr. 323 Fri. 10:20 am to 12:00 pm

Optical Materials and Detectors

Session Chair: Hai Xiao, Missouri Univ. of Science and Technology (USA)

10:20 am: **Exact analytical solutions to one-dimensional photonic detector with variable mass**, Juan M. Lopez, Univ. EAFIT (Colombia) [8376-21]

10:40 am: **Novel approach to improve reliable color recognition in a-Si:H photodiodes**, Krystian Watty, Andreas Bablich, Konstantin Seibel, Christian Merfort, Markus Boehm, Univ. Siegen (Germany) [8376-22]

11:00 am: **III-nitride/SiC avalanche photodetectors for enabling compact biological agent identification and detection**, Anand V. Sampath, U.S. Army Research Lab. (USA); Quigui Zhou, Univ. of Virginia (USA); Ryan W. Enck, Chad Gallinat, U.S. Army Research Lab. (USA); Dion McIntosh, Univ. of Virginia (USA); H. Shen, U.S. Army Research Lab. (USA); Joe C. Campbell, Univ. of Virginia (USA); Michael Wraback, U.S. Army Research Lab. (USA) [8376-23]

11:20 am: **The monolithic integration of high-speed Ge photo detector on SOI-based WDM receiver**, Wei Qian, Dazeng Feng, Hong Liang, Joe Zhou, Shirong Liao, ChengChih Kung, Joan Fong, Yong Liu, Jonathan Luff, Roshanak Shafiiha, Daniel Lee, Wayne White, Mehdi Asghari, Kotura, Inc. (USA) . . [8376-24]

11:40 am: **FIB-assisted a-SiGe:H/a-SiC:H alloy analysis for ultra-low biased multispectral pixn sensors with enhanced color separation features and low-reflective ZnO:Al back-contacts**, Andreas Bablich, Krystian Watty, Christian Merfort, Markus Boehm, Univ. Siegen (Germany) [8376-25]

Energy Harvesting and Storage: Materials, Devices, and Applications III

Conference Chairs: **Nibir K. Dhar**, Defense Advanced Research Projects Agency/Microelectronics Technology Office (USA); **Priyalal S. Wijewarnasuriya**, U.S. Army Research Lab. (USA); **Achyut K. Dutta**, Banpil Photonics, Inc. (USA)

Program Committee: **Pulickel M. Ajayan**, Rice Univ. (USA); **Palani Balaya**, National Univ. of Singapore (Singapore); **Deryn Chu**, U.S. Army Research Lab. (USA); **Angelo S. Gilmore**, EPIR Technologies, Inc. (USA); **M. Saif Islam**, Univ. of California, Davis (USA); **Nobuhiko P. Kobayashi**, Univ. of California, Santa Cruz (USA); **Pat McGrath**, Booz Allen Hamilton Inc. (USA); **Robert Olah**, Banpil Photonics, Inc. (USA); **A. Fred Semendy**, U.S. Army Research Lab. (USA); **Ashok K. Sood**, Magnolia Optical Technologies, Inc. (USA); **Patrick J. Taylor**, U.S. Army Research Lab. (USA); **Sudhir B. Trivedi**, Brimrose Corp. of America (USA); **Rama Venkatasubramanian**, RTI International (USA); **Chunlei Wang**, Florida International Univ. (USA)

Monday 23 April

Opening Remarks

Room: Conv. Ctr. 305 Mon. 8:00 to 8:10 am

Session Chair: **Nibir K. Dhar**, Defense Advanced Research Projects Agency (USA)

SESSION 1

Room: Conv. Ctr. 305 Mon. 8:10 to 9:20 am

Advanced Power and Energy Storage Technologies: Battery and Fuel Cells

Session Chairs: **Nibir K. Dhar**, Defense Advanced Research Projects Agency (USA); **Palani Balaya**, National Univ. of Singapore (Singapore)

8:10 am: **Advanced power and energy program at ARL (Keynote Presentation)**, Edward Shaffer, U.S. Army Research Lab. (USA) [8377-01]

8:50 am: **Influence of nanosize and thermodynamics on lithium storage (Invited Paper)**, Palani Balaya, National Univ. of Singapore (Singapore) . . [8377-02]

SESSION 2

Room: Conv. Ctr. 305 Mon. 9:20 to 11:40 am

Advanced Energy Storage Technologies: Battery and Fuel Cells I

Session Chairs: **Nibir K. Dhar**, Defense Advanced Research Projects Agency (USA); **Achyut K. Dutta**, Banpil Photonics, Inc. (USA)

9:20 am: **High-energy density electrode materials for next-generation lithium-ion batteries (Invited Paper)**, Arumugam Manthiram, The Univ. of Texas at Austin (USA) [8377-04]

9:50 am: **Portable direct methanol fuel cells for practical applications: lessons learned and the road ahead (Invited Paper)**, Deryn Chu, U.S. Army Research Lab. (USA) [8377-05]

Coffee Break 10:20 to 10:50 am

10:50 am: **Lightweight carbon nanotube-based structural-energy storage devices for micro-unmanned systems**, Monica Rivera, Daniel P. Cole, Motile Robotics Inc. (USA) and U.S. Army Research Lab. (USA); Myung G. Hahm, Arava L. M. Reddy, Robert Vajtai, Pulickel M. Ajayan, Rice Univ. (USA); Shashi P. Karna, Mark L. Bundy, U.S. Army Research Lab. (USA) [8377-06]

11:10 am: **Molecularly tailored nanothermoelectrics and interfaces for energy harvesting and management (Invited Paper)**, Ganpati Ramanath, Rensselaer Polytechnic Institute (USA) [8377-07]

Lunch Break 11:30 am to 1:00 pm

SESSION 3

Room: Conv. Ctr. 305 Mon. 1:00 to 3:00 pm

Advanced Energy Storage Technologies: Battery and Fuel Cells II

Session Chairs: **Palani Balaya**, National Univ. of Singapore (Singapore); **Priyalal S. Wijewarnasuriya**, U.S. Army Research Lab. (USA)

1:00 pm: **Recent advanced in design and fabrication of on-chip microsupercapacitors (Invited Paper)**, Majid Beidaghi, Chunlei Wang, Florida International Univ. (USA) [8377-08]

1:30 pm: **Multifunctional structural composite batteries and supercapacitors**, James F. Snyder, Edwin Gienger, Eric D. Wetzel, Conrad K. Xu, U.S. Army Research Lab. (USA) [8377-09]

1:50 pm: **Development of biologically modified anodes for energy harvesting using microbial fuel cells**, James J. Sumner, U.S. Army Research Lab. (USA); Rahul Ganguli, Teledyne Scientific Co. (USA); Bradley F. Chmelka, Univ. of California, Santa Barbara (USA) [8377-10]

2:10 pm: **III-V nitride semiconductors for solar fuels production**, Vijay Parameshwaran, Stanford Univ. (USA) and Banpil Photonics, Inc. (USA); Bruce Clemens, Stanford Univ. (USA); Ryan W. Enck, Chad Gallinat, Anand V. Sampath, Paul H. Shen, Michael Wraback, U.S. Army Research Lab. (USA); Shaul Aloni, Teyve Kuykendall, Lawrence Berkeley National Lab. (USA) [8377-11]

2:30 pm: **Toward rechargeable magnesium batteries (Invited Paper)**, Kristin A. Persson, Robert Doe, Gerbrand Ceder, Pellion Technologies, Inc. (USA) [8377-12]

Coffee Break 3:00 to 3:20 pm

SESSION 4

Room: Conv. Ctr. 305 Mon. 3:20 to 4:20 pm

Advanced Energy Harvesting Technologies

Session Chairs: **Priyalal S. Wijewarnasuriya**, U.S. Army Research Lab. (USA); **Palani Balaya**, National Univ. of Singapore (Singapore)

3:20 pm: **Pyroelectric thermal energy harvesting using MEMS-based resonant structures (Invited Paper)**, Scott R. Hunter, Nickolay V. Lavrik, Slobodan Rajic, Panos George C. Datskos, Oak Ridge National Lab. (USA) [8377-13]

3:50 pm: **Quantum-structured III-V energy harvesting devices: pathways to ultra-high conversion efficiencies (Invited Paper)**, Ashok K. Sood, Roger E. Welsler, Magnolia Solar, Inc. (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA); Priyalal S. Wijewarnasuriya, U.S. Army Research Lab. (USA) [8377-15]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 5

Room: Conv. Ctr. 305 Tues. 8:30 to 9:15 am

Advanced Energy Storage Technologies and Applications

Session Chairs: **Nibir K. Dhar**, Defense Advanced Research Projects Agency (USA); **Achyut K. Dutta**, Banpil Photonics, Inc. (USA)

8:30 am: **Flexible electronics and energy-related applications** (*Keynote Presentation*), Anupama B. Kaul, National Science Foundation (USA) [8377-16]

SESSION 6

Room: Conv. Ctr. 305 Tues. 9:15 to 10:35 am

Advanced Thermoelectric Energy Technologies I

Session Chairs: **Rama Venkatasubramanian**, RTI International (USA); **Patrick J. Taylor**, U.S. Army Research Lab. (USA)

9:15 am: **Nanostructured materials for thermoelectric energy conversion** (*Invited Paper*), Ali Shakouri, Purdue Univ. (USA) [8377-17]

9:45 am: **Scalable thermoelectric (TE) device technologies for power generation**, Peter M. Thomas, Bruce Cook, David Stokes, Gordon Krueger, Rama Venkatasubramanian, RTI International (USA) [8377-18]

10:05 am: **Novel methodology to determine thermal conductivity of thermoelectric materials and comparison with device performance** (*Invited Paper*), Jay Maddux, Patrick J. Taylor, U.S. Army Research Lab. (USA) . [8377-19]

Coffee Break 10:35 to 11:00 am

SESSION 7

Room: Conv. Ctr. 305 Tues. 11:00 am to 12:10 pm

Advanced Thermoelectric Energy Technologies II

Session Chairs: **Patrick J. Taylor**, U.S. Army Research Lab. (USA); **Rama Venkatasubramanian**, RTI International (USA)

11:00 am: **Advanced bulk thermoelectric materials and devices for energy harvesting** (*Invited Paper*), Jim Bierschenk, Marlow Industries, Inc. (USA) [8377-20]

11:30 am: **Development of PbTe material for advanced thermoelectric power generation**, Narasimha S. Prasad, NASA Langley Research Ctr. (USA); Sudhir B. Trivedi, Witold Palosz, Robert Rosemeier, Cory Rosemeier, Brimrose Corp. of America (USA); Patrick J. Taylor, U.S. Army Research Lab. (USA); Jay Maddux, Brimrose Corp. of America (USA); Jogender Singh, The Pennsylvania State Univ. (USA) [8377-21]

11:50 am: **Universal scaling relations for the thermoelectric power factor of semiconducting nanostructures**, Oded Rabin, Jane E. Cornett, Univ. of Maryland, College Park (USA) [8377-22]

Lunch/Exhibition Break 12:10 to 2:00 pm

SESSION 8

Room: Conv. Ctr. 305 Tues. 2:00 to 3:30 pm

Advanced Thermoelectric Energy Technologies III

Session Chairs: **Rama Venkatasubramanian**, RTI International (USA); **Patrick J. Taylor**, U.S. Army Research Lab. (USA)

2:00 pm: **Practical thermoelectric generators for automotive and industrial waste heat recovery** (*Invited Paper*), Douglas T. Crane, Dmitri Kossakovski, Vladimir Jovovic, John LaGrandeur, Eric Poliquin, Amerigon, Inc. (USA) . [8377-23]

2:30 pm: **Thermoelectric waste heat recovery from an M1 Abrams tank**, David Stokes, Peter M. Thomas, Michael J. Mantini, Nicholas G. Baldasaro, Rama Venkatasubramanian, RTI International (USA); Michael D. Barton, Creare, Inc. (USA); Christopher Cardine, General Dynamics Land Systems (USA) . . . [8377-24]

2:50 pm: **Two-cavity MEMS capacitive power scavenger**, Jie Lin, Jianxiong Zhu, Manoj Sonje, Zaichun Feng, Mahmoud F. Almasri, Univ. of Missouri-Columbia (USA) [8377-25]

3:10 pm: **MEMS capacitors with dual cavity for power harvesting**, Nuh S. Yuksek, Jie Lin, Zaichun Feng, Manoj Sonje, Jianxiong Zhu, Mahmoud F. Almasri, Univ. of Missouri-Columbia (USA) [8377-26]

Coffee Break 3:30 to 4:00 pm

SESSION 9

Room: Conv. Ctr. 305 Tues. 3:30 to 4:50 pm

Advanced Thermoelectric Energy Technologies IV

Session Chairs: **Chunlei Wang**, Florida International Univ. (USA); **Palani Balaya**, National Univ. of Singapore (Singapore)

3:30 pm: **Recent development in thermoelectric materials** (*Invited Paper*), Ram P. Tandon, Univ. of Delhi (India) [8377-27]

4:00 pm: **Alpha Schottky junction energy source**, Marc S. Litz, Stanley L. Henriquez, James J. Carroll, U.S. Army Research Lab. (USA) [8377-28]

4:20 pm: **Emerging applications and markets for thin-film thermoelectric energy harvesting** (*Invited Paper*), James J. Mundell, Nextreme Thermal Solutions, Inc. (USA) [8377-29]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Solar-powered, ad-hoc, wireless-sensor network for border surveillance, Jun He, Robert A. Norwood, Mahmoud Fallahi, Nasser N. Peyghambarian, College of Optical Sciences, The Univ. of Arizona (USA) [8377-30]

DNA: multiple architectures for use in electronics applications, Amethyst S. Finch, U.S. Army Research Lab. (USA) [8377-31]

A new microwave-based control system for emulsion-layer removal in oil tanks, Mahmoud Meribout, The Petroleum Institute (United Arab Emirates) [8377-32]

An electric emergency system using energy harvesting sources, Eduardo I. Ortiz-Rivera, Carlos I. Gonzalez, Univ. de Puerto Rico Mayagüez (USA) . [8377-33]

An integrated thermoelectric harvesting system for sensor applications, Eduardo I. Ortiz-Rivera, Univ. de Puerto Rico Mayagüez (USA) [8377-34]

A maximum power point tracking for solar cells using an analog design control system for a low-voltage sensor applications, Eduardo I. Ortiz-Rivera, Univ. de Puerto Rico Mayagüez (USA) [8377-35]

Courses of Related Interest

SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Scanning Microscopies 2012: Advanced Microscopy Technologies for Defense, Homeland Security, Forensic, Life, Environmental, and Industrial Sciences

Conference Chairs: **Michael T. Postek**, National Institute of Standards and Technology (USA); **Dale E. Newbury**, National Institute of Standards and Technology (USA); **S. Frank Platek**, U.S. Food and Drug Administration (USA)

Conference Co-Chairs: **David C. Joy**, The Univ. of Tennessee (USA); **Tim K. Mangel**, Univ. of Maryland, College Park (USA)

Program Committee: **Eva M. Campo**, Univ. of Pennsylvania (USA); **Ronald G. Dixon**, National Institute of Standards and Technology (USA); **Lucille A. Giannuzzi**, L.A. Giannuzzi & Associates LLC (USA); **Brendan J. Griffin**, The Univ. of Western Australia (Australia); **Michael J. McVicar**, Ctr. of Forensic Sciences (Canada); **John P. Petrali**, U.S. Army Medical Research Institute of Chemical Defense (USA); **John Henry Scott**, National Institute of Standards and Technology (USA); **Vladimir A. Ukraintsev**, Nanometrology International, Inc. (USA); **John S. Villarrubia**, National Institute of Standards and Technology (USA); **András E. Vladár**, National Institute of Standards and Technology (USA); **Oliver C. Wells**, IBM Corp. (USA)

Tuesday 24 April

SESSION 1

Room: Conv. Ctr. 317 Tues. 7:55 to 9:50 am

Scanning Microscopies for Micro and Nanotechnology Applications

Note room change.

Joint Session with Conference 8373

Session Chairs: **Michael T. Postek**, National Institute of Standards and Technology (USA); **Thomas George**, Zyomed Corp. (USA)

Introduction 7:55 to 8:00 am

8:00 am: **Past, present, and future of BSE imaging in the SEM** (*Invited Paper*), Oliver C. Wells, Lynne M. Gignac, Michael S. Gordon, IBM Thomas J. Watson Research Ctr. (USA) [8378-01]

8:30 am: **Faults and foibles of quantitative EDS** (*Invited Paper*), Dale E. Newbury, National Institute of Standards and Technology (USA) [8378-02]

8:50 am: **Quantitative mechanical mapping at nanometer scale** (*Invited Paper*), Chanmin Su, Bruker Nano Inc. (USA) [8378-03]

9:10 am: **Nanoscale chemical composition mapping of polymers at 100nm spatial resolution with AFM-based IR spectroscopy** (*Invited Paper*), Kevin Kjoller, Craig B. Prater, Mike Lo, Anasys Instruments (USA); Alexandre Dazzi, Univ. of Paris-Sud-XI (France); Roshan Shetty, Anasys Instruments (USA) [8373-21]

9:30 am: **Does your SEM really tell the truth?** (*Invited Paper*), Michael T. Postek, National Institute of Standards and Technology (USA) [8378-04]

Coffee Break 9:50 to 10:20 am

SESSION 2

Room: Conv. Ctr. 312 Tues. 10:20 am to 12:10 pm

Scanning Microscopies and the Study of Chemical Warfare Agents

Session Chairs: **John P. Petrali**,

U.S. Army Medical Research Institute of Chemical Defense (USA);

Tim K. Mangel, Univ. of Maryland, College Park (USA)

10:20 am: **Introduction to chemical warfare agents** (*Invited Paper*), John P. Petrali M.D., U.S. Army Medical Research Institute of Chemical Defense (USA) [8378-05]

10:50 am: **Tissue injury due to mustard gas exposure: cellular and molecular mechanisms**, Radharaman Ray, Brian Keyser, Devon Andres, Betty Benton, Alina Grigorovitch, Dana Anderson, Wesley Holmes, U.S. Army Medical Research Institute of Chemical Defense (USA); Cynthia Rosenthal, Dean S. Rosenthal, Georgetown Univ. School of Medicine (USA) [8378-06]

11:10 am: **Ultrastructural characterization of the acute and delayed-onset injury in rabbit corneas following exposure to sulfur mustard vapor**, Patrick McNutt, Angela Adkins, Marian Nelson, Adam Swartz, Kaylie Tuznik, Megan Lyman, Tracey Hamilton, U.S. Army Medical Research Institute of Chemical Defense (USA) [8378-07]

11:30 am: **Progression of brain injury following exposure to the chemical warfare nerve agent Soman: involvement of different brain cells and neuroinflammation**, Robert Kan, Jessica A. Leuschner, Dominique F. Scutella, Thuy T. Dao, Shane W. Kaski, Catherine R. Braue, Erik A. Johnson, U.S. Army Medical Research Institute of Chemical Defense (USA) [8378-08]

11:50 am: **Development and efficacy of cwa countermeasures: sulfur mustard**, William J. Smith, U.S. Army Medical Research Institute of Chemical Defense (USA) [8378-09]

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

SESSION 3

Room: Conv. Ctr. 312 Tues. 1:40 to 3:10 pm

Atomic Force Microscopy for Imaging and Metrology I

Session Chairs: **Ndubuisi Orji**,

National Institute of Standards and Technology (USA);

Ronald G. Dixon, National Institute of Standards and Technology (USA)

1:40 pm: **Characterization of a New Traceable Metrology AFM at NIST** (*Invited Paper*), Ronald G. Dixon, Ndubuisi Orji, National Institute of Standards and Technology (USA) [8378-10]

2:10 pm: **Atomic force microscope cantilevers as encoder for real-time displacement measurements**, Ludger Koenders, Xiaomei Chen, Helmut Wolff, Physikalisch-Technische Bundesanstalt (Germany) [8378-11]

2:30 pm: **Development of a laser interferometer for implementation in a metrological scanning probe microscope**, Malcolm B. Gray, Terry G. McRae, Magnus Hsu, Chris H. Freund, Jan Herrmann, National Measurement Institute of Australia (Australia) [8378-12]

2:50 pm: **High throughput and non-destructive sidewall roughness measurement using 3-dimensional atomic force microscopy**, Yueming Hua, Cynthia Buenviaje-Coggins, Park Systems Inc. (USA); Yong-Ha Paul Lee, Sang-Il Park, Park Systems Corp. (Korea, Republic of) [8378-14]

Coffee Break 3:10 to 3:40 pm

Conference 8378 · Room: Conv. Ctr. 312

SESSION 4

Room: Conv. Ctr. 312 Tues. 3:40 to 5:00 pm

Atomic Force Microscopy for Imaging and Metrology II

Session Chairs: **Ronald G. Dixon**,
National Institute of Standards and Technology (USA);
Ndbuisi Orji, National Institute of Standards and Technology (USA)

3:40 pm: **Hybrid metrology for critical dimension based on scanning methods to answer to the semiconductor industry requirements**, Johann Foucher, CEA-LETI (France) [8378-15]

4:00 pm: **Deformation of polystyrene nanoparticles under different AFM tapping loads**, Wei-En Fu, Huay-Chung Liou, Shan-Peng Pan, Industrial Technology Research Institute (Taiwan); Hung Min Lin, YenFu Chen, Bruker Taiwan (Taiwan) [8378-16]

4:20 pm: **Influence of surface coatings on nanoparticle measurement with atomic force microscopy**, Malcolm A. Lawn, Asa K. Jämtning, Victoria A. Coleman, Heather J. Catchpole, Jan Herrmann, National Measurement Institute of Australia (Australia) [8378-17]

4:40 pm: **Extension of gravity center method for diameter calibration of polystyrene standard particles with a metrological AFM**, Ichiko Misumi, Keiji Takahata, Kentaro Sugawara, Satoshi Gonda, Kensei Ehara, National Institute of Advanced Industrial Science and Technology (Japan) [8378-18]

Wednesday 25 April

SESSION 5

Room: Conv. Ctr. 312 Wed. 8:30 to 10:00 am

Modeling

Session Chairs: **John S. Villarrubia**,
National Institute of Standards and Technology (USA);
András E. Vladár, National Institute of Standards and Technology (USA)

8:30 am: **Modeling for multi-beam microscopy** (*Invited Paper*), David C. Joy, The Univ. of Tennessee (USA); Brendan J. Griffin, The Univ. of Western Australia (Australia) [8378-19]

9:00 am: **The sensitivity of backscattering coefficients to elastic scattering cross sections and electron stopping powers**, Mohamed M. El-Gomati, The Univ. of York (United Kingdom) [8378-21]

9:20 am: **Modeling and verification of SEM Imaging simulation of crystalline copper with amorphous top layer**, Satoshi Takada, State Univ. of New York (USA) and Hitachi High-Technologies Corp. (Japan); Makoto Suzuki, Hitachi High-Technologies Corp. (Japan); Sergey S. Borisov, Abeam Technologies (USA); Eric Eisenbraun, The State Univ. of New York (USA) [8378-22]

9:40 am: **Image processing with Maple for simplified analysis in scanning microscopy**, Alejandro Mesa, EAFIT Univ. (Colombia) [8378-23]

Coffee Break 10:00 to 10:30 am

SESSION 6

Room: Conv. Ctr. 312 Wed. 10:30 to 11:50 am

Particle Beam Microscopies I

Session Chairs: **John Henry Scott**,
National Institute of Standards and Technology (USA);
Lucille A. Giannuzzi, L.A. Giannuzzi & Associates LLC (USA)

10:30 am: **Nano-manipulation systems for scanning electron microscope** (*Invited Paper*), Patrick Woo, I. Mekuz, Hitachi High-Technologies Canada, Inc. (Canada); B. Chen, Univ. of Toronto (Canada) [8378-24]

10:50 am: **Multi-signal FIB/SEM tomography** (*Invited Paper*), Lucille A. Giannuzzi, L.A. Giannuzzi & Associates LLC (USA) [8378-25]

11:10 am: **Nanostructuring of photonics devices in the helium ion microscope**, Larry Scipioni, Chuong Y. Huynh, Carl Zeiss SMT Inc. (USA); Yao-Te Cheng, Stanford Univ. (USA) [8378-27]

11:30 am: **Advances in high-speed, low-latency communications for nanopositioning in advanced microscopy**, Scott C. Jordan, PI (Physik Instrumente) L.P. (USA) [8378-28]

Lunch/Exhibition Break 11:50 to 2:00 pm

SESSION 7

Room: Conv. Ctr. 312 Wed. 2:00 to 4:00 pm

Particle Beam Microscopies II

Session Chairs: **Eva M. Campo**, Univ. of Pennsylvania (USA);
John Henry Scott, National Institute of Standards and Technology (USA)

2:00 pm: **How much is enough? Spectrum depth and classification accuracy in automated particle analysis**, Jaideep Bharagava, Poolesville High School (USA); Nicholas W. M. Ritchie, National Institute of Standards and Technology (USA) [8378-29]

2:20 pm: **Improving the performance of the critical dimension scanning electron microscope with the contrast transfer function**, Aron J. Cepler, SEMATECH (USA); Bradley Thiel, Univ. at Albany (USA) [8378-30]

2:40 pm: **How to get your SEM to always perform at its best**, András E. Vladár, Petr Cizmar, Michael T. Postek, National Institute of Standards and Technology (USA) [8378-31]

3:00 pm: **An active pixel sensor for detecting low energy electrons**, Mohamed M. El-Gomati, The Univ. of York (United Kingdom); Xiaoping Zha, YPS Ltd. (United Kingdom) [8378-32]

3:20 pm: **Microanalysis of Al₂O₃-(Al-Fe) ceramic-metal interpenetrating phase composites using scanning and transmission microscopy techniques**, Virgil C. Solomon, Marjan Moro, Youngstown State Univ. (USA); Klaus-Markus Peter, Brian Hetzel, Fireline TCON, Inc. (USA); Matthias Zeller, Timothy R. Wagner, Youngstown State Univ. (USA) [8378-33]

3:40 pm: **Dispersion and alignment studies of electrospun CNT composites by focus ion beam**, Benjamin Berson, Jack M. Barrack Hebrew Academy (USA) and Univ. of Pennsylvania (USA); Rocio d. A. Cardona, Jorge J. Santiago-Aviles, Eva M. Campo, Univ. of Pennsylvania (USA) [8378-34]

Thursday 26 April

SPECIAL SESSION

Room: Conv. Ctr. 312 Thurs. 8:15 to 8:30 am

Introduction: Microscopy for STEM Educators

Session Chairs: **Michael T. Postek**, National Institute of Standards and Technology (USA); **Mary Satterfield**, Robert Gordon Hitachi High

Technologies (USA) and National Institute of Standards and Technology (USA)
The future of our nation hinges on our ability to prepare our next generation to be innovators in science, technology, engineering and math (STEM). Excitement for STEM begins in the earliest stages of our education process. Yet, today far too few of our students are prepared for the challenges ahead. The special session "Microscopy for STEM Educators" is a general interest forum with several notable invited speakers discussing their successful programs implementing microscopy in STEM education to foster student interest and excitement. A hands-on session with tabletop scanning electron microscopes will be held at the end of the presentations and the attendees are encouraged to bring samples of interest and operate the instruments. STEM educators will receive one-day reduced registration fees and will be able to visit the exposition where other microscopes may be on display.

All meeting attendees are invited to attend. Educators attending this session only may complete the Special Registration Form for STEM Educators.

SESSION 8

Room: Conv. Ctr. 312 Thurs. 8:30 to 10:30 am

Special Session on Microscopy for STEM Educators I

Session Chairs: **Michael T. Postek**,
National Institute of Standards and Technology (USA);
Mary Satterfield, National Institute of Standards and Technology (USA)

8:30 am: **Forensic practice in the field of protection of cultural heritage** (*Invited Paper*), Marek Kotrly, Ivana Turkova, Institute of Criminalistics Prague (Czech Republic) [8378-35]

9:00 am: **Science and art at the nanoscale** (*Invited Paper*), Baratunde A. Cola, Georgia Institute of Technology (USA); Kelly Voss, Renee Gaither, Tucker High School (USA); Jamila Cola, Georgia Institute of Technology (USA) [8378-36]

9:30 am: **The National Nanotechnology Infrastructure Network's Education and Outreach Programs: understanding size and scale and the tools of nano** (*Invited Paper*), Nancy Healy, Georgia Institute of Technology (USA) [8378-37]

10:00 am: **Integrating research and advanced microscopy into the high school curriculum** (*Invited Paper*), Dave Becker, Craig Queenan, Alyssa Calabro, Bergen County Academies (USA) [8378-38]

Coffee Break 10:30 to 11:00 am

SESSION 9

Room: Conv. Ctr. 312 Thurs. 11:00 am to 12:30 pm

**Special Hands-on Session on
Microscopy for STEM Educators II**

Session Chairs: Michael T. Postek, National Institute of Standards and Technology (USA); Mary Satterfield, National Institute of Standards and Technology (USA) Table-top scanning electron microscopes will be available during this hands-on session and experts will be available to answer questions. The attendees are invited to bring samples of interest and to operate the instruments. Attendees should also bring a memory stick to obtain scanning electron microscope images. Other scanning electron microscopes including laboratory instruments may be found on the exhibition floor. Attendees are encouraged to visit these instruments, as well.

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

SESSION 10

Room: Conv. Ctr. 312 Thurs. 1:30 to 3:10 pm

Microscopies for Nanotechnological Applications

Session Chairs: **Vladimir A. Ukraintsev**, Nanometrology International, Inc. (USA); **Eva M. Campo**, Univ. of Pennsylvania (USA)

1:30 pm: **Synthesis of silicon nanowires via electron-beam templating and metal-assisted catalytic etching**, Dagny Fleischman, Kathryn F. Murphy, Daniel S. Gianola, Univ. of Pennsylvania (USA) [8378-39]

1:50 pm: **Robust probes for high-resolution chemical detection and imaging**, Rebecca L. Agapov, The Univ. of Akron (USA); Alexei P. Sokolov, Oak Ridge National Lab. (USA) and The Univ. of Tennessee (USA); Mark D. Foster, The Univ. of Akron (USA) [8378-40]

2:10 pm: **Relation between morphological and processing parameters in the electro-spinning of poly-lactic acid (PLA) - carbon nano-tubes (CNT) composites**, Eva M. Campo, Univ. of Pennsylvania (USA); Melvin Berrios-Soto, Univ. de Puerto Rico Mayagüez (USA); Rocio d. A. Cardona, Jorge J. Santiago-Aviles, Univ. of Pennsylvania (USA) [8378-41]

2:30 pm: **Response of electrospun CNT composites to IR-irradiation**, Eva M. Campo, Univ. of Pennsylvania (USA); Idalia Ramos, Sabrina Rosa, Jean P. Crespo, Univ. de Puerto Rico en Humacao (USA); Jorge J. Santiago-Aviles, Univ. of Pennsylvania (USA) [8378-42]

2:50 pm: **Effects of impurities on stress-driven microstructural evolution in nanocrystalline aluminum**, Patrick J. Malone, Mo-Rigen He, Univ. of Pennsylvania (USA); Gang Feng, Villanova Univ. (USA); Daniel S. Gianola, Univ. of Pennsylvania (USA) [8378-43]

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SPIE

Laser Radar Technology and Applications XVII

Conference Chairs: **Monte D. Turner**, Air Force Research Lab. (USA); **Gary W. Kamerman**, FastMetrix, Inc. (USA)

Program Committee: **Philip Gatt**, Lockheed Martin Coherent Technologies (USA); **Richard M. Heinrichs**, Defense Advanced Research Projects Agency (USA); **Robert T. Hintz**, Naval Air Warfare Ctr. Weapons Div. (USA); **Norman Lopez**, FastMetrix, Inc. (USA); **Vasyl Molebny**, National Taras Shevchenko Univ. of Kyiv (Ukraine); **Russell Philbrick**, North Carolina State Univ. (USA); **Upendra N. Singh**, NASA Langley Research Ctr. (USA); **Ove Steinvall**, Swedish Defence Research Agency (Sweden)

Tuesday 24 April

Opening Remarks

Room: Conv. Ctr. 325 Tues. 9:30 to 9:40 am

Session Chairs: **Monte D. Turner**, Air Force Research Lab. (USA); **Gary W. Kamerman**, FastMetrix, Inc. (USA)

SESSION 1

Room: Conv. Ctr. 325 Tues. 9:40 to 11:20 am

3D Flash Lidar

Session Chair: **Monte D. Turner**, Air Force Research Lab. (USA)

9:40 am: **Three-dimensional imaging with 1.06um Geiger-mode lidar camera**, Ping Yuan, Rengarajan Sudharsanan, Xiaogang Bai, Paul A. McDonald, Eduardo L. Labios, Spectrolab, Inc. (USA); Bryan A. Morris, John P. Nicholson, Gary M. Stuart, Harrison Danny, Boeing-SVS, Inc. (USA) [8379-01]

10:00 am: **Low-cost compact MEMS-scanned lidar system for robotic applications**, Robert D. Moss, Ping Yuan, Xiaogang Bai, Rengarajan Sudharsanan, Emilio Quesada, Spectrolab, Inc. (USA); Barry L. Stann, John F. Dammann, Mark M. Giza, William B. Lawler, U.S. Army Research Lab. (USA) [8379-02]

Coffee Break 10:20 to 10:40 am

10:40 am: **Pulsed 3D laser sensor with scan-less receiver**, Hidenobu Tsuji, Akihito Hirai, Nobuki Kotake, Masaharu Imaki, Shumpei Kameyama, Mikio Takabayashi, Yoshihito Hirano, Mitsubishi Electric Corp. (Japan) [8379-03]

11:00 am: **Flash lidar performance testing: configuration and results**, Ilya Poberezhskiy, Andrew Johnson, Daniel Chang, Eric Ek, David Natzic, Gary Spiers, Jet Propulsion Lab. (USA); Steve Penniman, Brad Short, Advanced Scientific Concepts, Inc. (USA) [8379-04]

SESSION 2

Room: Conv. Ctr. 325 Tues. 11:20 to 11:40 am

3D Data Exploitation I

Session Chair: **Gary W. Kamerman**, FastMetrix, Inc. (USA)

11:20 am: **Detecting trails in lidar point cloud data**, Angela M. Kim, Richard C. Olsen, Naval Postgraduate School (USA) [8379-06]

Lunch/Exhibition Break 11:40 am to 2:00 pm

SESSION 3

Room: Conv. Ctr. 325 Tues. 2:00 to 5:40 pm

3D Data Exploitation II

Session Chair: **Gary W. Kamerman**, FastMetrix, Inc. (USA)

2:00 pm: **Line-of-sight measurement in large urban areas using voxelized lidar**, Shea Hagstrom, David Messinger, Rochester Institute of Technology (USA) [8379-07]

2:20 pm: **Real-time 3D change detection of IEDs**, Mitch Wathen, U.S. Army Research Lab. (USA); Norah Link, CAE (Canada); Peter Iles, Neptec Design Group Ltd. (Canada); Paul Mrstik, GeoDigital International Inc. (Canada); John Jinkerson, CAE USA (USA); David Kovats, CAE (Canada); Kresimir Kusevic, GeoDigital International Inc. (Canada) [8379-08]

2:40 pm: **A new method of 3D reconstruction using point cloud and distance images of laser radar**, Jinhui Lan, Jiehui Li, Univ. of Science and Technology Beijing (China) [8379-09]

Coffee/Exhibition Break 3:00 to 4:00 pm

4:00 pm: **Landing zone determination using video rate point cloud data**, Christopher T. Rodgers, Javier Méndez-Rodríguez, ITT Corp. Geospatial Systems (USA) [8379-10]

4:20 pm: **Foliage penetration by using 4D point cloud data**, Javier Méndez-Rodríguez, Pedro J. Sánchez-Reyes, Sol M. Cruz-Rivera, ITT Corp. Geospatial Systems (USA) [8379-11]

4:40 pm: **Geometric-model-free tracking of extended targets using 3D lidar measurements**, Philipp Steinemann, Jens Klappstein, Juergen Dickmann, Daimler AG (Germany); Felix von Hundelshausen, Hans-Joachim Wünsche, Univ. der Bundeswehr München (Germany) [8379-12]

5:00 pm: **Improved target detection using occupancy grids**, Gustav Tolt, Tomas R. Chevalier, Philip Engström, Christina A. Grönwall, Swedish Defence Research Agency (Sweden) [8379-13]

5:20 pm: **A lidar bare earth extraction technique for diverse topography and complex scenes**, Amy L. Neuenschwander, Terry H. Stevenson, Lori A. Magruder, The Univ. of Texas at Austin (USA) [8379-14]

Wednesday 25 April

SESSION 4

Room: Conv. Ctr. 325 Wed. 9:00 am to 12:20 pm

Atmospheric Measurements

Session Chair: **Philip Gatt**,

Lockheed Martin Coherent Technologies (USA)

9:00 am: **Lidar imaging analytical approach using both outward and return path atmospheric turbulence phase-screens**, Douglas G. Youmans, Cobham Analytic Solutions (USA) [8379-15]

9:20 am: **AGLITE: multiwavelength lidar for real-time characterization of aerosol mass concentration**, Michael D. Wojcik, Space Dynamics Lab. (USA); Randal S. Martin, Kori D. Moore, Utah State Univ. (USA); Jerry L. Hatfield, Agricultural Research Service (USA) [8379-16]

9:40 am: **Ground and airborne methane measurements with optical parametric amplifier**, Kenji Numata, Haris Riris, Steve Li, Stewart Wu, Stephan R. Kawa, Martha W. Dawsey, Anand Ramanathan, James B. Abshire, NASA Goddard Space Flight Ctr. (USA) [8379-17]

10:00 am: **Measurement of atmospheric formaldehyde profiles with a laser-induced formaldehyde lidar**, Guangkun Li, MassTech Inc. (USA); Jie Lei, Coorg R. Prasad, Science & Engineering Services, Inc. (USA) [8379-18]

Coffee Break 10:20 to 10:40 am

Thursday 26 April

SESSION 7

Room: Conv. Ctr. 325 Thurs. 9:00 to 10:40 am

Novel Systems

Session Chair: Vasyl Molebny,

National Taras Shevchenko Univ. of Kyiv (Ukraine)

9:00 am: **A wide angle bistatic scanning lidar for navigation**, Xiang Zhu, Doug Aikman, Chris Bell, Adam M. DesLauriers, Louis Gagnon, Martin Guibert, Mike Jamieson, Bill Shadid, Neptec Design Group Ltd. (Canada); Sébastien Gemme, Luminita Ilinca-Ignat, Canadian Space Agency (Canada) [8379-31]

9:20 am: **Slant path 1.5µm-range gated imaging of static and moving targets**, Ove Steinvall, Magnus Elmqvist, Ove K. Gustafsson, Kjell Karlsson, Swedish Defence Research Agency (Sweden) [8379-32]

9:40 am: **Improvement of the sensitivity of lidar with sensor-head of thumb size by using optical fiber preamplifier**, Daisuke Inoue, Tadashi Ichikawa, Hiroyuki Matsubara, Xuesong Mao, Mitsutoshi Maeda, Chie Nagashima, Manabu Kagami, Toyota Central R&D Labs., Inc. (Japan) [8379-33]

10:00 am: **Compact high-speed scanning lidar system**, Cameron Dickinson, MacDonald, Dettwiler and Associates Ltd. (Canada); Marwan Hussein, Jeff Tripp, Optech, Inc. (Canada); Manny Nimelman, MacDonald, Dettwiler and Associates Ltd. (Canada); Sébastien Gemme, Canadian Space Agency (Canada) .. [8379-34]

10:20 am: **Advanced compact 3D lidar using the high-speed fiber coupled pulsed laser diode and high-accuracy timing discrimination readout circuit**, Min-Gu Lee, Seung-Ho Baeg, SangDeok Park, Korea Institute of Industrial Technology (Korea, Republic of) [8379-35]

Coffee Break 10:40 to 11:00 am

SESSION 8

Room: Conv. Ctr. 325 Thurs. 11:00 am to 12:00 pm

Component Technologies

Session Chair: Gary W. Kamerman, FastMetrix, Inc. (USA)

11:00 am: **Development of a ROIC for lidar on planetary lander by CMOS technology**, Takahide Mizuno, Hirokazu Ikeda, Kousuke Kawahara, Japan Aerospace Exploration Agency (Japan) [8379-36]

11:20 am: **An overview of heat dissipation technologies in classical lidar instruments**, Yue Zhang, Zhou Feng, Beijing Institute of Space Mechanics and Electricity (China) [8379-37]

11:40 am: **Laser sources for lidar applications**, Joyce P. Kilmer, Andrew Iadevaia, Yusong Yin, Photonics Industries International, Inc. (USA) [8379-38]

Lunch/Exhibition Break 12:00 to 1:50 pm

SESSION 9

Room: Conv. Ctr. 325 Thurs. 1:50 to 2:50 pm

Maritime Applications

Session Chair: Monte D. Turner, Air Force Research Lab. (USA)

1:50 pm: **The impact of sea state conditions on airborne lidar bathymetry measurements**, Torbjörn Karlsson, Lund Univ. (Sweden); Shachak Pe'eri, The Univ. of New Hampshire (USA); Andreas Axelsson, Airborne Hydrography AB (Sweden) [8379-40]

2:10 pm: **Feasibility study for airborne fluorescence lidar bathymetry**, Ove Steinvall, Swedish Defence Research Agency (Sweden); Hans Kautsky, Stockholm Univ. (Sweden); Michael Tuldahl, Tomas R. Chevalier, Erika Wollner, Swedish Defence Research Agency (Sweden) [8379-39]

2:30 pm: **Remote topographic collections in an estuarine intertidal zone using a single photon counting imager**, Scott R. Greenfield, David C. Thompson, Los Alamos National Lab. (USA); Alfred Garrett, Savannah River National Lab. (USA) [8379-41]

10:40 am: **Time-resolved remote Raman and fluorescence spectrometers for planetary exploration**, Shiv K. Sharma, Anupam K. Misra, Tayro E. Acosta, Paul G. Lucey, Univ. of Hawai'i (USA) [8379-19]

11:00 am: **Simulation framework to estimate the performance of CO₂ and O₂ sensing from space and airborne platforms for the proposed ASCENDS mission implementation**, Denis V. Pliutau, Narasimha S. Prasad, NASA Langley Research Ctr. (USA) [8379-20]

11:20 am: **Airborne Doppler wind lidar data fusion with a diagnostic wind model**, Yansen Wang, U.S. Army Research Lab. (USA) [8379-21]

11:40 am: **Airborne wind profiling with the data acquisition and processing system for a pulsed 2-micron coherent doppler lidar system**, Jeffrey Y. Beyon, NASA Langley Research Ctr. (USA) [8379-22]

12:00 pm: **Noise whitening in airborne wind profiling with a pulsed 2-micron coherent Doppler lidar at NASA Langley Research Center**, Jeffrey Y. Beyon, NASA Langley Research Ctr. (USA) [8379-23]

Lunch/Exhibition Break 12:20 to 2:30 pm

SESSION 5

Room: Conv. Ctr. 325 Wed. 2:30 to 3:10 pm

Modeling and Simulation

Session Chair: Upendra N. Singh, NASA Langley Research Ctr. (USA)

2:30 pm: **Ladar performance simulations with a high spectral resolution atmospheric transmittance and radiance model: LEEDR**, Benjamin D. Roth, Steven T. Fiorino, Air Force Institute of Technology (USA) [8379-24]

2:50 pm: **Spatial integration considerations for coherent array receivers**, Philip Gatt, Don Jacob, Lockheed Martin Coherent Technologies (USA) . [8379-25]

SESSION 6

Room: Conv. Ctr. 325 Wed. 3:10 to 5:10 pm

Signal and Data Processing

Session Chair: Ove Steinvall, Swedish Defence Research Agency (Sweden)

3:10 pm: **Noise filter techniques for photon-counting lidar data**, Lori A. Magruder, Kevin D. Stout, Michael E. Wharton, Amy L. Neuenschwander, The Univ. of Texas at Austin (USA) [8379-26]

Coffee Break 3:30 to 3:50 pm

3:50 pm: **A novel range ambiguity resolution technique applying pulse-position modulation in time-of-flight ranging applications**, Peter Rieger, Andreas Ullrich, RIEGL Laser Measurement Systems GmbH (Austria) . . [8379-27]

4:10 pm: **A calibration-and-error correction method for improved texel (fused lidar/digital camera) images**, Brittin Bennett, Scott E. Budge, Utah State Univ. (USA) [8379-28]

4:30 pm: **Measurement of transient dynamics with a scannerless infrared laser Doppler vibrometer**, James M. Kilpatrick, Advanced Systems & Technologies, Inc. (USA) [8379-29]

4:50 pm: **An unsupervised classification for full-waveform lidar point data using IHSL transform and the FCM algorithm**, Jinhu Wang, Chuanrong Li, Lingli Tang, Mei Zhou, The Academy of Opto-Electronics (China) [8379-30]

POSTERS—THURSDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Ultraviolet scanning Raman lidar with fast telescope for measurements of water vapor and aerosols in lower atmosphere, Fei Gao, Samo Stanic, Tingyao He, Univ. of Nova Gorica (Slovenia); Dengxin Hua, Xi'an Univ. of Technology (China) [8379-42]

Performance improvement of real-time 3D imaging lidar based on a modified array receiver, Nobuki Kotake, Shumpei Kameyama, Masaharu Imaki, Hidenobu Tsuji, Akihito Hirai, Mikio Takabayashi, Yoshihito Hirano, Mitsubishi Electric Corp. (Japan) [8379-43]

3D scene reconstruction with monocular visual odometer based on inverse perspective mapping, Yu Cao, Ying Feng, Lian Wei, Bing Lei, National Univ. of Defense Technology (China) [8379-44]

Fusion of 3D imaging lidar and binocular stereo vision for improved 3D measurement, Jinliang Yang, Xingshu Wang, Shiqiao Qin, Chunsheng Hu, Zhongsheng Huang, National Univ. of Defense Technology (China) [8379-45]

A modified lidar system with a Geiger mode APD to remove a dead time problem, Sung Eun Jo, Hong Jin Kong, Tae Hoon Kim, KAIST (Korea, Republic of); Jonghan Jin, Jae Wan Kim, Jong-Ahn Kim, Korea Research Institute of Standards and Science (Korea, Republic of) [8379-46]

Improvement of SNR by temporal filtering method in lidar system using two Geiger-mode avalanche photodiodes, Tae Hoon Kim, Hong Jin Kong, Sung Eun Jo, KAIST (Korea, Republic of). [8379-47]

Courses of Related Interest

- SC1031 **Radar Micro-Doppler Signatures - Principles and Applications** (Chen, Tahmoush) Wednesday, 8:30 am to 12:30 pm
- SC1032 **Direct Detection Laser Radar Systems for Imaging Applications** (Richmond, Cain) Monday, 8:30 am to 5:30 pm
- SC167 **Introduction to Laser Radar** (Kammerman) Monday, 8:30 am to 12:30 pm
- SC1035 **Military Laser Safety** (Marshall) Thursday, 8:30 am to 5:30 pm
- SC160 **Precision Stabilized Pointing and Tracking Systems** (Hilkert) Monday, 8:30 am to 5:30 pm
- SC997 **High Power Laser Beam Quality** (Ross) Thursday, 8:30 am to 12:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Defense, Security, and Sensing Facility Maps:

Baltimore Convention Center pp. 3–4
Hilton Baltimore p. 5

Atmospheric Propagation IX

Conference Chairs: **Linda M. Wasiczko Thomas**, U.S. Naval Research Lab. (USA); **Earl J. Spillar**, Air Force Research Lab. (USA)

Program Committee: **Ammar Al-Habash**, Raytheon Space & Airborne Systems (USA); **Gary J. Baker**, Lockheed Martin Space Systems Co. (USA); **Harris R. Burris, Jr.**, U.S. Naval Research Lab. (USA); **Gary G. Gimmestad**, Georgia Tech Research Institute (USA); **Ken Grant**, Defence Science and Technology Organisation (Australia); **Juan C. Juarez**, The Johns Hopkins Univ. Applied Physics Lab. (USA); **Christopher I. Moore**, U.S. Naval Research Lab. (USA); **Jonathan M. Saint Clair**, The Boeing Co. (USA); **David H. Tofsted**, U.S. Army Research Lab. (USA); **Morio Toyoshima**, National Institute of Information and Communications Technology (Japan); **Cynthia Y. Young**, Univ. of Central Florida (USA)

Wednesday 25 April

SESSION 1

Room: Conv. Ctr. 306Wed. 8:20 to 10:00 am

Laser Communications I

Session Chair: **Juan C. Juarez**,

The Johns Hopkins Univ. Applied Physics Lab. (USA)

8:20 am: **Retro-reflector diversity effects in free-space optical links**, William S. Rabinovich, Rita Mahon, Christopher I. Moore, Michele R. Suite, Mike S. Ferraro, Linda M. Wasiczko Thomas, Peter G. Goetz, U.S. Naval Research Lab. (USA) [8380-01]

8:40 am: **Miniature lasercomm module for integration into a small, unmanned, aerial platform**, Michael J. Vilcheck, Harris R. Burris, Jr., L. D. Epp, Christopher I. Moore, Walter R. Smith, Jr., Linda L. Summers, Linda M. Wasiczko Thomas, U.S. Naval Research Lab. (USA) [8380-02]

9:00 am: **Fade and surge asymmetry of direct single-mode-fiber coupled free-space optical signal under weak atmospheric turbulences**, Yoshinori Arimoto, National Institute of Information and Communications Technology (Japan) [8380-03]

9:20 am: **Automating a lasercomm terminal on a small, unmanned, aerial platform**, Walter R. Smith, Jr., Harris R. Burris, Jr., Michael J. Vilcheck, Christopher I. Moore, Linda L. Summers, Linda M. Wasiczko Thomas, U.S. Naval Research Lab. (USA) [8380-04]

9:40 am: **Design simulation and analysis of a fiber-bundle-based optical wireless link**, Peter G. LoPresti, The Univ. of Tulsa (USA); Dayong Zhou, The Univ. of Oklahoma - Tulsa (USA); Zhaorui Shi, The Univ. of Tulsa (USA); Hazem Refai, The Univ. of Oklahoma - Tulsa (USA) [8380-05]

Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 306Wed. 10:30 am to 12:20 pm

Laser Communications II

Session Chair: **Linda M. Wasiczko Thomas**,
U.S. Naval Research Lab. (USA)

10:30 am: **Analysis of link performance for the FOENEX laser communications system (Invited Paper)**, Juan C. Juarez, David W. Young, The Johns Hopkins Univ. Applied Physics Lab. (USA); Radha Venkat, Princeton Univ. (USA); David M. Brown, Andrea M. Brown, Johns Hopkins Univ. Applied Physics Lab. (USA); Rachel L. Oberc, Joseph E. Sluz, The Johns Hopkins Univ. Applied Physics Lab. (USA); Alan Pike, Defense Strategies and Systems (USA); Larry B. Stotts, Defense Advanced Research Projects Agency (Retired) (USA) . . . [8380-06]

11:00 am: **Development of a large area InGaAs APD receiver based on an impact ionization engineered detector for free-space lasercomm applications**, Harris R. Burris, Jr., Mike S. Ferraro, Wade Freeman, Christopher I. Moore, James L. Murphy, William S. Rabinovich, Walter R. Smith, Jr., Linda L. Summers, Linda M. Wasiczko Thomas, Michael J. Vilcheck, U.S. Naval Research Lab. (USA); William R. Clark, William D. Waters, OptoGration Inc. (USA) . [8380-08]

11:20 am: **High-performance free-space optical modem hardware**, Joseph E. Sluz, Juan C. Juarez, Chun-Huei Bair, Rachel L. Oberc, The Johns Hopkins Univ. Applied Physics Lab. (USA); Radha Venkat, Princeton Univ. (USA); Derek Rollend, David W. Young, The Johns Hopkins Univ. Applied Physics Lab. (USA) . [8380-08]

11:40 am: **Characterization of InGaAs avalanche photodiode arrays with varying geometries for free-space optical communication**, Mike S. Ferraro, Harris R. Burris, Jr., Rita Mahon, William S. Rabinovich, Wade Freeman, James L. Murphy, Peter G. Goetz, Christopher I. Moore, Linda M. Wasiczko Thomas, U.S. Naval Research Lab. (USA); William R. Clark, William D. Waters, OptoGration Inc. (USA) [8380-09]

12:00 pm: **Evaluation of optical transceivers for mobile FSO applications**, Dayong Zhou, The Univ. of Oklahoma - Tulsa (USA); Zhaorui Shi, Peter G. LoPresti, The Univ. of Tulsa (USA); Hazem Refai, The Univ. of Oklahoma - Tulsa (USA) [8380-10]

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

SESSION 3

Room: Conv. Ctr. 306Wed. 1:40 to 2:00 pm

Laser Communications III

Session Chair: **Linda M. Wasiczko Thomas**,
U.S. Naval Research Lab. (USA)

1:40 pm: **Improved atmospheric characterization for free-space link analysis using numerical weather prediction**, Billy D. Felton, Philip D. Hayes, Randall J. Alliss, Northrop Grumman Corp. (USA) [8380-11]

SESSION 4

Room: Conv. Ctr. 320Wed. 2:00 to 3:00 pm

Adaptive Optics Systems

Session Chair: **Earl J. Spillar**, Air Force Research Lab. (USA)

2:00 pm: **Fast, compact, computer-free holographic adaptive optics**, Geoff P. Andersen, Fassil Ghebremichael, HUA Inc. (USA); Ravi Gaddipati, Phani Gaddipati, Centum Engineering (USA) [8380-12]

2:20 pm: **Validity of using Gaussian Schell model for extended beacon studies**, Santasri Basu, Salvatore J. Cusumano, Milo W. Hyde IV, Michael A. Marciniak, Steven T. Fiorino, Air Force Institute of Technology (USA) . . . [8380-13]

2:40 pm: **High contrast imaging in the presence of turbulence**, Brett A. Sickmiller, SAIC (USA); Darryl J. Sanchez, Patrick R. Kelly, Air Force Research Lab. (USA); Denis W. Oesch, SAIC (USA) [8380-14]

Coffee/Exhibition Break 3:00 to 4:00 pm

Conference 8380 · Room: Conv. Ctr. 306

SESSION 5

Room: Conv. Ctr. 306 Wed. 4:00 to 6:20 pm

Turbulence

Session Chair: Earl J. Spillar, Air Force Research Lab. (USA)

4:00 pm: **Near-surface turbulent temperature variances and anisotropy at multiple scales of motion**, Cheryl L. Klipp, U.S. Army Research Lab. (USA) [8380-15]

4:20 pm: **Atmospheric characterization with multiwavelength laser beams over tactical and long-range propagation paths**, Mikhail A. Vorontsov, Univ. of Dayton (USA); Gary W. Carhart, U.S. Army Research Lab. (USA); Venkata S. R. Gudimetla, Air Force Research Lab. (USA); Svetlana L. Lachinova, Optonicus (USA); Thomas Weyrauch, Ernst E. Polnau, Univ. of Dayton (USA); Jony Jiang Liu, U.S. Army Research Lab. (USA) [8380-16]

4:40 pm: **Automation of Cn₂ profile extraction from weather radar images**, Steven T. Fiorino, Lee Burchett, Matthew Buchanan, Air Force Institute of Technology (USA) [8380-17]

5:00 pm: **Turbulence characterization and image processing data sets from a NATO RTO SET 165 trial in Dayton, OH, USA**, Marie-Therese Velluet, ONERA (France); Mikhail A. Vorontsov, Univ. of Dayton (USA); Richard L. Espinola, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Gabriele Marchi, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Stephane Nicolas, Forsvarets Forsknings Institute (Norway); Jim Riker, Air Force Research Lab. (USA); Piet B. W. Scherwing, TNO Defence, Security and Safety (Netherlands) [8380-18]

5:20 pm: **The measurement and remediation of coude path turbulence at the Starfire Optical Range Auxiliary Beam Director**, Marjorie Shoemaker, Ann C. Slavin, Boeing-SVS, Inc. (USA); Robert L. Johnson, Air Force Research Lab. (USA) [8380-19]

5:40 pm: **The statistics of the temporal variation of r₀**, Earl J. Spillar, Air Force Research Lab. (USA); David L. Fried, Consultant (USA); Marjorie Shoemaker, Boeing-SVS, Inc. (USA) [8380-20]

6:00 pm: **Propagation of laser light through aero-optic flow: dry air at 0.4 Mach with three-dimensional turret**, Rebecca L. Beauchamp, Air Force Institute of Technology (USA) [8380-21]

Thursday 26 April

SESSION 6

Room: Conv. Ctr. 306 Thurs. 8:50 to 11:00 am

Atmospheric Propagation Theory

Session Chair: Gary J. Baker, Lockheed Martin Space Systems Co. (USA)

8:50 am: **The phase Strehl cumulative distribution function (cdf) in the performance modeling of adaptive optics systems**, Thomas C. Farrell, U.S. Air Force (USA) [8380-22]

9:10 am: **The aggregate behavior of branch points: verification in wave optical simulation I**, Denis W. Oesch, SAIC (USA); Carolyn M. Tewksbury-Christie, Darryl J. Sanchez, Patrick R. Kelly, Air Force Research Lab. (USA) [8380-24]

9:30 am: **Theoretical justification for branch point velocity and invariance under a two layer atmosphere**, Darryl J. Sanchez, Air Force Research Lab. (USA); Denis W. Oesch, SAIC (USA) [8380-25]

9:50 am: **High-energy laser multivariable linear-regression performance modeling for surface-to-surface engagements**, Charles L. Leakeas, Shay R. Capehart, Richard J. Bartell, Salvatore J. Cusumano, Air Force Institute of Technology (USA); Matthew R. Whiteley, MZA Associates Corp. (USA) . [8380-26]

Coffee Break 10:10 to 10:40 am

10:40 am: **Using Maple and special functions to study the propagation of coherent light beams inside the Earth's ionosphere waveguide with turbulent media**, Sebastian Montoya, Juan F. Ospina, Univ. EAFIT (Colombia) . . . [8380-27]

SESSION 7

Room: Conv. Ctr. 306 Thurs. 11:00 am to 12:30 pm

Clouds, Aerosols, and Bulk Effects

Session Chair: David H. Tofsted, U.S. Army Research Lab. (USA)

11:00 am: **The mitigation of cloud impacts on free-space optical communications (Invited Paper)**, Randall J. Alliss, Billy D. Felton, Michael Mason, Northrop Grumman Corp. (USA) [8380-28]

11:30 am: **Potential impacts of elevated aerosol levels on high-energy laser aerial-defense engagements**, Steven T. Fiorino, Stephen Shirey, Michelle Via, Daniel Grahm, Matthew J. Krizo, Air Force Institute of Technology (USA) [8380-29]

11:50 am: **Assimilation of nontraditional datasets to improve atmospheric compensation**, Michael A. Kelly, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8380-30]

12:10 pm: **Atmospheric propagation properties of various laser systems**, Greg A. Pitz, Air Force Research Lab. (USA); Sara Glass, Haverford College (USA); Brian Kamer, Air Force Research Lab. (USA); Wade Klennert, Boeing-SVS, Inc. (USA); David A. Hostutler, Air Force Research Lab. (USA) [8380-31]

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A Thurs. 6:00 to 7:30 pm

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Detection probability of non-diffracting Bessel beams propagation in a slant atmospheric communication channel, Yixin Zhang, Jiangnan Univ. (China) [8380-32]

USAF high-energy laser (HEL) systems: HEL-generated extinction effects and degradation of multispectral algorithm efficiencies during missile staging (case PRC DF-31; GHADR 110), Clifford A. Paiva, Harold S. Slusher, BSM Research Associates (USA) [8380-33]

Mobile free-space optical communications: a feasibility study of various battlefield scenarios, Alan Harris, Univ. of North Florida (USA); Mouhammad K. Al-Akkoumi, James J. Sluss, Jr., The Univ. of Oklahoma - Tulsa (USA) . . [8380-34]

Courses of Related Interest

SC997 **High Power Laser Beam Quality** (Ross) Thursday, 8:30 am to 12:30 pm
SC1035 **Military Laser Safety** (Marshall) Thursday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Laser Technology for Defense and Security VIII

Conference Chairs: **Mark Dubinskii**, U.S. Army Research Lab. (USA); **Stephen G. Post**, Missile Defense Agency (USA)

Program Committee: **Steven R. Bowman**, U.S. Naval Research Lab. (USA); **Scott Christensen**, Nufern (USA); **Iyad Dajani**, Air Force Research Lab. (USA); **Anthony M. Johnson**, Univ. of Maryland, Baltimore County (USA); **Mark W. Neice**, High Energy Laser Joint Technology Office (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 303 Mon. 8:10 to 10:20 am

New Fiber Designs, Fiber Laser Components, and Crystalline Fibers

Session Chair: **Scott Christensen**, Nufern (USA)

8:10 am: **Glass-clad single crystalline fiber lasers** (*Invited Paper*), Chien-Chih Lai, Kuang-Yu Hsu, Chieh-Wei Huang, Dong-Yo Jheng, Shih-Chang Wang, Shiuian-Li Lin, Mu-Han Yang, Yin-Wen Lee, Ding-Wei Huang, Sheng-Lung L. Huang, National Taiwan Univ. (Taiwan) [8381-01]

8:40 am: **Mode-converters for rectangular-core fiber amplifiers to achieve diffraction-limited power scaling**, Arun K. Sridharan, Paul H. Pax, John E. Heebner, Derrek R. Drachenberg, Jay W. Dawson, Lawrence Livermore National Lab. (USA) [8381-02]

9:00 am: **Fabrication and properties of Ho-doped silica core fibers for high-energy laser applications**, E. Joseph Friebele, Charles G. Askins, John R. Peele, Steven R. Bowman, Nicholas J. Condon, Shawn P. O'Connor, U.S. Naval Research Lab. (USA) [8381-03]

9:20 am: **Modal properties of photonic crystal fiber for high-power two micron fiber laser systems**, Axel Schülzgen, Clemence Jollivet Salvin, Robert A. Sims, Pankaj Kadwani, Lawrence Shah, Martin C. Richardson, Rodrigo Amezcua Correa, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Thomas T. Alkeskjold, Lasse Leick, NKT Photonics A/S (Denmark) [8381-04]

9:40 am: **Mode area scaling for high-power fiber lasers with all solid photonic bandgap fibers**, Liang Dong, Clemson Univ. (USA); Kunimasa Saitoh, Hokkaido Univ. (Japan); Fanting Kong, Paul Foy, Thomas W. Hawkins, Devon McClane, Clemson Univ. (USA) [8381-05]

10:00 am: **Femtosecond fabrication of waveguides in Dy:RbPb₂Cl₅ single crystal for mid-IR**, Andrey G. Okrimchuk, A. M. Prokhorov General Physics Institute (Russian Federation); Vladimir Mesentsev, Aston Univ. (United Kingdom) [8381-06]

Coffee Break 10:20 to 10:50 am

SESSION 2

Room: Conv. Ctr. 303 Mon. 10:50 to 11:50 am

Advanced SSL Components and Diode-Pumped Alkaline Lasers

Session Chair: **Iyad Dajani**, Air Force Research Lab. (USA)

10:50 am: **Advanced smart multifunctional laser crystals for next generation solid state lasers**, David C. Brown, Katie Kowalewski, Victoria Envid, Jason Zembek, Snake Creek Lasers, LLC (USA); Joseph Kolis, Colin McMillen, Clemson Univ. (USA); Henry Geisber, Advanced Photonic Crystals (USA) [8381-07]

11:10 am: **Alternative wavelengths for optically pumped alkali lasers**, Glen P. Perram, Air Force Institute of Technology (USA) [8381-08]

11:30 am: **Diode pumped alkali laser kinetics: comparison of theory and experiment**, Charleton D. Lewis, David E. Weeks, Glen P. Perram, Air Force Institute of Technology (USA) [8381-09]

Lunch Break 11:50 am to 1:20 pm

SESSION 3

Room: Conv. Ctr. 303 Mon. 1:20 to 3:10 pm

Mid-IR Lasers and Materials

Session Chair: **Anthony M. Johnson**, Univ. of Maryland, Baltimore County (USA)

1:20 pm: **Crystalline fibers for the middle infrared** (*Invited Paper*), Leonid N. Butvina, Alexey L. Butvina, Eugeny M. Dianov, A. M. Prokhorov General Physics Institute (Russian Federation); Ninel Lichkova, Vladimir N. Zagorodnev, Institute of Microelectronics Technology and High Purity Materials (Russian Federation) [8381-10]

1:50 pm: **High-power quantum cascade lasers and laser arrays**, Mariano Troccoli, Jenyu Fan, Gene Tsvid, Xiaojun Wang, AdTech Optics, Inc. (USA) [8381-11]

2:10 pm: **Correlation of mid-infrared quantum cascade laser performance with laser design parameters**, Richard P. Leavitt, John L. Bradshaw, Kevin M. Lascola, Frederick J. Towner, John T. Pham, John D. Bruno, Maxion Technologies, Inc. (USA); Claire F. Gmachl, Peter Q. Liu, Princeton Univ. (USA) [8381-12]

2:30 pm: **Tunable mid-infrared generation using a synchronized programmable fiber laser**, Francis Th  berge, Marc Ch  teau neuf, Jacques Dubois, Defence Research and Development Canada, Valcartier (Canada); Alain Villeneuve, Bryan Bourgoyne, Joseph Salhany, Genia Photonics Inc. (Canada); Jean-Fran  ois Daigle, AEREX Avionics Inc. (Canada) [8381-13]

2:50 pm: **Modeling of the type-II InGaAs/GaAsSb quantum well designs for mid-infrared laser diodes by k  p method**, Baile Chen, Archie L. Holmes, Jr., Univ. of Virginia (USA); Viktor Khalfin, Igor Kudryashov, Bora M. Onat, Princeton Lightwave, Inc. (USA) [8381-14]

Coffee Break 3:10 to 3:40 pm

SESSION 4

Room: Conv. Ctr. 303 Mon. 3:40 to 4:20 pm

Diode Lasers I

Session Chair: **Steven R. Bowman**, U.S. Naval Research Lab. (USA)

3:40 pm: **Advancements in high-power diode laser stacks for defense applications**, Rajiv Pandey, David D. Merchen, Dean Stapleton, Steve Patterson, DILAS Diode Laser, Inc. (USA); Wilhem Fassbender, Jens Biesenbach, Heiko Kissel, DILAS Diodenlaser GmbH (Germany) [8381-15]

4:00 pm: **High-brightness, frequency-stabilized diode laser at 1530nm**, Stefan W. Heinemann, Benjamin E. Lewis, Boris Regaard, Torsten Schmidt, Fraunhofer USA, Inc. (USA) [8381-16]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Conference 8381· Room: Conv. Ctr. 303

Tuesday 24 April

SESSION 5

Room: Conv. Ctr. 303 Tues. 8:20 to 10:00 am

Diode Lasers II

Session Chair: **Stephen G. Post**, Missile Defense Agency (USA)

8:20 am: **High-power vertical-cavity surface-emitting lasers for diode pumped solid-state lasers**, Robert Van Leeuwen, Yihan Xiong, Jean-Francois Seurin, Guoyang Xu, Alexander Miglo, Qing Wang, Bing Xu, Wei-Xiong Zou, Daizong Li, James D. Wynn, Viktor Khalfin, Chuni L. Ghosh, Princeton Optronics, Inc. (USA) [8381-18]

8:40 am: **Low SWaP semiconductor laser transmitter modules for ASCENDS mission applications**, Narasimha S. Prasad, NASA Langley Research Ctr. (USA); Alex Rosiewicz, Steve Coleman, EM4, Inc. (USA) [8381-19]

9:00 am: **Wavelength-stabilized, fiber-coupled, 975-nm diode-laser module with > 500 W output and 20 mm x mrad beam quality**, Daniel M. Grasso, Nathan Shou, Henry Chen, Gerald Cheung, Rajiv Pathak, Pamela Liang, Dicky Lee, Coherent, Inc. (USA) [8381-20]

9:20 am: **Enhanced fiber coupled laser power and brightness for defense applications through tailored diode and thermal design**, Steve Patterson, Tobias Koenning, DILAS Diode Laser, Inc. (USA); Bernd Köhler, Jens Biesenbach, DILAS Diodenlaser GmbH (Germany) [8381-21]

9:40 am: **Brightness scaling of laser diodes at 9xx and 15xx nm**, Kirk Price, Ling Bao, John Bai, Zhigang Chen, David Dawson, Mark DeVito, Manoj Kanskar, nLIGHT Corp. (USA) [8381-22]

Coffee Break 10:00 to 10:30 am

SESSION 6

Room: Conv. Ctr. 303 Tues. 10:30 am to 12:00 pm

Beam Combining

Session Chair: **Brian J. Hankla**, High Energy Laser Joint Technology Office (USA)

10:30 am: **Recent developments in passive phase locking and combining of lasers (Invited Paper)**, Nir Davidson, Asher A. Friesem, Micha Nixon, Weizmann Institute of Science (Israel); Moti Fridman, Cornell Univ. (USA); Eitan Ronen, Ben-Gurion Univ. of the Negev (Israel) [8381-23]

11:00 am: **Coherent coupling of spectrally broadband laser channels**, Anatoliy I. Khizhnyak, Vladimir B. Markov, Advanced Systems & Technologies, Inc. (USA) [8381-24]

11:20 am: **Coherent beam combining of single-mode fiber lasers using multiplexed 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) [8381-25]

11:40 am: **High-efficiency, multilevel, diffractive optical elements for spectral beam combining**, Shanalyn A. Kemme, David W. Peters, David A. Scrymgeour, Sandia National Labs. (USA) [8381-26]

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

SESSION 7

Room: Conv. Ctr. 303 Tues. 1:20 to 3:00 pm

Cryo-Cooled Solid State Lasers

Session Chair: **Mark Dubinskii**, U.S. Army Research Lab. (USA)

1:20 pm: **High average power-high peak power cryogenic Yb:YAG lasers for pumping Ti:Sapphire and OPCPA ultrafast lasers**, David C. Brown, Sten Tornegard, Katie Kowalewski, Victoria Envid, Jason Zembek, Snake Creek Lasers, LLC (USA) [8381-27]

1:40 pm: **High average power Yb:YLF cryogenic laser amplifier for subpicosecond pulses**, Daniel E. Miller, MIT Lincoln Lab. (USA) [8381-28]

2:00 pm: **Cryogenic Yb:YAG picosecond laser with high average power visible and ultraviolet harmonic generation**, David C. Brown, Katie Kowalewski, Victoria Envid, Jason Zembek, Brad Canale, Snake Creek Lasers, LLC (USA); Joseph Kolis, Colin McMillen, Clemson Univ. (USA); Henry Geisber, Advanced Photonic Crystals (USA) [8381-29]

2:20 pm: **High-efficiency resonantly pumped Ho³⁺:YVO₄2.05-µm laser**, George A. Newburgh, Mark Dubinskii, U.S. Army Research Lab. (USA) [8381-30]

2:40 pm: **Spectroscopic properties and laser performance of resonantly pumped Er:GdVO₄**, Nikolay E. Ter-Gabrielyan, Viktor Fromzel, U.S. Army Research Lab. (USA); Tadeusz Lukaszewicz, Institute of Electronic Materials Technology (Poland); Witold Ryba-Romanowski, Institute of Low Temperature and Structure Research (Poland); Mark Dubinskii, U.S. Army Research Lab. (USA) [8381-31]

Coffee/Exhibition Break 3:00 to 4:00 pm

SESSION 8

Room: Conv. Ctr. 303 Tues. 4:00 to 5:20 pm

Waveguide and Fiber Lasers; Beam Combining; Lasers for Space Applications

Session Chair: **Iyad Dajani**, Air Force Research Lab. (USA)

4:00 pm: **Recent results for the Raytheon RELI program**, David W. Mordaunt, David M. Filgas, Steven Hughes, Raytheon Space & Airborne Systems (USA) [8381-32]

4:20 pm: **Active coherent beam combining of fiber lasers by multiplexed volume Bragg gratings**, Angel Flores, Chunte A. Lu, William P. Roach, Air Force Research Lab. (USA); Vadim Smirnov, OptiGrate Corp. (USA); Leonid Glebov, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [8381-33]

4:40 pm: **Laser transceivers for future NASA missions**, Michael A. Krainak, Anthony W. Yu, Mark A. Stephen, Jordan Camp, James B. Abshire, NASA Goddard Space Flight Ctr. (USA) [8381-34]

5:00 pm: **Integrated 100 W thulium fiber MOPA system**, Lawrence Shah, Robert A. Sims, Pankaj Kadwani, Christina C. Willis, Joshua D. Bradford, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Zachary A. Roth, Aaron J. Pung, Menelaos K. Poutous, The Univ. of North Carolina at Charlotte (USA); Eric G. Johnson, Clemson Univ. (USA); Martin C. Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [8381-35]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Beam combining with using beam shaping, Alexander V. Laskin, AdlOptica Optical Systems GmbH (Germany); Leonid B. Glebov, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Vadim Laskin, AdlOptica Optical Systems GmbH (Germany) [8381-59]

High-energy laser tactical decision aid (HELTDA) for mission planning and predictive avoidance, Jarred Burley, Steven T. Fiorino, Robb M. Randall, Richard J. Bartell, Salvatore J. Cusumano, Air Force Institute of Technology (USA) [8381-60]

Laser photography system: hardware configuration, Marek Piszczek, Krzysztof Rutyna, Marcin Kowalski, Marek Zyczkowski, Military Univ. of Technology (Poland) [8381-61]

Laser-induced microwave emission from dual laser illumination of solid targets, Joseph A. Miragliotta, Sanjay Varma, Benjamin Brawley, Jane W. Maclachlan Spicer, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8381-64]

A study of Huygens-Fresnel diffraction inside a laser cavity, Narasimha S. Prasad, David Park, NASA Langley Research Ctr. (USA) [8381-65]

Novel silicon/aluminum alloys for use as cold plate materials in cryogenically cooled solid state lasers, John F. Schill, U.S. Army Research Lab. (USA); Andrew J. Ogilvy, Sandvik Osprey Ltd. (United Kingdom) [8381-66]

Recent developments in coherent laser combination using a self-Fourier cavity, Christopher Corcoran, Corcoran Engineering Inc. (USA); Frederic M. Durville, Optical Fiber Systems, Inc. (USA) [8381-67]

Large-area, high-power VCSEL pump arrays optimized for high-energy lasers, Chad Wang, Jonathan C. Geske, Henry Garrett, Terri Cardellino, Daniel S. Renner, FLIR Electro-Optical Components (USA) [8381-68]

Wednesday 25 April

SESSION 9

Room: Conv. Ctr. 303 Wed. 8:00 to 10:10 am

Laser Ceramics and Bulk SSLs

Session Chair: Mark Dubinskii, U.S. Army Research Lab. (USA)

8:00 am: **Polycrystalline transparent YAG ceramics for mid-infrared, solid-state lasers** (*Invited Paper*), Ding Yuan Tang, Jian Zhang, Nanyang Technological Univ. (Singapore); Deyuan Shen, Xuzhou Normal Univ. (China); Jan Ma, Nanyang Technological Univ. (Singapore) [8381-36]

8:30 am: **Influence of processing variables on the optical attenuation of polycrystalline yttrium aluminum garnet (YAG) fibers**, Hyun Jun Kim, UES, Inc. (USA) and Air Force Research Lab. (USA); Nicholas G. Usechak, Air Force Research Lab. (USA); Hee Dong Lee, UES, Inc. (USA) and Air Force Research Lab. (USA); Geoff E. Fair, Air Force Research Lab. (USA) [8381-37]

8:50 am: **Initial testing of a ceramic Yb:YAG edge-pumped, solid state disk laser**, John Vetrovec, Drew A. Copeland, Amardeep S. Litt, Aqwest, LLC (USA); Detao Du, General Atomics Aeronautical Systems, Inc. (USA) [8381-38]

9:10 am: **Towards high-quality optical ceramics for high-energy laser (HEL) applications**, Hee Dong Lee, Kristin Keller, Brian Sim, Mikiyas Barkneh, UES, Inc. (USA) [8381-39]

9:30 am: **A 243 mJ, eye-safe, frequency-agile, optical parametric oscillator-based DIAL transmitter**, Michael D. Wojcik, Robert Foltynowicz, Space Dynamics Lab. (USA) [8381-40]

9:50 am: **Athermal slab laser system**, Mark E. Kushina, Northrop Grumman Cutting Edge Optronics (USA); Greg Kemner, Wade F. Collins, Northrop Grumman Aerospace Systems (USA) [8381-41]

Coffee Break 10:10 to 10:40 am

SESSION 10

Room: Conv. Ctr. 303 Wed. 10:40 am to 12:20 pm

Fiber Lasers I

Session Chair: Scott Christensen, Nufern (USA)

10:40 am: **Ultra-short-pulsed, fiber-ring laser using photonic crystal fiber**, Shaozhen Ma, Wenbo Li, Hongyu Hu, Niloy K. Dutta, Univ. of Connecticut (USA) [8381-42]

11:00 am: **911nm fiber laser-based source for underwater application at blue wavelengths**, Doruk Engin, Jean-Luc Fournon, Andromeda Huffman, Youming Chen, Fran Fitzpatrick, Ralph L. Burnham, Shantanu Gupta, Fibertek, Inc. (USA) [8381-43]

11:20 am: **Waveform agile, high-power, fiber laser illuminators for directed-energy weapon systems**, Doruk Engin, Frank Kimpel, Shantanu Gupta, Fibertek, Inc. (USA) [8381-44]

11:40 am: **Very large mode area Er-doped high aspect ratio core (HARC) rectangular fiber producing 5-mJ, 13-nsec pulses at 1572 nm**, Victor Khitrov, Vladimir V. Shkunov, David A. Rockwell, Yuri A. Zakharenkov, Friedrich P. Strohkendl, Raytheon Space & Airborne Systems (USA) [8381-45]

12:00 pm: **Supercontinuum: broad as a lamp, bright as a laser, now in the mid-infrared**, Peter M. Moselund, Christian Petersen, NKT Photonics A/S (Denmark); Sune Dupont, Aarhus Univ. (Denmark); Ole Bang, Technical Univ. of Denmark (Denmark); Soren R. Keiding, Aarhus Univ. (Denmark) [8381-46]

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

SESSION 11

Room: Conv. Ctr. 303 Wed. 1:40 to 3:20 pm

Fiber Lasers II

Session Chair: Stephen G. Post, Missile Defense Agency (USA)

1:40 pm: **Experimental and theoretical studies of phase modulation in Yb-doped fiber amplifiers**, Angel Flores, Chunte A. Lu, Craig Robin, Iyad Dajani, Air Force Research Lab. (USA) [8381-47]

2:00 pm: **All-glass resonantly cladding-pumped Yb-free Er-doped fiber laser**, Jun Zhang, John McElhenny, Viktor Fromzel, Mark Dubinskii, U.S. Army Research Lab. (USA) [8381-48]

2:20 pm: **High peak power two micron single frequency Q-switched fiber laser**, Shibin Jiang, AdValue Photonics, Inc. (USA) [8381-49]

2:40 pm: **Kilowatt monolithic PCF fiber amplifiers for narrow linewidth and single mode operation**, Donald L. Sipes, Jr., Jason D. Tafoya, Daniel S. Schulz, Optical Engines, Inc. (USA); Chad G. Carlson, Benjamin G. Ward, U.S. Air Force Academy (USA) [8381-50]

3:00 pm: **CW and pulsed performance of Tm-doped photonic crystal fiber lasers**, Pankaj Kadwani, Robert A. Sims, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Lasse Leick, Jes Broeng, NKT Photonics A/S (Denmark); Lawrence Shah, Martin C. Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [8381-51]

Coffee Break 3:20 to 3:40 pm

SESSION 12

Room: Conv. Ctr. 303 Wed. 3:40 to 5:10 pm

Bulk SSLs and Laser Material

Session Chair: Steven R. Bowman, U.S. Naval Research Lab. (USA)

3:40 pm: **60 Watt, CW guidestar laser with Pound-Drever-Hall Locking** (*Invited Paper*), Jonathan Stohs, Air Force Research Lab. (USA) [8381-52]

4:10 pm: **Demonstration of a yellow dysprosium laser**, Shawn P. O'Connor, Steven R. Bowman, U.S. Naval Research Lab. (USA) [8381-56]

4:30 pm: **Nonlinear optical devices based on gallium nitride**, Steven R. Bowman, Shawn P. O'Connor, Nicholas J. Condon, Jerry R. Meyer, Igor Vurgaftman, Charles R. Eddy, Jr., Jennifer K. Hite, Francis J. Kub, Jaime A. Freitas, Jr., U.S. Naval Research Lab. (USA) [8381-57]

4:50 pm: **Synthesis and spectroscopic properties of Er³⁺:Al₂O₃ ceramics**, Tigran V. Sanamyan, Robert Pavlacka, Gary A. Gilde, Mark Dubinskii, U.S. Army Research Lab. (USA) [8381-58]

Courses of Related Interest

- SC997 **High Power Laser Beam Quality** (Ross) Thursday, 8:30 am to 12:30 pm
- SC1035 **Military Laser Safety** (Marshall) Thursday, 8:30 am to 5:30 pm
- SC160 **Precision Stabilized Pointing and Tracking Systems** (Hilkert) Monday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Active and Passive Signatures III

Conference Chairs: **G. Charmaine Gilbreath**, U.S. Naval Research Lab. (USA); **Chadwick Todd Hawley**, National Signature Program (USA)

Program Committee: **Kelly W. Bennett**, U.S. Army Research Lab. (USA); **Carlos O. Font**, U.S. Naval Research Lab. (USA); **Herbert J. Mitchell**, Naval Postgraduate School (USA); **Joseph E. Peak**, U.S. Naval Research Lab. (USA); **Frank Pipitone**, U.S. Naval Research Lab. (USA); **Carl Salvaggio**, Rochester Institute of Technology (USA); **Noriko Satake**, UC Davis Medical Ctr. (USA)

Wednesday 25 April

SESSION 1

Room: Conv. Ctr. 305 Wed. 1:20 to 2:30 pm

Active and Passive Signatures III

Session Chair: **Charmaine Gilbreath**, U.S. Naval Research Lab. (USA)

1:20 pm: **Active and passive signatures in 2012 (Invited Paper)**, Chadwick T. Hawley, National Signature Program (USA) [8382-01]

1:50 pm: **The U.S. Army Research Laboratory (ARL) multimodal signature database (MMSDB) advanced data storage solutions and security of data over the web**, Kelly W. Bennett, U.S. Army Research Lab. (USA); James Robertson, Clearhaven Technologies LLC (USA) [8382-02]

2:10 pm: **An interactive 2D power-line modeling and simulation tool**, Ross N. Adelman, David M. Hull, U.S. Army Research Lab. (USA) [8382-03]

SESSION 2

Room: Conv. Ctr. 305 Wed. 2:30 to 5:40 pm

Materials Detection Signatures

Session Chair: **Kelly W. Bennett**, U.S. Army Research Lab. (USA)

2:30 pm: **Signatures of materials of interest using dielectric spectroscopy and statistical methodologies for classification (Invited Paper)**, Charmaine Gilbreath, U.S. Naval Research Lab. (USA); William F. Brooks, Northrop Grumman Information Technology-TASC (USA) [8382-05]

3:00 pm: **Enhancing nuclear quadrupole resonance (NQR) signature detection leveraging subspace B-field interference suppression algorithms**, Wilbur Myrick, IvySys Technologies, LLC (USA); G. Charmaine Gilbreath, Joel B. Miller, U.S. Naval Research Lab. (USA) [8382-06]

Coffee Break 3:20 to 3:50 pm

3:50 pm: **Sensitivity characterization for low-frequency dielectric spectroscopy system electrodes**, Blerta Bajramaj, U.S. Naval Research Lab. (USA); Wilbur Myrick, IvySys Technologies, LLC (USA); Charmaine Gilbreath, U.S. Naval Research Lab. (USA); Jason Terrosky, ITT Exelis (USA) [8382-07]

4:10 pm: **Neutron detection based on capture-gamma sensing and calorimetry**, Guntram Pausch, Claus-Michael Herbach, FLIR Radiation GmbH (USA); Dean Mitchell, Sandia National Labs. (USA); Ralf Lentering, Juergen Stein, FLIR Radiation GmbH (USA) [8382-08]

4:30 pm: **Photofission signatures for the detection of highly enriched uranium**, Sara Pozzi, Univ. of Michigan (USA) [8382-09]

4:50 pm: **Detection and identification of compound explosive using the SDA-method of the reflected THz signal (Invited Paper)**, Vyacheslav A. Trofimov, Svetlana A. Varentsova, Lomonosov Moscow State Univ. (Russian Federation); Norbert Palka, Tomasz Trzcinski, Mieczyslaw Szustakowski, Military Univ. of Technology (Poland) [8382-10]

5:20 pm: **Resonance structure of water complexes of β -HMX for THz frequencies**, Ling Huang, U.S. Naval Research Lab. (USA); Andrew Shabaev, George Mason Univ. (USA); Samuel Lambrakos, Noam Bernstein, Verne L. Jacobs, U.S. Naval Research Lab. (USA); Lou Massa, Hunter College (USA) [8382-11]

Thursday 26 April

SESSION 3

Room: Conv. Ctr. 305 Thurs. 8:30 to 9:30 am

Human Signatures

Session Chair: **Carlos Omar Font**, U.S. Naval Research Lab. (USA)

8:30 am: **Data dependency on measurement uncertainties in speaker recognition evaluation**, Jin Chu Wu, Alvin Martin, Craig Greenberg, Raghu Kacker, National Institute of Standards and Technology (USA) [8382-12]

8:50 am: **Speckle signatures of articulating humans**, Dallis G. Conrad III, Univ. of Dayton (USA); Edward A. Watson, Air Force Research Lab. (USA) ... [8382-13]

9:10 am: **The use of skin reflectivity data to determine the optimal site and wavelength to collect human vital sign signatures**, Kenneth A. Byrd, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8382-14]

SESSION 4

Room: Conv. Ctr. 305 Thurs. 9:30 am to 12:30 pm

Spectral Signatures

Session Chair: **Chadwick Todd Hawley**, National Signature Program (USA)

9:30 am: **Signatures of explosives and precursors at deep ultraviolet to near-infrared wavelengths (Invited Paper)**, Jacob Grun, Robert Lunsford, Sergei Nikitin, U.S. Naval Research Lab. (USA) [8382-15]

10:00 am: **Dependence of observed resonance Raman intensities of energetic materials on their Raman cross sections**, Sanford A. Asher, Luling Wang, Manash K. Ghosh, Univ. of Pittsburgh (USA) [8382-16]

Coffee Break 10:20 to 10:50 am

10:50 am: **Opposition effect spectropolarimetry in the visible and near-infrared**, Kyle Foster, Guido Cervone, George Mason Univ. (USA); Ronald G. Resmini, The MITRE Corp. (USA) [8382-18]

11:10 am: **Study of hyperspectral characteristics of different types of flares and smoke candles**, Philippe Lagueux, Vincent Farley, Martin Chamberland, Telops (Canada); Mariusz Kastek, Tadeusz Piatkowski, Rafal Dulski, Military Univ. of Technology (Poland) [8382-19]

11:30 am: **Multispectral and hyperspectral measurements of soldier's camouflage equipment**, Mariusz Kastek, Military Univ. of Technology (Poland); Philippe Lagueux, Telops (Canada); Tadeusz Piatkowski, Military Univ. of Technology (Poland); Martin Chamberland, Telops (Canada); Rafal Dulski, Military Univ. of Technology (Poland); Vincent Farley, Telops (Canada) [8382-20]

11:50 am: **Blind separation of human- and horse-footstep signatures using independent component analysis**, Asif Mehmood, U.S. Army Research Lab. (USA) [8382-21]

12:10 pm: **Analysis of electrostatic charge on small-arms projectiles**, Stephen Vinci, David M. Hull, Jack Zhu, U.S. Army Research Lab. (USA) [8382-22]

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

SESSION 5

Room: Conv. Ctr. 305 Thurs. 2:00 to 3:50 pm

Mathematical Methods

Session Chair: Noriko Satake, UC Davis Medical Ctr. (USA)

2:00 pm: **Clairvoyant fusion methods of detection applied to dielectric spectroscopy** (*Invited Paper*), Alan P. Schaum, U.S. Naval Research Lab. (USA); Brian T. Williams, Space and Naval Warfare Systems Ctr. Pacific (USA); David Robinson, TASC, Inc. (USA) [8382-23]

2:30 pm: **Tripod operators for efficient search of point cloud data for known surface shapes** (*Invited Paper*), Frank Pipitone, U.S. Naval Research Lab. (USA) [8382-24]

Coffee Break 3:00 to 3:30 pm

3:30 pm: **Acoustic change detection algorithm using an FM radio**, Geoffrey H. Goldman, Owen Wolfe, U.S. Army Research Lab. (USA) . . . [8382-25]

SESSION 6

Room: Conv. Ctr. 305 Thurs. 3:50 to 5:20 pm

Atmospheric and Tropospheric Signatures

Session Chair: Frank Pipitone, U.S. Naval Research Lab. (USA)

3:50 pm: **Characterization of the atmosphere as a random bit-stream generator**, Carlos O. Font, David Bonanno, Charmaine Gilbreath, Blerta Bajramaj, U.S. Naval Research Lab. (USA) [8382-26]

4:10 pm: **High-power, high-resolution imaging radar: detection and characterization advances via coherent uplink array techniques applied to space situational awareness** (*Invited Paper*), Barry Geldzahler, Richard McGinnis, Jason Crusan, NASA Headquarters (USA); Karl B. Fielhauer, David P. Watson, Johns Hopkins Univ. Applied Physics Lab. (USA); Chris Moulton, Greg Ushomirsky, MIT Lincoln Lab. (USA) [8382-27]

4:40 pm: **Extension of coherent uplink arraying to high frequency: the New York New York demonstration**, Kathy M. Minear, G. P. Martin, Harris Corp. (USA) [8382-28]

5:00 pm: **The NASA uplink arraying test bed: implementation at Kennedy Space Center**, Marc Seibert, NASA Glenn Research Ctr. (USA); Michael Miller, Peter Aragona, NASA Headquarters (USA) [8382-29]

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A 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.

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Quantum Raman spectroscopy, Marco O. Lanzagorta, ITT Exelis (USA) [8382-30]

Courses of Related Interest

SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Wednesday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours



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Head- and Helmet-Mounted Displays XVII: Design and Applications

Conference Chairs: **Peter L. Marasco**, Air Force Research Lab. (USA); **Paul R. Havig II**, Air Force Research Lab. (USA)

Program Committee: **Randall E. Bailey**, NASA Langley Research Ctr. (USA); **Sion A. Jennings**, National Research Council Canada (Canada)

Wednesday 25 April

SESSION 1

Room: Conv. Ctr. 308Wed. 8:30 to 10:30 am

Systems

Session Chair: **Peter L. Marasco**, Air Force Research Lab. (USA)

8:30 am: **Novel HMD concepts from the DARPA SCENICC program** (*Invited Paper*), Randy Sprague, MicroVision, Inc. (USA) [8383A-01]

9:00 am: **Scorpion HMCS developmental and organizational flight test status and results** (*Invited Paper*), Robert Atac, Gentex Corp. (USA) [8383A-02]

9:30 am: **Advanced Helmet Vision System (AHVS) integrated night vision HMD**, Todd Ashcraft, Robert Atac, Gentex Corp. (USA) [8383A-03]

9:50 am: **Soldier-worn augmented reality system for tactical icon visualization**, David C. Roberts, Stephen Snarski, Todd Sherrill, Alberico Menozzi, Brian Clipp, Patrick Russler, Applied Research Associates, Inc. (USA) [8383A-04]

10:10 am: **Critical testing for helmet-mounted displays: a tracking system accuracy test for the Joint Helmet Mounted Cueing System**, Adam Renner, Air Force Research Lab. (USA) [8383A-05]

Coffee Break 10:30 to 11:00 am

SESSION 2

Room: Conv. Ctr. 308 Wed. 11:00 am to 12:00 pm

System Design Guides

Session Chair: **Sion A. Jennings**, National Research Council Canada (Canada)

11:00 am: **Designing the HMD for perfection: a look at the human eye**, Paul R. Havig II, John P. McIntire, Eric E. Geiselman, Air Force Research Lab. (USA) [8383A-06]

11:20 am: **Ergonomic design considerations for an optical data link between a warfighter's head and body-worn technologies**, Noel Trew, Gregory Burnett, Michael Sedillo, Candace S. Washington, Air Force Research Lab. (USA); Aaron Linn, Ball Aerospace & Technologies Corp. (USA); Zachery Nelson, Oak Ridge Institute for Science & Education (USA) [8383A-07]

11:40 am: **Systems engineering considerations in body-mounted sensing**, Peter L. Marasco, Air Force Research Lab. (USA) [8383A-08]

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

SESSION 3

Room: Conv. Ctr. 308 Wed. 1:30 to 3:20 pm

Enabling (Micro)Displays Technology

Session Chair: **Paul R. Havig**, Air Force Research Lab. (USA)

1:30 pm: **How microdisplays enable today's and tomorrow's military vision systems** (*Invited Paper*), Jerry Carollo, eMagin Corp. (USA) [8383A-09]

2:00 pm: **A 5.6Mdot OLED microdisplay for digital night vision and image fusion**, Gunther Haas, Laurent Espuno, Eric Marcellin-Dibon, Christophe Prat, MicroOLED (France) [8383A-10]

2:20 pm: **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) [8383A-11]

2:40 pm: **Design considerations of HUD projection systems applied to automobile industry**, J. Alejandro Betancur Ramirez, Univ. EAFIT (Colombia) [8383A-12]

3:00 pm: **Optical waveguide technology and its application in head-mounted displays**, Alexander A. Cameron, BAE Systems (United Kingdom) . . . [8383A-13]

Coffee Break 3:20 to 3:50 pm

SESSION 4

Room: Conv. Ctr. 308 Wed. 3:50 to 4:50 pm

Situation Awareness

Session Chair: **Randall E. Bailey**, NASA Langley Research Ctr. (USA)

3:50 pm: **HMDs as enablers of situation awareness, the OODA loop and sense-making**, James E. Melzer, Rockwell Collins Optronics (USA) . . [8383A-14]

4:10 pm: **Rotary wing brown-out symbology: what's the advantage of conformality?**, Sion A. Jennings, National Research Council Canada (Canada) [8383A-15]

4:30 pm: **Making the case for off-axis ownship attitude symbology: we may not miss it until it's not there**, Eric E. Geiselman, Paul R. Havig II, Air Force Research Lab. (USA) [8383A-16]

Courses of Related Interest

SC159 **Head-Mounted Displays: Design and Applications** (Melzer, Browne) Tuesday, 8:30 am to 5:30 pm

SC1068 **Introduction to Night Vision** (Browne) Thursday, 8:30 am to 12:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Display Technologies and Applications for Defense, Security, and Avionics VI

Conference Chairs: **Daniel D. Desjardins**, Consultant (USA); **Kalluri R. Sarma**, Honeywell Technology (USA)

Program Committee: **James C. Byrd**, Consultant (USA); **Jerome S. Conway**, L-3 Display Systems (USA); **Joseph L. Cox**, Missile Defense Agency (USA); **Reginald Daniels**, Air Force Research Lab. (USA); **Eric W. Forsythe**, U.S. Army Research Lab. (USA); **Paul R. Havig II**, Air Force Research Lab. (USA); **Gary W. Jones**, NanoQuantum Sciences, Inc. (USA); **Gail M. Nicholson**, Naval Surface Warfare Ctr. Crane Div. (USA); **Robert D. Seinfeld**, Astronautics Corp. of America (USA); **Lawrence E. Tannas, Jr.**, Tannas Electronic Displays, Inc. (USA); **Joe Tchon**, Rockwell Collins, Inc. (USA); **Paul L. Wisely**, Aardvark Aerospace, Ltd. (United Kingdom)

Thursday 26 April

SESSION 5

Room: Conv. Ctr. 308 Thurs. 8:00 to 9:00 am

Invited Session

Session Chair: **Kalluri R. Sarma**, Honeywell Technology (USA)

8:00 am: **Impediments to the rapid insertion of innovative displays and peripherals** (*Invited Paper*), Gail M. Nicholson, Naval Surface Warfare Ctr. Crane Div. (USA) [8383B-17]

8:30 am: **Evaluation of a 15-inch widescreen OLED with sunlight-readable resistive touch** (*Invited Paper*), Joe Tchon, Bruce Hufnagel, Rockwell Collins, Inc. (USA) [8383B-18]

SESSION 6

Room: Conv. Ctr. 308 Thurs. 9:00 to 11:10 am

Cockpit Avionics and Vetrionics

Session Chair: **Daniel D. Desjardins**, Consultant (USA)

9:00 am: **An electronic flight bag for NextGen avionics**, Eyton Zelazo, Astronautics Corp. of America (USA) [8383B-19]

9:20 am: **An avionics touch screen-based control display concept**, Michael Mertens, Barco N.V. (Belgium); Herman J. Damveld, Technische Univ. Delft (Netherlands) [8383B-20]

9:40 am: **Display challenges resulting from the use of WFOV imaging devices**, Gregory J. Petty, Ean J. Seals, Jack E. Fulton, Jr., Gail M. Nicholson, Naval Surface Warfare Ctr. Crane Div. (USA) [8383B-21]

10:00 am: **A high-performance approach to minimizing interactions between inbound and outbound signals in helmet**, Chiman Kwan, Jin Zhou, Bulent Ayhan, Signal Processing, Inc. (USA); Scott Sands, NASA Glenn Research Ctr. (USA) [8383B-22]

Coffee Break 10:20 to 10:50 am

10:50 am: **Biocular vehicle display optical designs**, Katie M. MacIntyre, SCHOTT North America, Inc. (USA) [8383B-23]

SESSION 7

Room: Conv. Ctr. 308 Thurs. 11:10 am to 12:10 pm

Technical and Applications Advances for AMOLED

Session Chair: **Gary W. Jones**, NanoQuantum Sciences, Inc. (USA)

11:10 am: **Recent advances in AMOLED display technologies for application to aerospace and military systems**, Kalluri R. Sarma, Honeywell Technology (USA) [8383B-24]

11:30 am: **Ultra-high resolution and high-brightness AMOLED**, Ihor Wacyk, Amal Ghosh, Olivier Prache, eMagin Corp. (USA); Russell Draper, David A. Fellowes, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8383B-25]

11:50 am: **Bio-kinetic energy harvesting using electroactive polymers**, Jeremiah Slade, Infocscitex Corp. (USA) [8383B-26]

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

SESSION 8

Room: Conv. Ctr. 308 Thurs. 1:30 to 2:30 pm

Streaming/Wireless Video for Security and Defense

Session Chair: **James C. Byrd**, Consultant (USA)

1:30 pm: **Coherent visualization of spatial data adapted to roles, tasks, and hardware**, Boris Wagner, Elisabeth Peinsipp-Byma, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [8383B-27]

1:50 pm: **Future display considerations for security applications**, Jack E. Fulton, Jr., Gail M. Nicholson, Gregory J. Petty, Ean J. Seals, Naval Surface Warfare Ctr. Crane Div. (USA) [8383B-28]

2:10 pm: **Free-space optical applications with head-mounted displays**, Greg Hays, Leo Volfson, Michael A. Strauss, Torrey Pines Logic, Inc. (USA) . [8383B-29]

SESSION 9

Room: Conv. Ctr. 308 Thurs. 2:30 to 4:40 pm

3D Displays, Body-Worn Displays, and Systems

Session Chair: **Jerome S. Conway**, L-3 Display Systems (USA)

2:30 pm: **Three-dimensional system integration for HUD placement on a new tactical airlift platform: design eye point vs. HUD eye box with accommodation and perceptual implications**, Steven D. Harbour, U.S. Air Force Aeronautical Systems Ctr. (USA) [8383B-30]

2:50 pm: **Cockpit considerations for helmet-mounted SWIR imaging systems**, Greg J. Grabski, John Green, Mickey A. Jacobson, Timothy R. Robinson, Esterline Control Systems (USA) [8383B-31]

3:40 pm: **What is 3D good for? A review of human performance on stereoscopic 3D displays**, John P. McIntire, Paul R. Havig, Eric E. Geiselman, Air Force Research Lab. (USA) [8383B-32]

4:00 pm: **3D laptop for defense applications**, Richard Edmondson, David B. Chenault, Polaris Sensor Technologies, Inc. (USA) [8383B-37]

4:20 pm: **ARINC 818 Express for high-speed avionics video and power over coax**, Tim Keller, Jon A. Alexander, Great River Technology, Inc. (USA) [8383B-35]

Closing Remarks

Room: Conv. Ctr. 308 Thurs. 4:40 to 4:45 pm

Session Chairs: **Daniel D. Desjardins**, Consultant (USA); **Kalluri R. Sarma**, Honeywell Technology (USA)

Conference 8383B · Room: Conv. Ctr. 308

POSTERS—THURSDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Military display performance parameters, Daniel D. Desjardins, Frederick M. Meyer, Air Force Research Lab. (USA) [8383B-36]

Courses of Related Interest

- SC1068 **Introduction to Night Vision** (Browne) Thursday, 8:30 am to 12:30 pm
- SC159 **Head-Mounted Displays: Design and Applications** (Melzer, Browne) Tuesday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Three-Dimensional Imaging, Visualization, and Display 2012

Conference Chairs: **Bahram Javidi**, Univ. of Connecticut (USA); **Jung-Young Son**, Konyang Univ. (Korea, Republic of)

Conference Co-Chairs: **Manuel Martinez-Corral**, Univ. de València (Spain); **Wolfgang Osten**, Univ. Stuttgart (Germany); **Fumio Okano**, NHK Engineering Services, Inc. (Japan)

Program Committee: **Saeed R. Bagheri**, IBM Thomas J. Watson Research Ctr. (USA); **Michael T. Eismann**, Air Force Research Lab. (USA); **Pietro Ferraro**, Istituto Nazionale di Ottica (Italy); **Thierry Fournel**, Lab. Hubert Curien (France); **Yi-Pai Huang**, National Chiao Tung Univ. (Taiwan); **Naomi Inoue**, National Institute of Information and Communications Technology (Japan); **Jinwoong Kim**, Electronics and Telecommunications Research Institute (Korea, Republic of); **Osamu Matoba**, Kobe Univ. (Japan); **Takanori Nomura**, Wakayama Univ. (Japan); **Thomas J. Naughton**, National Univ. of Ireland, Maynooth (Ireland); **Min-Chul Park**, Korea Institute of Science and Technology (Korea, Republic of); **Adrian Stern**, Ben-Gurion Univ. of the Negev (Israel); **Chao-Hsu Tsai**, Industrial Technology Research Institute (Taiwan); **Edward A. Watson**, Air Force Research Lab. (USA); **Kenji Yamamoto**, National Institute of Information and Communications Technology (Japan); **Sumio Yano**, NHK Science & Technical Research Labs. (Japan); **Zeev Zalevsky**, Bar-Ilan Univ. (Israel)

Tuesday 24 April

SESSION 1

Room: Conv. Ctr. 326 Tues. 8:00 to 10:25 am

Electro- and Digital Holography I

Session Chairs: **Jinwoong Kim**, Electronics and Telecommunications Research Institute (Korea, Republic of); **Jeho Nam**, Electronics and Telecommunications Research Institute (Korea, Republic of)

8:00 am: **Holographic 3D display using MEMS spatial light modulator** (*Invited Paper*), Yasuhiro Takaki, Tokyo Univ. of Agriculture and Technology (Japan) [8384-01]

8:25 am: **Face and eye tracking for subhologram-based digital holographic display system** (*Invited Paper*), Jinwoong Kim, Hee Kyung Lee, Jihun Cha, Jeho Nam, Electronics and Telecommunications Research Institute (Korea, Republic of) [8384-02]

8:50 am: **Spatial light modulator-based phase-shifting Gabor holography** (*Invited Paper*), Vicente Micó, Javier García, Univ. de València (Spain); Zeev Zalevsky, Bar-Ilan Univ. (Israel); Bahram Javidi, Univ. of Connecticut (USA) [8384-03]

9:15 am: **3D visual systems using integral photography camera, camera array, and electronic holography display** (*Invited Paper*), Kenji Yamamoto, Yasuyuki Ichihashi, Takanori Senoh, Ryutaro Oi, Taiichiro Kurita, National Institute of Information and Communications Technology (Japan) [8384-04]

9:40 am: **Is it worth using an array of cameras to capture the spatio-angular information of a 3D scene or is it enough with just two?** (*Invited Paper*), Hector Navarro, Manuel Martinez-Corral, Genaro Saavedra-Tortosa, Univ. de València (Spain); Bahram Javidi, Univ. of Connecticut (USA) [8384-05]

10:05 am: **Electro-holography display using computer-generated hologram of 3D objects based on projection spectra**, Sujuan Huang, Duo Cheng Wang, Tingyun Wang, Shanghai Univ. (China) [8384-06]

Coffee Break 10:25 to 10:55 am

SESSION 2

Room: Conv. Ctr. 326 Tues. 10:55 am to 12:00 pm

Electro- and Digital Holography II

Session Chairs: **Pietro Ferraro**, Istituto Nazionale di Ottica (Italy); **Manuel Martinez-Corral**, Univ. de València (Spain)

10:55 am: **An autofocusing algorithm for digital holograms** (*Invited Paper*), Pietro Ferraro, Pasquale Memmolo, Cosimo Distanto, Melania Paturzo, Andrea Finizio, Istituto Nazionale di Ottica (Italy); Bahram Javidi, Univ. of Connecticut (USA) [8384-07]

11:20 am: **Recognition and classification of red blood cells using three-dimensional digital holographic imaging and data clustering with discriminant analysis**, Ran Liu, Dipak K. Dey, Univ. of Connecticut (USA); Daniel Boss, Pierre Marquet, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Bahram Javidi, Univ. of Connecticut (USA) [8384-08]

11:40 am: **3D microscopic imaging at 193nm with single beam Fresnel intensity sampling and iterative phase retrieval** (*Invited Paper*), Arun Anand, Maharaja Sayajirao Univ. of Baroda (India); Ahmad Faridian, Univ. Stuttgart (Germany); Vani Chhaniwal, Parul Trust (India); Giancarlo Pedrini, Wolfgang Osten, Univ. Stuttgart (Germany); Bahram Javidi, Univ. of Connecticut (USA) [8384-09]

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

SESSION 3

Room: Conv. Ctr. 326 Tues. 1:30 to 4:40 pm

Applications of 3D Images I

Session Chairs: **Thierry Fournel**, Lab. Hubert Curien (France); **José Manuel Rodríguez Ramos**, Univ. de La Laguna (Spain)

1:30 pm: **Combining in-depth viewing and color visual cryptography for securing color image display** (*Invited Paper*), Jacques Machizaud, Thierry Fournel, Lab. Hubert Curien (France) [8384-10]

1:55 pm: **Unknown sensor position estimation in axially distributed sensing 3D imaging**, Xiao Xiao, Bahram Javidi, Univ. of Connecticut (USA) [8384-11]

2:15 pm: **Atmospherical wavefront phases using the plenoptic sensor (real data)** (*Invited Paper*), José Manuel Rodríguez Ramos, Univ. de La Laguna (Spain); Luis F. Rodríguez-Ramos, Iciar Montilla, Instituto de Astrofísica de Canarias (Spain); Marcos López-Marrero, Juan José Fernández-Valdivia, Jonas Philipp Lüke, José Gil Marichal-Hernández, Fernando L. Rosa González, Univ. de La Laguna (Spain); Roberto López López, Bruno Femenia Castellá, Instituto de Astrofísica de Canarias (Spain) [8384-12]

2:40 pm: **Multiple objects tracking in unknown background using Bayesian estimation in 3D space**, Yige Zhao, Xiao Xiao, Myungjin Cho, Bahram Javidi, Univ. of Connecticut (USA) [8384-13]

Coffee/Exhibition Break 3:00 to 4:00 pm

4:00 pm: **A 3D x-ray security checkpoint screening device with image rotation**, Kenneth R. Fernandez, GaN Corp. (USA) [8384-14]

4:20 pm: **High-accuracy, real-time pedestrian detection system using 2D and 3D features**, David Chambers, William C. Flannigan, Southwest Research Institute (USA); Benjamin Wheeler, Naval Surface Warfare Ctr. Dahlgren Div. (USA) [8384-15]

SESSION 4

Room: Conv. Ctr. 326 Tues. 4:40 to 5:45 pm

3D Displays and Related I

Session Chairs: **Toshiaki Fujii**, Tokyo Institute of Technology (Japan);
Yi-Pai Huang, National Chiao Tung Univ. (Taiwan)

4:40 pm: **Ray-space acquisition system for 3DTV** (*Invited Paper*), Toshiaki Fujii, Nagoya Univ. (Japan) [8384-16]

5:05 pm: **Interactive 3D crosstalk simulator for autostereoscopic display design**, Yeong-Seon Choe, Korea Univ. (Korea, Republic of); Ho-Dong Lee, Min-Chul Park, Korea Institute of Science and Technology (Korea, Republic of); Jung-Young Son, Konyang Univ. (Korea, Republic of); Gwi-Tae Park, Korea Univ. (Korea, Republic of) [8384-17]

5:25 pm: **Virtual 3D interactive system with embedded multiwavelength optical sensor array and sequential devices**, Guo-Zhen Wang, National Chiao Tung Univ. (Taiwan) and Industrial Technology Research Institute (Taiwan); Yi-Pai Huang, National Chiao Tung Univ. (Taiwan); Kuo-Jui Hu, Industrial Technology Research Institute (Taiwan) [8384-18]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A Tues. 6:00 to 7:30 pm

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Auto-converging stereo cameras for 3D robotic tele-operation, Richard Edmondson, Todd Aycock, David B. Chenault, Polaris Sensor Technologies, Inc. (USA) [8384-39]

Performance evaluation of 3D photon counting integral imaging for object recognition, Inkyu Moon, Chosun Univ. (Korea, Republic of) [8384-40]

Space bandwidth product analysis of digital holography applied to video hologram recording and reconstruction, Anh-Hoang Phan, Jae-Hyeung Park, Nam Kim, Chungbuk National Univ. (Korea, Republic of) [8384-41]

3D resolution in computationally reconstructed integral photography, Manuel Martinez-Corral, Genaro Saavedra-Tortosa, Hector Navarro, Univ. de València (Spain); Zahra Kavehvasht, Khashayar Mehrany, Sharif Univ. of Technology (Iran, Islamic Republic of); Saeed R. Bagheri, Philips Research North America (USA) [8384-42]

Experiments on axially distributed three-dimensional imaging techniques, Eric P. Flynn, Bahram Javidi, Univ. of Connecticut (USA) [8384-43]

Three-dimensional stereoscopic display system on the table-top, Ki-Hyuk Yoon, Hyoung Lee, Sung-Kyu Kim, Korea Institute of Science and Technology (Korea, Republic of) [8384-44]

Method of crosstalk reduction using lenticular lens, Hyoung Lee, Yonsei Univ. (Korea, Republic of) and Korea Institute of Science and Technology (Korea, Republic of); Kwang-Hoon Lee, Sung-Kyu Kim, Korea Institute of Science and Technology (Korea, Republic of) [8384-45]

Imaging characteristics of holographic stereoscopic 3D projection display, Hwi Kim, Korea Univ. Sejong Campus (Korea, Republic of); Yohan Park, Electronics and Telecommunications Research Institute (Korea, Republic of); Hyun-Eui Kim, Chungbuk National Univ. (Korea, Republic of); Byung Gyu Chae, Jeho Nam, Jinwoong Kim, Electronics and Telecommunications Research Institute (Korea, Republic of) [8384-46]

Computer generated hologram of deep 3D scene from the data captured by integral imaging, Koki Wakunami, Masahiro Yamaguchi, Tokyo Institute of Technology (Japan); Bahram Javidi, Univ. of Connecticut (USA) [8384-47]

Wednesday 25 April

SESSION 5

Room: Conv. Ctr. 326 Wed. 8:00 to 10:25 am

Integral Imaging

Session Chairs: **Adrian Stern**, Ben-Gurion Univ. of the Negev (Israel);
Fumio Okano, NHK Engineering Services, Inc. (Japan)

8:00 am: **An overview of 3D visualization with integral imaging in photon starved conditions** (*Invited Paper*), Adrian Stern, Doron Aloni, Ben-Gurion Univ. of the Negev (Israel); Bahram Javidi, Univ. of Connecticut (USA) [8384-19]

8:25 am: **Improved resolution in far-field integral imaging** (*Invited Paper*), Manuel Martinez-Corral, Hector Navarro, Genaro Saavedra-Tortosa, Adrian Dorado, Univ. de València (Spain); Bahram Javidi, Univ. of Connecticut (USA) [8384-20]

8:50 am: **One-dimensional integral imaging based on parallax image's virtual reconstruction** (*Invited Paper*), Qiong-Hua Wang, Huan Deng, Sichuan Univ. (China) [8384-21]

9:15 am: **Functional three-dimensional imaging based on integral imaging technique** (*Invited Paper*), Jae-Hyeung Park, Chungbuk National Univ. (Korea, Republic of) [8384-22]

9:40 am: **Integral imaging system with enlarged horizontal viewing angle** (*Invited Paper*), Masato Miura, Jun Arai, Tomoyuki Mishina, Makoto Okui, Japan Broadcasting Corp. (Japan); Fumio Okano, NHK Engineering Services, Inc. (Japan) [8384-23]

10:05 am: **Automatic target recognition of 3D objects under photon starved condition using advanced correlation filters**, Myungjin Cho, Univ. of Connecticut (USA); Abhijit Mahalanobis, Lockheed Martin Missiles and Fire Control (USA); Bahram Javidi, Univ. of Connecticut (USA) [8384-24]

Coffee Break 10:25 to 10:55 am

SESSION 6

Room: Conv. Ctr. 326 Wed. 10:55 am to 12:45 pm

3D Imaging

Session Chairs: **Jung-Young Son**, Konyang Univ. (Korea, Republic of);
Bahram Javidi, Univ. of Connecticut (USA)

10:55 am: **3D shape measurement using deterministic phase retrieval and a partially developed speckle field** (*Invited Paper*), Percival F. Almero, Univ. of the Philippines (Philippines); Laura Waller, Princeton Univ. (USA); Mostafa Agour, Bremer Institut für angewandte Strahltechnik GmbH (Germany) and South Valley Univ. (Egypt); Claas Falldorf, Bremer Institut für Angewandte Strahltechnik GmbH (Germany); Giancarlo Pedrini, Wolfgang Osten, Univ. Stuttgart (Germany); Steen G. Hanson, Technical Univ. of Denmark (Denmark) [8384-25]

11:20 am: **Three-dimensional imaging and visualization of camouflaged objects by use of axially distributed sensing method**, Donghak Shin, Bahram Javidi, Univ. of Connecticut (USA) [8384-26]

11:40 am: **New synthesizing 3D stereo image based on multisegmented method** (*Invited Paper*), Woonchul Ham, Luubaatar Badarch, Enkhbaatar Tumenjargal, Hyeokjae Kwon, Chonbuk National Univ. (Korea, Republic of) [8384-27]

12:05 pm: **SSVEP-based BCI for manipulating three-dimensional contents and devices**, Sungchul Mun, Min-Chul Park, Korea Institute of Science and Technology (Korea, Republic of); MinCheol Whang, Sangmyung Univ. (Korea, Republic of) [8384-28]

12:25 pm: **Real-time embodiment of the multiview images having corrected and scaled depth sense in any types of autostereoscopic 3D display system**, Kwang-Hoon Lee, Sung-Kuk Chun, Sung-Kyu Kim, Korea Institute of Science and Technology (Korea, Republic of) [8384-29]

Lunch/Exhibition Break 12:45 to 2:15 pm

SESSION 7

Room: Conv. Ctr. 326 Wed. 2:15 to 4:15 pm

Applications of 3D Images II

Session Chairs: **Kevin G. Harding**, GE Global Research (USA);
Kenji Yamamoto, National Institute of Information and Communications
Technology (Japan)

2:15 pm: **3D visual guidance interface for industrial operations** (*Invited Paper*),
Kevin G. Harding, Gil Abramovich, Chris Nafis, GE Global Research (USA); Arun
Vemury, U.S. Dept. of Homeland Security (USA) [8384-30]

2:40 pm: **Cylindrical liquid crystal lenses system for autostereoscopic 2D/3D
display** (*Invited Paper*), Chih-Wei Chen, Yi-Pai Huang, Po-Hao Wang, National
Chiao Tung Univ. (Taiwan); Chao-Hsu Tsai, Industrial Technology Research
Institute (Taiwan) [8384-31]

3:05 pm: **Inexpensive robust 3D reconstruction using multisensor signals**,
Prakash Duraisamy, Univ. of North Texas (USA) [8384-32]

Coffee Break 3:25 to 3:55 pm

3:55 pm: **Measurement methods with moving image sensor in
autostereoscopic display**, Seon-Kyu Yoon, Sung-Kyu Kim, Korea Institute of
Science and Technology (Korea, Republic of) [8384-33]

SESSION 8

Room: Conv. Ctr. 326 Wed. 4:15 to 6:00 pm

3D Displays and Related II

Session Chairs: **Min-Chul Park**, Korea Institute of Science and
Technology (Korea, Republic of); **Shunsuke Yoshida**, National Institute
of Information and Communications Technology (Japan)

4:15 pm: **Viewing zones of IP and MV** (*Invited Paper*), Jung-Young Son,
Konyang Univ. (Korea, Republic of); Min-Chul Park, Korea Institute of Science
and Technology (Korea, Republic of); Hyoung Lee, Yonsei Univ. (Korea, Republic
of); Jeho Nam, Wook-Ho Son, Electronics and Telecommunications Research
Institute (Korea, Republic of) [8384-34]

4:40 pm: **Crosstalk minimization in multiview 3D display by eye tracking and
viewpoint fusion**, Sung-Kyu Kim, Seon-Kyu Yoon, Ki-Hyuk Yoon, Korea Institute
of Science and Technology (Korea, Republic of) [8384-35]

5:00 pm: **fVisiOn: glasses-free tabletop 3D display to provide virtual 3D media
naturally alongside real media** (*Invited Paper*), Shunsuke Yoshida, National
Institute of Information and Communications Technology (Japan) [8384-36]

5:20 pm: **3D display crosstalk simulator system based on mixed reality**,
Min-Chul Park, Ho-Dong Lee, Korea Institute of Science and Technology (Korea,
Republic of); Jeong-Eom Lee, Korea Institute of Science and Technology (Korea,
Republic of); Jung-Young Son, Konyang Univ. (Korea, Republic of) [8384-37]

5:40 pm: **ATSC 8-VSB and M/H hybrid 3DTV system development
for terrestrial broadcasting services**, Sung-Hoon Kim, Electronics and
Telecommunications Research Institute (Korea, Republic of) [8384-38]

Courses of Related Interest

SC159 **Head-Mounted Displays: Design and Applications** (Melzer, Browne)
Tuesday, 8:30 am to 5:30 pm

SC1068 **Introduction to Night Vision** (Browne) Thursday, 8:30 am to 12:30 pm

See Course Materials Desk, located near the SPIE Registration Area,
Pratt St. Lobby, Open during Registration Hours

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Tuesday · 10:00 am to 5:00 pm

Wednesday · 10:00 am to 5:00 pm

Thursday · 10:00 am to 2:00 pm

Sensors and Systems for Space Applications V

Conference Chairs: **Khanh D. Pham**, Air Force Research Lab. (USA); **Joseph L. Cox**, Missile Defense Agency (USA); **Richard T. Howard**, NASA Marshall Space Flight Ctr. (USA); **Henry Zmuda**, Univ. of Florida (USA)

Program Committee: **Thomas George**, Zyomed Corp. (USA); **Ou Ma**, New Mexico State Univ. (USA); **Greg J. Meyer**, U.S. Air Force (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 306 Mon. 8:30 to 11:20 am

Photonics for Space Applications I

Session Chair: **Henry Zmuda**, Univ. of Florida (USA)

8:30 am: **2µm pulsed fiber laser transmitters based on highly TM-doped germanate fibers for space applications** (*Invited Paper*), Wei Shi, Eliot B. Petersen, NP Photonics, Inc. (USA); Qiang Fang, Khanh Q. Kieu, College of Optical Sciences, The Univ. of Arizona (USA); Arturo Chavez-Pirson, NP Photonics, Inc. (USA); Nasser N. Peyghambarian, College of Optical Sciences, The Univ. of Arizona (USA) [8385-39]

8:50 am: **Single frequency fiber laser for external volume Bragg resonator** (*Invited Paper*), Aleksandr Rysanyanskiy, OptiGrate Corp. (USA); Nikolai S. Vorobiev, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Vadim Smirnov, O. Mokun, Eugeniu V. Rotari, Julien Lumeau, Larissa Glebova, Christine P. Spiegelberg, Alexey Podvyaznyy, OptiGrate Corp. (USA); Leonid Glebov, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [8385-01]

9:10 am: **Frequency up-conversion detection system for space-based lidar** (*Invited Paper*), Ioulia B. Zotova, ArkLight, Inc. (USA); Yujie J. Ding, Lehigh Univ. (USA); Narasimha S. Prasad, NASA Langley Research Ctr. (USA) [8385-02]

9:30 am: **Polarization maintaining coherent fiber bundle** (*Invited Paper*), Shibin Jiang, AdValue Photonics, Inc. (USA) [8385-03]

9:50 am: **Metal-mesh optical filter technology for mid-IR, far-IR, and submillimeter** (*Invited Paper*), William R. McGovern, Phil R. Swinehart, Eric L. Hogue, Lake Shore Cryotronics, Inc. (USA) [8385-04]

Coffee Break 10:10 to 10:40 am

10:40 am: **Low-noise, UV-to-SWIR broadband photodiodes for large-format focal plane array sensors** (*Invited Paper*), Abhay Joshi, Shubhashish Datta, Discovery Semiconductors, Inc. (USA) [8385-05]

11:00 am: **Near-infrared silicon, resonant cavity RC-GPD and ROIC arrays** (*Invited Paper*), Stefan A. Vasile, Ryan Murphy, Jerold Lipson, aPeak, Inc. (USA); Selim M. Unlu, Boston Univ. (USA) [8385-06]

SESSION 2

Room: Conv. Ctr. 306 Mon. 11:20 am to 12:20 pm

Photonics for Space Applications II

Session Chair: **Greg J. Meyer**, U.S. Air Force (USA)

11:20 am: **A low-cost thermal infrared hyperspectral imager for small satellites**, Sarah T. Crites, Paul G. Lucey, Robert Wright, Harold Garbeil, Keith Horton, Univ. of Hawai'i (USA) [8385-07]

11:40 am: **Highly emissive (0.9999) and highly accurate (0.1 K) blackbody for spaceflight or laboratory use**, Michael D. Wojcik, Harri Latvakoski, Michael Watson, Shane Topham, Space Dynamics Lab. (USA); Martin Mlynczak, NASA Langley Research Ctr. (USA) [8385-08]

12:00 pm: **FalconSAT 7: a CubeSat solar membrane telescope**, Geoff P. Andersen, Geoff McHarg, Michael Dearborn, U.S. Air Force Academy (USA) [8385-09]

Lunch Break 12:20 to 1:20 pm

SESSION 3

Room: Conv. Ctr. 306 Mon. 1:20 to 2:20 pm

Photonics for Space Applications III

Session Chair: **Greg J. Meyer**, U.S. Air Force (USA)

1:20 pm: **Laser ablation-optical cavity isotopic spectrometer for Mars rovers** (*Invited Paper*), Alexander A. Bol'shakov, Applied Spectra, Inc. (USA); Xianglei Mao, Inhee Choi, Dale Perry, Lawrence Berkeley National Lab. (USA); Chris P. McKay, NASA Ames Research Ctr. (USA); Richard E. Russo, Lawrence Berkeley National Lab. (USA) [8385-10]

1:40 pm: **Interferometric imaging of geostationary satellites**, J. Thomas Armstrong, Elynn K. Baines, U.S. Naval Research Lab. (USA); Henrique R. Schmitt, Computational Physics, Inc. (USA); Robert B. Hindsley, Sergio R. Restaino, U.S. Naval Research Lab (USA); Anders M. Jorgensen, New Mexico Institute of Mining and Technology (USA); David Mozurkewich, Seabrook Engineering (USA) [8385-11]

2:00 pm: **Noncontact, reagentless, nondestructive, detection of organics, biosignatures, and water** (*Invited Paper*), Rohit Bhartia, Jet Propulsion Lab. (USA); William F. Hug, Ray D. Reid, Photon Systems, Inc. (USA); Everett C. Salas, Jet Propulsion Lab. (USA); Arthur L. Lane, Photon Systems, Inc. (USA) . [8385-12]

SESSION 4

Room: Conv. Ctr. 306 Mon. 2:20 to 4:30 pm

Structures and Mechanics

Session Chair: **Ou Ma**, New Mexico State Univ. (USA)

2:20 pm: **Agile hardware and software system engineering for critical military space applications**, Philip Huang, The Johns Hopkins Univ. Applied Physics Lab. (USA); Andrew Knuth, Robert Krueger, Back Nine Engineering (USA); Margaret A. Garrison-Darrin, The Johns Hopkins Univ. Applied Physics Lab. (USA) . [8385-13]

2:40 pm: **Utilizing low-cost 3U single-sensor satellites for ISR tactical mission capabilities**, Philip Huang, The Johns Hopkins Univ. Applied Physics Lab. (USA); Andrew Knuth, Robert Krueger, Back Nine Engineering (USA); Matthew A. Anderson, Air Force Research Lab. (USA); Margaret A. Garrison-Darrin, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8385-14]

3:00 pm: **Sensitivity analysis of liquid rocket POGO oscillation characteristic**, Ye Tang, Bo Fang, Yaxin Zhen, Harbin Institute of Technology (China) . [8385-15]

Coffee Break 3:20 to 3:50 pm

3:50 pm: **A BCI-based humanoid robot system for development of perception and cognition model**, Wei Li, Christian Jaramillo, California State Univ., Bakersfield (USA); Genshe Chen, DCM Research Resources, LLC (USA); Dan Shen, I-Fusion Technologies, Inc. (USA); Erik Blasch, Khanh Pham, Air Force Research Lab. (USA); Robert S. Lynch, Naval Undersea Warfare Ctr. (USA) [8385-16]

4:10 pm: **Control of a robot for minimal impact to the base satellite for capturing a moving object: a contact-dynamics based approach**, Angel Flores-Abad, Ou Ma, New Mexico State Univ. (USA) [8385-17]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 5

Room: Conv. Ctr. 306 Tues. 8:40 to 10:00 am

Communications and Networking I

Session Chair: Richard T. Howard, NASA Marshall Space Flight Ctr. (USA)

8:40 am: **DataBus-based hybrid routing approach for orbit access networks in lunar exploration**, Hui Zeng, Ke Meng, Julia Deng, Intelligent Automation, Inc. (USA) [8385-18]

9:00 am: **Spatial telecommunications antennas behavior in presence of plasma thrusters**, Henri Vallon, Thales Alenia Space (France) and INSA Rennes (France); Jean-Paul Courson, Laurence Laval, Thales Alenia Space (France); Frederic Grillot, Telecom ParisTech (France) [8385-19]

9:20 am: **Building a feasible software tool for analyzing RF inter-satellite links**, Karim A. Fouad, The Egyptian Air Force (Egypt) [8385-20]

9:40 am: **Integrated situational awareness for cyber-attack detection, analysis, and mitigation**, Yi Cheng, Yalin Sagduyu, Julia Deng, Jason Li, Intelligent Automation, Inc. (USA); Peng Liu, The Pennsylvania State Univ. (USA) [8385-21]

Coffee Break 10:00 to 10:30 am

SESSION 6

Room: Conv. Ctr. 306 Tues. 10:30 to 11:50 am

Communications and Networking II

Session Chair: Joseph L. Cox, Missile Defense Agency (USA)

10:30 am: **On effectiveness of network sensor-based defense framework**, Difan Zhang, Linqiang Ge, Wei Yu, Towson Univ. (USA); Genshe Chen, DCM Research Resources, LLC (USA); Khanh Pham, Air Force Research Lab. (USA) [8385-22]

10:50 am: **Game models in frequency hopping based proactive jamming mitigation for space communication networks**, Dan Shen, I-Fusion Technologies, Inc. (USA); Genshe Chen, DCM Research Resources, LLC (USA); Khanh Pham, Erik Blasch, Air Force Research Lab. (USA) [8385-23]

11:10 am: **Multileader Stackelberg games for anti-jamming cognitive radio**, Zhi Tian, Michigan Technological Univ. (USA); Xin Tian, Dan Shen, I-Fusion Technologies, Inc. (USA); Khanh Pham, Erik Blasch, Air Force Research Lab. (USA); Genshe Chen, DCM Research Resources, LLC (USA) [8385-24]

11:30 am: **High-fidelity, wireless-network evaluation for heterogeneous cognitive radio networks**, Lei Ding, Yalin Sagduyu, Justin Yackoski, Babak Azimi-Sadjadi, Jason Li, Intelligent Automation, Inc. (USA); Tammaso Melodia, Univ. at Buffalo (USA) [8385-25]

SESSION 7

Room: Conv. Ctr. 306 Tues. 11:50 am to 12:30 pm

Terrestrial Surveillance from Space

Session Chair: Khanh D. Pham, Air Force Research Lab. (USA)

11:50 am: **Negentropy-based detection of radio-frequency interference in spaceborne microwave radiometers**, Damon C. Bradley, Univ. of Maryland, Baltimore County (USA) and NASA Goddard Space Flight Ctr. (USA); Joel Morris, Univ. of Maryland, Baltimore County (USA) [8385-26]

12:10 pm: **Ground emitter localization via fusing terrain map and DOA using two miniature UAS**, Zhonghai Wang, Missouri Univ. of Science and Technology (USA); Erik Blasch, Khanh Pham, Air Force Research Lab. (USA); Genshe Chen, Independent Consultant (USA); Dan Shen, Peter Lin, I-Fusion Technologies, Inc. (USA) [8385-27]

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

SESSION 8

Room: Conv. Ctr. 306 Tues. 2:30 to 5:10 pm

Space Situational Awareness

Session Chair: Khanh D. Pham, Air Force Research Lab. (USA)

2:30 pm: **On the robustness of a new sparse data association technique for low-earth-orbit object tracking**, Thibaut Castaigns, Benjamin Pannetier, Florent Muller, ONERA (France); Michèle Rombaut, Institut National Polytechnique de Grenoble (France) [8385-28]

2:50 pm: **GEOScan: a geoscience facility from space**, Lars P. Dyrud, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8385-30]

Coffee/Exhibition Break 3:10 to 4:10 pm

4:10 pm: **Overview of the Sapphire payload for space situational awareness**, John P. Hackett, Richard M. Brisby, COM DEV International Ltd. (Canada); Kenneth W. Smith, COM DEV Canada (Canada) [8385-31]

4:30 pm: **Earth impactors: threat analysis and multistage intervention mission architecture**, Jeremy Straub, Ronald A. Fevig, The Univ. of North Dakota (USA) [8385-32]

4:50 pm: **Short arc gating in multiple hypothesis tracking for space surveillance**, Sabino M. Gadaleta, Joshua T. Horwood, Aubrey Poore, Numerica Corp. (USA) [8385-33]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Management of radar resources for space debris tracking, Magdalena Mendijur, Piermario Besso, Massimo Sciotti, European Space Operations Ctr. (Germany) [8385-29]

Mechanisms for space applications, Mustapha Meftah, Ctr. National de la Recherche Scientifique (France) [8385-34]

Space object, high-resolution, optical imaging simulation of space-based systems, Haopeng Zhang, Wei Zhang, Zhiguo Jiang, BeiHang Univ. (China) [8385-35]

Precise altitude measurements of LEO objects with simultaneous observations by multiple telescopes, Henrique R. Schmitt, Computational Physics, Inc. (USA); Robert B. Hindsley, J. Thomas Armstrong, Elyn K. Baines, U.S. Naval Research Lab. (USA) [8385-37]

Full Motion Video (FMV) Workflows and Technologies for Intelligence, Surveillance, and Reconnaissance (ISR) and Situational Awareness

Conference Chair: **Donnie Self**, National Geospatial-Intelligence Agency (USA)

Program Committee: **Mark A. Aitken**, Sinclair Broadcast Group, Inc. (USA); **Lawrence Brody**, Communications Engineering, Inc. (USA); **John Marino**, National Association of Broadcasters (USA); **Gary Nadler**, Consultant, Commercial Broadcast Industry (USA); **James Snyder**, U.S. Library of Congress (USA); **Norman S. Stein**, TASC, Inc. (USA); **Peter Symes**, Society of Motion Picture and Television Engineers (USA); **Kevin L. West**, Office of the Under Secretary of Defense for Intelligence (USA)

Monday 23 April

PANEL DISCUSSION

Room: Conv. Ctr. 315 Mon. 8:30 to 10:15 am

Motion Imagery Overview and Strategies

Panel Moderators: **Donnie Self**, National Geospatial-Intelligence Agency (USA); **Samuel Oliver**, U.S. Air Force (USA); **Kevin L. West**, Office of the Under Secretary of Defense for Intelligence (USA); **Phil Suarez**, U.S. Army (USA)

The Air Force vision for full motion video exploitation Samuel Oliver, U.S Air Force

Due to the fixed number of analysts and increasing collection of Full Motion Video and Wide Area Motion Imagery, the Air Force, in conjunction with the NGA and DARPA, is taking steps to maximize the analytical effectiveness of our Intelligence, Surveillance, and Reconnaissance force by developing, procuring, and integrating automated target cueing and exploitation tools. The Air Force is looking to maximize the analytical effectiveness of our workforce by helping to develop "smart sensors". Smart sensors can conduct some level of on-board processing that will ease the burden on ground processing and communications capabilities and enable faster transmission and exploitation of large volume, complex data sets.

Optimizing video quality for battlespace awareness

Kevin West, Office of the Undersecretary of Defense for Intelligence

Over the past decade, the Department of Defense (DoD) has increasingly relied on the information gleaned from motion video for all aspects of Battlespace Awareness. The number of platforms with video sensors has grown significantly. Video sensor derived information has played a major role in helping US forces defeat adversaries repeatedly. Given today's fiscal environment, the significant investment in video sensors and technologies to process, exploit, analyze, produce and disseminate information from those sensors highlights the need to optimize video quality. This paper will examine the current state of video quality within the DoD and will consider opportunities to improve the capabilities and processes currently utilized throughout the department to ensure that video quality meets operational requirements.

Use of motion imagery sensing systems in overseas contingency operations

Brad Van Cleve, U.S. Army Intelligence Ctr. of Excellence (USA)

The growing use of motion imagery sensors and the resulting deluge of new data has been both a blessing and a struggle to manage efficiently for warfighters in the field. Presenter will draw on the collective warfighting and intelligence operations experiences from the US Army Intelligence Center of Excellence to shine light on emerging doctrine in the growing use of motion imagery derived information for intelligence gathering activities. Discussions will cover efficiencies in tasking, processing, exploitation and dissemination processes for increased effectiveness within the larger community of the National System for Geospatial Intelligence (NSG). Presenter will further address quality assurance and quality control for validation of information derived from the various motion imagery sensor platforms. Finally, the presenter will discuss functions and directives that are currently lacking and yet sorely needed in the data management aspects of motion imagery operations to increase the utility of motion imagery.

Q&A

Coffee Break 10:15 to 10:45 am

SESSION 1

Room: Conv. Ctr. 315 Mon. 10:45 am to 12:00 pm

The Future: Converging Motion Imagery and Intelligence

Session Chair: **Gregory Creech**,
National Geospatial-Intelligence Agency (USA)

- 10:45 am: **Successes and challenges of merging motion imagery into intelligence analysis**, Geoffrey Young, National Geospatial-Intelligence Agency (USA) [8386-01]
- 11:10 am: **Transformational motion imagery processing, exploitation, and dissemination (PED) technologies**, Greg Creech, Michelle Brennan, National Geospatial-Intelligence Agency (USA) [8386-02]
- 11:35 am: **Convergence in full motion video processing, exploitation, and dissemination and activity based intelligence**, Marja Phipps, Gina Lewis, General Dynamics Advanced Information Systems (USA) [8386-03]
- Lunch Break 12:00 to 1:30 pm

SESSION 2

Room: Conv. Ctr. 315 Mon. 1:30 to 3:10 pm

Challenges and Solutions with Motion Imagery

Session Chair: **Gary Nadler**,
Consultant, Commercial Broadcast Industry (USA)

- 1:30 pm: **Improving usability for video analysis using gaze-based interaction**, Jutta Hild, Elisabeth Peinsipp-Byma, Edmund Klaus, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [8386-04]
- 1:55 pm: **Georegistration of motion imagery with error propagation**, Mark D. Pritt, Lockheed Martin Information Systems & Global Services (USA); Kevin J. LaTourette, Lockheed Martin Tactical Defense Systems (USA) [8386-05]
- 2:20 pm: **Full-motion video georegistration for accuracy improvement, accuracy assessment, and robustness**, Charles R. Taylor, Farhana Bandukwala, Reuben J. Settergren, BAE Systems (USA) [8386-06]
- 2:45 pm: **Dealing with the data deluge: file systems and storage technologies**, Kirk Kern, NetApp U.S. Public Sector (USA) [8386-07]
- Coffee Break 3:10 to 3:40 pm

SESSION 3

Room: Conv. Ctr. 315 Mon. 3:40 to 4:55 pm

The Cloud and Motion Imagery Plus Video Test Data

Session Chair: **Randy L. Richard**,
Defense Information Systems Agency (USA)

- 3:40 pm: **Motion/imagery secure cloud enterprise architecture analysis**, John L. DeLay, Harris Corp. (USA) [8386-08]
- 4:05 pm: **Transitioning ISR architecture into the cloud**, Tom Lash, SAIC (USA) [8386-09]
- 4:30 pm: **NGA/JITC GEOINT repository provides centralized and formalized source of community test data**, Randy L. Richard, Joint Interoperability Test Command (USA) [8386-10]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 4

Room: Conv. Ctr. 315 Tues. 8:00 to 10:05 am

Activity-Based Intelligence I

Session Chair: Gregory Creech,

National Geospatial-Intelligence Agency (USA)

8:00 am: **Activity-based intelligence: concept, challenges, and way ahead,** Mark Choiniere, National Geospatial-Intelligence Agency (USA) [8386-11]

8:25 am: **Activity-based exploitation of full motion video,** Shashi Kant, Cognika Intelligence & Defense Solutions, LLC (USA) [8386-12]

8:50 am: **Automated motion imagery exploitation for surveillance and reconnaissance,** Stephen Se, France Laliberte, Vinay Kotamraju, Melanie Dutkiewicz, MacDonald, Dettwiler and Associates Ltd. (Canada) [8386-13]

9:15 am: **Unsupervised visual landmark extraction for place recognition,** Evangelos Sariyanidi, Hakan Temeltas, Istanbul Teknik Univ. (Turkey) . . [8386-14]

9:40 am: **Placement of full-motion video frames in geographic context using pursuer,** Clark N. Taylor, Daniel Uppenkamp, Kevin Shannon, Air Force Research Lab. (USA) [8386-15]

Coffee Break 10:05 to 10:35 am

SESSION 5

Room: Conv. Ctr. 315 Tues. 10:35 am to 12:15 pm

Activity-Based Intelligence II

Session Chair: Gary Nadler,

Consultant, Commercial Broadcast Industry (USA)

10:35 am: **Automated FMV SMART camera using dynamically updated LUTs,** Holger M. Jaenisch, James W. Handley, Licht Strahl Engineering, Inc. (USA) [8386-16]

11:00 am: **Real-time anomaly detection in full-motion video,** Glenn Konowicz, Jiang Li, Old Dominion Univ. (USA). [8386-17]

11:25 am: **Emerging standards suite for wide-area ISR,** Paul Maenner, NGA Motion Imagery Standards Board (USA) [8386-18]

11:50 am: **Increased ISR operator capability utilizing a centralized 360° full-motion video display,** Kevin Andryc, Timothy Eagleson, Pete Kuzdeba, Michael Rose, Greg Gottschalk, Jesse Chamberlain, Daniel LaValley, Brent Kowal, Nick Beluzo, Brian Rusiecki, Steve Quinn, Eric Myers, Kollmorgen Electro-Optical (USA) [8386-19]

Lunch/Exhibition Break 12:15 to 1:45 pm

PANEL DISCUSSION

Room: Conv. Ctr. 315 Tues. 1:45 to 3:10 pm

Standards—The Foundation of the Future

Panel Moderator: Donnie Self,

National Geospatial-Intelligence Agency (USA)

Panelists: Randy L. Richard, Defense Information Systems Agency (USA); *Jim Antonisse,* Booz Allen Hamilton Inc. (USA); *Scott Randall,* Booz Allen Hamilton Inc. (USA)

1:45 pm: **Introduction**

1:50 pm: **Motion imagery standard laboratory,** Randy L. Richard, Joint Interoperability Test Command (USA) [8386-20]

2:15 pm: **OGC observations and measurements in MISB's plug-and-play micro-architecture for tracking,** Jim Antonisse, Harris Corp. (USA); Scott Randall, Booz Allen Hamilton Inc. (USA) [8386-21]

2:40 pm: **Image-based tracking: a new standard,** Scott Randall, Booz Allen Hamilton Inc. (USA); Jim Antonisse, Harris Corp. (USA) [8386-22]

Q&A 3:05 to 3:10 pm

Coffee Break 3:10 to 3:40 pm

SESSION 7

Room: Conv. Ctr. 315 Tues. 3:40 to 4:55 pm

Tactical and Wireless Dissemination

Session Chair: Gary Nadler,

Consultant, Commercial Broadcast Industry (USA)

3:40 pm: **Wireless video technologies and standards in the broadcast and surveillance industries: a brief history,** Jacqueline Roy, VISLINK Law Enforcement & Public Safety (USA) [8386-23]

4:05 pm: **Salience-based compression: providing FMV over low-bit rate channels,** Michael Isnardi, SRI International Sarnoff (USA) [8386-24]

4:30 pm: **Dissemination of full motion video in a tactical network,** Frederick R. Carlson, U.S. Army Battle Command Battle Lab.-Gordon (USA) [8386-25]

Unmanned Systems Technology XIV

Conference Chairs: **Robert E. Karlson**, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); **Douglas W. Gage**, XPM Technologies (USA); **Charles M. Shoemaker**, U.S. Army CERDEC (USA); **Grant R. Gerhart**, U. S. Army Tank Automotive Research Development and Engineering Ctr. -Retired (USA)

Program Committee: **Stephen Balakirsky**, National Institute of Standards and Technology (USA); **Johann Borenstein**, Univ. of Michigan (USA); **Jonathan A. Bornstein**, U.S. Army Research Lab. (USA); **Jared Giesbrecht**, Defence Research and Development Canada, Suffield (Canada); **Rajiv V. Dubey**, Univ. of South Florida (USA); **Hobart Ray Everett**, Space and Naval Warfare Systems Ctr. Pacific (USA); **Gene A. Klager**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **James H. Lever**, U.S. Army Engineer Research and Development Ctr. (USA); **Larry H. Matthies**, Jet Propulsion Lab. (USA); **Paul L. Muench**, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); **Hoang G. Nguyen**, Space and Naval Warfare Systems Command (USA); **James L. Overholt**, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); **Mike Perschbacher**, RovnoTech (USA); **Marc Raibert**, Boston Dynamics (USA); **Klaus-Juergen Schilling**, Julius-Maximilians-Univ. Würzburg (Germany); **Nahid N. Sidki**, SAIC (USA); **Harpreet Singh**, Wayne State Univ. (USA); **Anthony Stentz**, Carnegie Mellon Univ. (USA); **David L. Stone**, Mechatron Consulting (USA); **Venkataraman Sundareswaran**, Teledyne Scientific Co. (USA); **Brian H. Wilcox**, Jet Propulsion Lab. (USA); **Gary Witus**, Turing Associates, Inc. (USA); **Brian M. Yamauchi**, iRobot Corp. (USA)

Wednesday 25 April

SESSION 1

Room: Conv. Ctr. 333Wed. 8:00 to 10:00 am

Multi-Robot Control

Joint Session with Conference 8405

Session Chairs: **Raja Suresh**, General Dynamics Advanced Information Systems (USA); **Grant R. Gerhart**, U. S. Army Tank Automotive Research Development and Engineering Ctr. -Retired (USA)

8:00 am: **A layered control architecture for single-operator control of heterogeneous unmanned system teams**, Stephen Buerger, Jason Neely, Charles Q. Little, Wendy Amai, Rommy Joyce, Sandia National Labs. (USA) [8387-01]

8:20 am: **Coordinating with humans by adjustable-autonomy for multirobot pursuit (CHAMP)**, Danielle Dumond, Jeanine Ayers, Nathan Schurr, Alan Carlin, Dustin Burke, Jeff Rousseau, Aptima, Inc. (USA) [8387-02]

8:40 am: **The reconnaissance and autonomy for small robots (RASR): MAGIC 2010 challenge**, Alberto Lacaze, Karl N. Murphy, Robotic Research LLC (USA); Mark Del Giorno, Del Services, LLC (USA); Katrina Corley, Embry-Riddle Aeronautical Univ. (USA) [8387-03]

9:00 am: **Teleoperation control of collaborative multifunctional robotic swarms for multitask, multitarget scenarios**, Yushing Cheung, Stevens Institute of Technology (USA); Jae Chung, Ketula Patel, U.S. Army Armament Research, Development and Engineering Ctr. (USA) [8387-04]

9:20 am: **A feedback-trained, autonomous control system for heterogeneous search-and-rescue applications**, Jeremy Straub, The Univ. of North Dakota (USA) [8387-05]

9:40 am: **Spatial grasp technology and its application to distributed robotized systems**, Peter S. Sapaty, National Academy of Sciences of Ukraine (Ukraine) [8387-06]

Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 333Wed. 10:30 to 11:50 am

Navigation and Mobility I

Session Chairs: **Robert E. Karlson**, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); **Brian M. Yamauchi**, iRobot Corp. (USA)

10:30 am: **Autonomous 3D exploration and mapping with unmanned ground robots**, John G. Rogers III, Georgia Institute of Technology (USA); Ethan A. Stump, Stuart H. Young, Laurel C. Sadler, U.S. Army Research Lab. (USA); Henrik I. Christensen, Georgia Institute of Technology (USA) [8387-07]

10:50 am: **Fast online learning of control regime transitions for adaptive robotic mobility**, Brian M. Yamauchi, iRobot Corp. (USA) [8387-08]

11:10 am: **Safe operations of unmanned systems for reconnaissance in complex environments (SOURCE): a year later**, N. Joseph Kott III, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); Edward Mottern, General Dynamics Robotic Systems (USA); Jeremy P. Gray, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA) .. [8387-09]

11:30 am: **Challenges to autonomous navigation in complex urban terrain**, Jeremy P. Gray, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); Edward Mottern, General Dynamics Robotics Systems (USA); N. Joseph Kott III, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA) [8387-10]

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

SESSION 3

Room: Conv. Ctr. 333 Wed. 1:00 to 3:00 pm

Intelligent Behaviors

Session Chairs: **Frank L. Lewis**, The Univ. of Texas at Arlington (USA); **Gregory R. Hudas**, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA)

1:00 pm: **Comparison of information theoretic functions to moving targets**, Wenjie Lu, Silvia Ferrari, Duke Univ. (USA); Tom A. Wettergrn, Naval Undersea Warfare Ctr. (USA); Rafael O. Fierro, Mike Anderson, The Univ. of New Mexico (USA) [8387-11]

1:20 pm: **Enabling civilian applications of unmanned teams through intelligent collaboration, cooperation, and sensing**, Allistair Moses, Matthew J. Rutherford, Kimon P. Valavanis, Univ. of Denver (USA) [8387-12]

1:40 pm: **Trust methods for multi-agent consensus**, Dariusz G. Mikulski, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (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) [8387-13]

2:00 pm: **Intelligent behaviors through vehicle-to-vehicle and vehicle-to-infrastructure communication**, Richard D. Garcia, Michael Brown, Purser Sturgeon, Southwest Research Institute (USA) [8387-14]

2:20 pm: **Multi-destination UGV navigation planning in coordinate-free and localization-free wireless sensor and actuator networks**, Guyu Zhang, Christian Duncan, Jinko Kanno, Rastko R. Selmic, Louisiana Tech Univ. (USA) [8387-15]

2:40 pm: **Neural network-based navigation and control of unmanned aerial vehicles for detecting unintended emissions**, Hassan Zargarzadeh, Missouri Univ. of Science and Technology (USA) [8387-16]

Coffee/Exhibition Break 3:00 to 4:00 pm

SESSION 4

Room: Conv. Ctr. 333 Wed. 4:00 to 6:00 pm

Human Robot Interface

Session Chair: **Jeremy P. Gray**, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA)

4:00 pm: **Designing the common controller**, Darren N. Powell, Space and Naval Warfare Systems Ctr. Pacific (USA) [8387-17]

4:20 pm: **A monocular leader-follower system for small mobile robots**, Camille Monnier, Stan German, Andrey Ostapchenko, Charles River Analytics, Inc. (USA) [8387-18]

4:40 pm: **Seamless human-machine control coordination for semi-autonomous obstacle avoidance in unmanned ground vehicles**, Sterling Anderson, Sisir Karumanchi, Massachusetts Institute of Technology (USA); Bryan Johnson, Victor E. Perlin, Mitch Rohde, Quantum Signal LLC (USA); Karl D. Iagnemma, Massachusetts Institute of Technology (USA) [8387-19]

5:00 pm: **Study of high-definition and stereoscopic head-aimed vision for improved teleoperation of an unmanned ground vehicle**, Dale R. Tyczka, Robert Wright, Brian Janiszewski, Martha Jane Chatten, Chatten Associates, Inc. (USA); Thomas A. Bowen, Brian K. Skibba, U.S. Air Force Materiel Command (USA) [8387-20]

5:20 pm: **Control solutions for robots using android devices**, A. William Evans, U.S. Army Research Lab. (USA); Jeremy P. Gray, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); David Rudnick, DCS Corp. (USA); Robert E. Karlsen, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA) [8387-21]

5:40 pm: **Development and human factors analysis of an augmented reality interface for multirobot, tele-operation, and control**, Sam Y. Lee, Nathan P. Lucas, Richard D. Ellis, Abhilash K. Pandya, Wayne State Univ. (USA) . . [8387-22]

Thursday 26 April

SESSION 5

Room: Conv. Ctr. 317 Thurs. 8:00 to 9:40 am

MAST: Small-Scale Autonomous Platforms

Note room change.

Joint Session with Conference 8373

Session Chair: **Christopher M. Kroninger**, U.S. Army Research Lab. (USA)

8:00 am: **Design and development of a revolutionary VTOL micro-air vehicle: the cyclocopter** (*Invited Paper*), Moble Benedict, Inderjit Chopra, Univ. of Maryland, College Park (USA) [8373-52]

8:20 am: **Millimeter-scale, piezoMEMS-enabled autonomous systems: system feasibility and mobility** (*Invited Paper*), Jeffrey S. Pulskamp, Ronald G. Polcawich, Gabriel L. Smith, Christopher M. Kroninger, U.S. Army Research Lab. (USA) [8373-53]

8:40 am: **Yaw feedback control of a bio-inspired flapping wing vehicle** (*Invited Paper*), Gregory Gremillion, James S. Humbert, Univ. of Maryland, College Park (USA); Paul D. Samuel, Daedalus Flight Systems, LLC (USA) [8373-54]

9:00 am: **Maneuverability and mobility in palm-sized, legged robots** (*Invited Paper*), Nicholas J. Kohut, Paul Birkmeyer, Kevin C. Peterson, Andrew O. Pullin, Ronald S. Fearing, Univ. of California, Berkeley (USA) [8373-55]

9:20 am: **Challenges for micro-scale, flapping-wing, micro air vehicles** (*Invited Paper*), Robert J. Wood, Benjamin Finio, Michael Karpelson, Nestor O. Perez Arancibia, Pratheev Sreetharan, John P. Whitney, Harvard Univ. (USA) . [8373-56]

Coffee Break 9:40 to 10:20 am

SESSION 6

Room: Conv. Ctr. 317 Thurs. 10:20 am to 12:00 am

MAST: Sensors for Small-Scale Autonomous Platforms

Note room change.

Joint Session with Conference 8373

Session Chair: **William D. Nothwang**, U.S. Army Research Lab. (USA)

10:20 am: **Biologically inspired, haltere, angular-rate sensors for micro-autonomous systems** (*Invited Paper*), Gabriel L. Smith, William D. Nothwang, Brian E. Schuster, Sarah S. Bedair, Christopher D. Meyer, Jeffrey S. Pulskamp, Ronald G. Polcawich, U.S. Army Research Lab. (USA) [8373-57]

10:40 am: **Hair-based sensors for micro-autonomous systems** (*Invited Paper*), Mahdi M. Sadeghi, Rebecca L. Peterson, Khalil Najafi, Univ. of Michigan (USA) [8373-58]

11:00 am: **Gallium nitride micromechanical resonators for IR detection** (*Invited Paper*), Mina Rais-Zadeh, Univ. of Michigan (USA) [8373-59]

11:20 am: **Micromachined low-mass RF front-end for beam steering radar** (*Invited Paper*), Mehrnoosh Vahidpour, Meysam Moallem, Jack R. East, Kamal Sarabandi, Univ. of Michigan (USA) [8373-60]

11:40 am: **A programmable palm-size gas analyzer for use in micro-autonomous systems** (*Invited Paper*), Robert J. M. Gordenker, Kensall D. Wise, Univ. of Michigan (USA) [8373-61]

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

SESSION 7

Room: Conv. Ctr. 333 Thurs. 1:00 to 3:00 pm

Perception

Session Chairs: **Larry H. Matthies**, Jet Propulsion Lab. (USA); **Camille Monnier**, Charles River Analytics, Inc. (USA)

1:00 pm: **Large-scale experimental design for decentralized SLAM**, Alexander G. Cunningham, Frank Dellaert, Georgia Institute of Technology (USA) . [8373-62]

1:20 pm: **Real-time, lidar-based place recognition using distinctive shape descriptors**, Jack A. Collier, Defence Research and Development Canada, Suffield (Canada); Stephen Se, Vinay Kotamraju, MacDonald, Dettwiler and Associates Ltd. (Canada) [8373-24]

1:40 pm: **Fully self-contained, vision-aided navigation and marker-free landing of a micro-air vehicle independent from external sensor inputs**, Roland Brockers, Larry H. Matthies, Jet Propulsion Lab. (USA) [8387-25]

2:00 pm: **Field evaluation of a prototype optical instrument for airborne sense-and-avoid applications**, Cyrus Minwalla, York Univ. (Canada); Paul Thomas, Topaz Technology Inc. (Canada); Kristopher Ellis, National Research Council Canada (Canada); Richard I. Hornsey, York Univ. (Canada); Sion A. Jennings, National Research Council Canada (Canada) [8387-26]

2:20 pm: **Saliency detection and model-based tracking: a two-part vision system for small-robot navigation in forested environment**, Richard Roberts, Duy-Nguyen H. Ta, Georgia Institute of Technology (USA); Julian Straub, Technische Univ. München (Germany); Kyel Ok, Frank Dellaert, Georgia Institute of Technology (USA) [8387-27]

2:40 pm: **Multiple object detection and tracking on the uneven terrain using multiple lidar for UGV**, Kuk Cho, Univ. of Science & Technology (Korea, Republic of); Seung-Ho Baeg, SangDeok Park, Korea Institute of Industrial Technology (Korea, Republic of) [8387-28]

Coffee Break 3:00 to 3:30 pm

SESSION 8

Room: Conv. Ctr. 333 Thurs. 3:30 to 5:50 pm

Robotics CTA

Session Chair: Jonathan A. Bornstein, U.S. Army Research Lab. (USA)

3:30 pm: **Foundations of autonomy for ground robotics**, Jonathan A. Bornstein, U.S. Army Research Lab. (USA); Robert R. Mitchell, General Dynamics Robotic Systems (USA) [8387-29]

3:50 pm: **High degree-of-freedom dynamic manipulation**, Michael P. Murphy, Benjamin Stephens, Marco da Silva, Alfred A. Rizzi, Boston Dynamics (USA) [8387-30]

4:10 pm: **Laboratory on legs: an architecture for adjustable morphology with legged robots**, G. Clark Haynes, Carnegie Mellon Univ. (USA); Jason L. Pusey, U.S. Army Research Lab. (USA); Ryan Knopf, Aaron M. Johnson, Daniel E. Koditschek, Univ. of Pennsylvania (USA) [8387-31]

4:30 pm: **Connecting a cognitive architecture to robotic perception**, Unmesh Kurup, Christian Lebiere, Anthony Stentz, Martial Hebert, Carnegie Mellon Univ. (USA) [8387-32]

4:50 pm: **Semantic perception for ground robotics**, Martial Hebert, Carnegie Mellon Univ. (USA); Max Bajracharya, Jet Propulsion Lab. (USA); Drew Bagnell, Jeffrey Cohn, Carnegie Mellon Univ. (USA); Kostas Daniilidis, Univ. of Pennsylvania (USA); Larry H. Matthies, Jet Propulsion Lab. (USA); Daniel D. Morris, General Dynamics Robotic Systems (USA); Pietro Perona, California Institute of Technology (USA); Jianbo Shi, Ben Taskar, Univ. of Pennsylvania (USA); Susan Thornton, General Dynamics Robotic Systems (USA) [8387-33]

5:10 pm: **Robust mobility in human-populated environments**, Juan Pablo Gonzalez, General Dynamics Robotic Systems (USA); Mike Phillips, Brad Neuman, Maxim Likhachev, Carnegie Mellon Univ. (USA) [8387-34]

5:30 pm: **The importance of shared mental models and shared situation awareness for transforming robots from tools to teammates**, Florian G. Jentsch, Scott Ososky, David Schuster, Stephen Fiore, Randall Shumaker, Univ. of Central Florida (USA); Christian Lebiere, Unmesh Kurup, Hyaejin Oh, Anthony Stentz, Carnegie Mellon Univ. (USA) [8387-35]

POSTERS—THURSDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Spatial learning and temporal measurements in a low-visibility, net-enabled, GPS-denied environment, Theodore B. Terry, Mark L. Axtell, Booz Allen Hamilton Inc. (USA) [8387-53]

Video analysis for high-speed, autonomous vehicle guidance, Patrick Wang, Peter A. Torrione, Leslie M. Collins, Kenneth D. Morton, Jr., Duke Univ. (USA) [8387-54]

An enhanced inertial navigation system based on low-cost IMU and laser scanner for mobile robot, HyungSoon Kim, Korea Univ. (Korea, Republic of); Seung-Ho Baeg, Kwang-Woong Yang, Korea Institute of Industrial Technology (Korea, Republic of); Kuk Cho, Univ. of Science & Technology (Korea, Republic of); SangDeok Park, Korea Institute of Industrial Technology (Korea, Republic of) [8387-55]

A pose estimation method for unmanned ground vehicles in GPS denied environments, Amirhossein Tamjidi, Cang Ye, Univ. of Arkansas at Little Rock (USA) [8387-56]

Adaptive electronic camouflage using texture synthesis, Narek Pezeshkian, Joseph D. Neff, Greg W. Anderson, Space and Naval Warfare Systems Ctr. Pacific (USA) [8387-57]

Adaptive information interactive mechanism for multi-UAV visual navigation, Hui Liu, Qionghai Dai, Tsinghua Univ. (China) [8387-58]

Fuzzy logic technique for detecting communication loss in unmanned aerial vehicles, Hector I. Reyes, Naima Kaabouch, The Univ. of North Dakota (USA) [8387-60]

A statistical approach for performance analysis of uncertain systems, Xinjia Chen, Southern Univ. and A&M College (USA) [8387-61]

Review of multirobot taxonomy, trends, and applications for defense and space, Nathan P. Lucas, Wayne State Univ. (USA) and U.S. Army Tank-Automotive and Armaments Command (USA); Abhilash K. Pandya, Richard D. Ellis, Wayne State Univ. (USA) [8387-62]

Videometric terminal guidance method and system for UAV accuracy landing, Xiang Zhou, Zhihui Lei, Qifeng Yu, Hongliang Zhang, Yang Shang, Jing Du, Yang Gui, Pengyu Guo, National Univ. of Defense Technology (China) [8387-63]

An underwater solar energy harvesting system for monitoring and security sensor applications, Rebecca Torres, Eduardo I. Ortiz-Rivera, Univ. de Puerto Rico Mayagüez (USA) [8387-64]

Autonomous robotic systems research project: a tool to improve undergraduate engineering education, Carlos I. Gonzalez, Eduardo I. Ortiz-Rivera, Univ. de Puerto Rico Mayagüez (USA) [8387-65]

Friday 27 April

SESSION 9

Room: Conv. Ctr. 333 Fri. 8:00 to 10:00 am

Articulation and Manipulation

Session Chairs: Paul L. Muench, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); Mike Perschbacher, RovnoTech (USA)

8:00 am: **Enhanced operator perception through 3D vision and haptic feedback**, Richard Edmondson, Polaris Sensor Technologies, Inc. (USA); Kenneth Light, Andrew Bodenhamer, U.S. Army Research Lab. (USA); Peter Boscher, Loren Wilkinson, Harris Corp. (USA) [8387-36]

8:20 am: **Autonomous urban reconnaissance ingress system (AURIS): providing a tactically relevant, autonomous door-opening kit for unmanned ground vehicles**, David J. Shane, Michael Rufo, Boston Engineering Corp. (USA); Matthew D. Berkemeier, Joel A. Alberts, Autonomous Solutions, Inc. (USA) [8387-37]

8:40 am: **Advanced dual-haptic manipulator system for CIED**, David R. Erickson, Defence Research and Development Canada, Suffield (Canada) [8387-38]

9:00 am: **Game theory applied to legged robotics: a variant of the dolichobrachistochrone problem**, Paul L. Muench, David B. Bednarz, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA) . . [8387-39]

9:20 am: **Detecting and learning of geometrically relevant features for legged locomotion**, Bruce L. Digney, Defence Research and Development Canada, Suffield (Canada) [8387-40]

9:40 am: **Improving UGV teleoperation performance using novel visualization techniques and manual interfaces**, Steven Vozar, Dawn Tilbury, Univ. of Michigan (USA) [8387-41]

Coffee Break 10:00 to 10:30 am

SESSION 10

Room: Conv. Ctr. 333 Fri. 10:30 to 11:50 am

Navigation and Mobility II

Session Chairs: **Robert E. Karlsen**, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA);
Brian M. Yamauchi, iRobot Corp. (USA)

10:30 am: **Autonomous exploration and mapping of unknown environments**, Jason L. Owens, U.S. Army Research Lab. (USA); Philip R. Osteen, Motile Robotics Inc. (USA); MaryAnne Fields, Ellen Haas, U.S. Army Research Lab. (USA); Kostas Daniilidis, Univ. of Pennsylvania (USA) [8387-42]

10:50 am: **Development and test results of autonomous behaviors for urban environment exploration**, Gaurav Ahuja, Donald Fellars, Gregory Kogut, Estrellina Pacis Rius, Alexander Xydes, Space and Naval Warfare Systems Ctr. Pacific (USA) [8387-43]

11:10 am: **Development of an info-gap-based path planner to enable non-deterministic, low-observability mobile sensor nodes**, David L. Mascareñas, Christopher J. Stull, Charles R. Farrar, Los Alamos National Lab. (USA) . [8387-44]

11:30 am: **Energy conservation for UGVs executing coverage tasks**, John Broderick, Dawn Tilbury, Ella Atkins, Univ. of Michigan (USA) [8387-45]

Lunch Break 11:50 am to 1:00 pm

SESSION 11

Room: Conv. Ctr. 333 Fri. 1:00 to 3:20 pm

Special Topics

Session Chairs: **Douglas W. Gage**, XPM Technologies (USA);
Charles M. Shoemaker, General Dynamics Robotic Systems (USA)

1:00 pm: **Enabling unmanned capabilities in the tactical-wheeled vehicle fleet of the future**, Noah Zych, Oshkosh Corp. (USA) [8387-46]

1:20 pm: **ROBODEXS: multirobot deployment and extraction system**, Jeremy P. Gray, James R. Mason, Michael S. Patterson, Matthew W. Skalny, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA) . . [8387-47]

1:40 pm: **Dealing with unreliable and long latency communications in tactical and space robotic applications**, Douglas W. Gage, XPM Technologies (USA) [8387-48]

2:00 pm: **Mesh networking optimized for robotic teleoperation**, Abraham Hart, Hoa G. Nguyen, Narek Pezeshkian, Kevin F. Holz, Space and Naval Warfare Systems Ctr. Pacific (USA) [8387-49]

2:20 pm: **Getting it right the first time: predicted performance guarantees from the analysis of emergent behavior in autonomous and semi-autonomous systems**, Ronald C. Arkin, Georgia Institute of Technology (USA); Damian M. Lyons, Fordham Univ. (USA) [8387-50]

2:40 pm: **Characteristics of a maritime-interdiction-operations, unmanned ground vehicle**, Hoa G. Nguyen, Mendel Baker, Space and Naval Warfare Systems Ctr. Pacific (USA) [8387-51]

3:00 pm: **Design of a transformative spherical mobile robot**, Kang Hou, Hanxu Sun, Qingxuan Jia, Beijing Univ. of Posts and Telecommunications (China) [8387-52]

Courses of Related Interest

SC996 **Introduction to GPS Receivers** (Zhu) Tuesday, 8:30 am to 12:30 pm
See Course Materials Desk, located near the SPIE Registration Area,
Pratt St. Lobby, Open during Registration Hours

Defense, Security, and Sensing Facility Maps:

Baltimore Convention Center pp. 3–4
Hilton Baltimore p. 5

Unattended Ground, Sea, and Air Sensor Technologies and Applications XIV

Conference Chair: **Edward M. Carapezza**, General Atomics (USA)

Program Committee: **Jacques Bédard**, Defence Research and Development Canada, Valcartier (Canada); **John G. Blicht**, Colorado State Univ. (USA); **John C. Carrano**, Carrano Consulting (USA); **Panos George C. Datskos**, Oak Ridge National Lab. (USA); **Christina J. Deckard**, Space and Naval Warfare Systems Ctr. Pacific (USA); **Sachi V. Desai**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Daniel D. Desjardins**, Air Force Research Lab. (USA); **Alan J. Gray**, Defence Science and Technology Lab. (United Kingdom); **Todd M. Hintz**, Space and Naval Warfare Systems Command (USA); **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA); **George C. McNamara**, Naval Undersea Warfare Ctr. (USA); **Tariq Manzur**, Naval Undersea Warfare Ctr. (USA); **Huub A.J.M. van Hoof**, TNO Defence, Security and Safety (Netherlands); **Graeme P. van Voorthuysen**, TNO Defence, Security and Safety (Netherlands)

Wednesday 25 April

SESSION 1

Room: Conv. Ctr. 311 Wed. 1:00 pm

Keynote Session

Note room change.

Joint with Conference 8359

Session Chairs: **Edward M. Carapezza**, General Atomics (USA); **Daniel Lehrfeld**, Blue Marble Group LLC (USA)

1:00 pm: **Non-lethal weapons: technologies and challenges** (Keynote Presentation), David B. Law, Joint Non-Lethal Weapons Directorate (USA) [8359-38]

SESSION 2

Room: Conv. Ctr. 311 Wed. 1:30 to 2:30 pm

Non-lethal Weapon and Surveillance Systems

Note room change.

Joint Session with Conference 8359

Session Chairs: **David B. Law**, Joint Non-Lethal Weapons Directorate (USA); **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

1:30 pm: **Characterization the influence of micro and terahertz waves on human in security systems**, Marek Zyczkowski, Norbert Palka, Mateusz Karol, Military Univ. of Technology (Poland); Beata Uzieblo-Zyczkowska, Military Institute of Medicine (Poland) [8359-39]

1:50 pm: **Direct electromagnetic stopper: an innovative nonlethal weapon working in time domain**, Michele D'Urso, Aniello Buonanno, Maria Grazia Labate, SELEX Sistemi Integrati S.p.A. (Italy); Domenico Pavone, Consorzio Nazionale di Ricerca per le Tecnologie Optoelettroniche dell'InP (Italy) . . [8359-40]

2:10 pm: **Detection and localization of R/C electronic devices using Hurst parameter**, Vivek Thotla, Mohammad Tayeb Ahmad Ghasr, Maciej Zawodniok, Sarangapani Jagannathan, Missouri Univ. of Science and Technology (USA); Sanjeev Agarwal, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8359-41]

SESSION 3

Room: Conv. Ctr. 311 Wed. 2:30 to 3:30 pm

Weapons, Projectiles, and Small Arms I

Note room change.

Joint Session with Conference 8359

Session Chairs: **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Sachi V. Desai**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

2:30 pm: **Passive electro-optical projectiles tracker**, Ilya P. Agurok, Waqidi Falicoff, Roberto Alvarez, Will Shatford, Light Prescriptions Innovators, LLC (USA) [8359-42]

2:50 pm: **Real-time vehicle noise cancellation techniques for gunshot acoustics**, Antonio L. Ramos, Hogskolen i Buskerud (Norway); Sverre Holm, Univ. of Oslo (Norway); Sigmund Gudvangen, Hogskolen i Buskerud (Norway); Ragnvald Otterlei, PosiCom AS (Norway) [8359-43]

3:10 pm: **Small arms mini-fire control system: projectile tracker sensor**, Slobodan Rajic, Oak Ridge National Lab. (USA) [8359-44]

Coffee Break 3:30 to 4:00 pm

SESSION 4

Room: Conv. Ctr. 311 Wed. 4:00 to 5:00 pm

Weapons, Projectiles, and Small Arms II

Note room change.

Joint Session with Conference 8359

Session Chairs: **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Sachi V. Desai**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

4:00 pm: **Small arms mini-fire control system: fiber optic barrel deflection sensor**, Slobodan Rajic, Oak Ridge National Lab. (USA) [8359-45]

4:20 pm: **A fusion solution for soldier wearable gunfire detection systems**, George Cakiades, Sachi V. Desai, U.S. Army Armament Research, Development and Engineering Ctr. (USA); Socrates Deligeorges, BioMimetic Systems, Inc. (USA) [8388-01]

4:40 pm: **Examination of techniques utilized to evaluate muzzle suppression systems**, David Grasing, U.S. Army Research, Development and Engineering Command (USA); Sachi V. Desai, U.S. Army Armament Research, Development and Engineering Ctr. (USA) [8388-02]

Thursday 26 April

SESSION 5

Room: Conv. Ctr. 311 Thurs. 8:00 to 8:40 am

Communications Technologies

Session Chairs: **Tariq Manzur**, Naval Undersea Warfare Ctr. (USA); **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

8:00 am: **Unattended ground sensors (UGS) and ultra-wideband (UWB) technologies: a perfect match**, Paolo Proietti, SELEX Sistemi Integrati S.p.A. (Italy); Alfonso Centuori, CMC Labs. (Italy); Luca Di Donato, Sandro Mattiacci, SELEX Sistemi Integrati S.p.A. (Italy) [8388-03]

8:20 am: **Near sea surface 1.55 µm free-space optical communication links through the evaporation layer**, John W. Zeller, Tariq Manzur, Naval Undersea Warfare Ctr. (USA) [8388-04]

SESSION 6

Room: Conv. Ctr. 311 Thurs. 8:40 to 9:40 am

EO/Imaging Algorithms, Devices, and Systems

Session Chairs: **Tariq Manzur**, Naval Undersea Warfare Ctr. (USA); **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

8:40 am: **Vision navigation for UAV based on scene matching**, Yang Shang, Xiang Li, Wang Hou, Xiaochun Liu, Xianwei Zhu, Xia Yang, Qifeng Yu, Hongliang Zhang, National Univ. of Defense Technology (China) [8388-06]

9:00 am: **Small form-factor ultraviolet laser source**, Robert Olah, Banpil Photonics, Inc. (USA) [8388-07]

9:20 am: **Passive sky angle mapping for unmanned ground vehicles**, Robert Grabowski, The MITRE Corp. (USA) [8388-08]

Coffee Break 9:40 to 10:30 am

SESSION 7

Room: Conv. Ctr. 311 Thurs. 10:30 to 11:00 am

Keynote Session

Session Chairs: **Sachi V. Desai**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Panos George Datskos**, Oak Ridge National Lab. (USA)

10:30 am: **The DARPA HUMS Program: revolutionizing magnetic field sensors using multiferroic materials and atomic gas vapor cells (Keynote Presentation)**, William Coblentz, Defense Advanced Research Projects Agency (USA); Scott Wartenberg, Booz Allen Hamilton Inc. (USA) [8388-09]

SESSION 8

Room: Conv. Ctr. 311 Thurs. 11:00 am to 12:20 pm

Chemical, Magnetic, Acoustic, and Seismic Sensors

Session Chairs: **Panos George Datskos**, Oak Ridge National Lab. (USA); **Sachi V. Desai**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

11:00 am: **MAGID-II: a next-generation magnetic, unattended ground sensor**, Paul A. Walter, Philip Huber, Fred Mauriello, L-3 Communication Systems-East (USA) [8388-10]

11:20 am: **Application of nodes with multiple orthogonal sensors in moving light vehicles study**, Alexander E. Ekimov, The Univ. of Mississippi (USA) [8388-11]

11:40 am: **Ultrasonic bistatic Doppler sonar in air for personnel motion detection**, Alexander E. Ekimov, Craig Hickey, The Univ. of Mississippi (USA) [8388-12]

12:00 pm: **Corner-cube retroreflector chemical sensors based on MEMS**, Panos George C. Datskos, Oak Ridge National Lab. (USA) [8388-13]

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

SESSION 9

Room: Conv. Ctr. 311 Thurs. 1:20 to 2:20 pm

Modeling, Organization, and Data Fusion

Session Chairs: **Tariq Manzur**, Naval Undersea Warfare Ctr. (USA); **Myron E. Hohil**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

1:20 pm: **Spatial voting with data modeling for behavior-based tracking and discrimination of human from fauna from GMTI radar tracks**, Holger M. Jaenisch, Licht Strahl Engineering, Inc. (USA) and The Johns Hopkins Univ. (USA); James W. Handley, Licht Strahl Engineering, Inc. (USA) [8388-14]

1:40 pm: **Optimizing the configuration patterns for heterogeneous distributed sensor fields**, Thomas A. Wettergren, Russell Costa, Naval Undersea Warfare Ctr. (USA) [8388-15]

2:00 pm: **Space-time statistical models for inhomogeneous acoustic propagation environments**, Joshua N. Ash, The Ohio State Univ. (USA) [8388-16]

SESSION 10

Room: Conv. Ctr. 311 Thurs. 2:20 to 5:50 pm

UGS Devices and Systems

Session Chairs: **Panos George Datskos**, Oak Ridge National Lab. (USA); **Sachi V. Desai**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

2:20 pm: **Pearls of wisdom: wireless networks of miniaturized unattended ground sensors**, Boaz Rippin, Pearls of Wisdom (Israel) [8388-17]

2:40 pm: **Dynamically reconfigurable, multivariable MEMS sensor array for unattended systems**, Stephen P. van der Velden, Ian G. Powlesland, Steve C. Galea, Defence Science and Technology Organisation (Australia); Jugdutt Singh, La Trobe Univ. (Australia) [8388-18]

3:00 pm: **Radiation detection and wireless networked early warning**, David A. Burns, Marc S. Litz, Dimos Katsis, James J. Carroll, U.S. Army Research Lab. (USA) [8388-19]

Coffee Break 3:20 to 3:50 pm

3:50 pm: **Seismic and ultrasonic data analysis for characterizing people and animals**, Thyagaraju Damarla, U.S. Army Research Lab. (USA) [8388-20]

4:10 pm: **Automatic human action recognition in a scene from visual inputs**, Henri Bouma, Patrick Hanckmann, Jan-Willem Marck, Leo Penning, Richard den Hollander, Johan-Martijn ten Hove, Sebastiaan P. van den Broek, Klamer Schutte, Gertjan Burghouts, TNO Defence, Security and Safety (Netherlands) ... [8388-21]

4:30 pm: **Multisensor system for the protection of critical infrastructure of a seaport**, Mariusz Kastek, Rafal Dulski, Marek Zyczkowski, Mieczyslaw Szustakowski, Piotr Trzaskawka, Wieslaw Ciurapinski, Military Univ. of Technology (Poland); Grazyna Grelowska, Ignacy Gloza, Stanislaw Milewski, Karol Listewnik, Polish Naval Academy (Poland) [8388-22]

4:50 pm: **Investigation of novel spectral and wavelet statistics for UGS-based intrusion detection**, Ranga Narayanaswami, Avinash Gandhe, Anastasia Tyurina, Raman K. Mehra, Scientific Systems Co., Inc. (USA) [8388-23]

5:10 pm: **The Android smartphone as an inexpensive ground sensor**, Neil C. Rowe, Riqui Schwamm, Naval Postgraduate School (USA) [8388-24]

5:30 pm: **Fully integrated, automated security surveillance system: managing a changing world through managed technology and product applications**, Glen Francisco, DRS RSTA, Inc. (USA) [8388-25]

Courses of Related Interest

- SC993 **Soil Physics For Non-Soil Engineers: Moisture, Thermal, And Dielectric Soil Properties Affecting IED Detection** (Hendrickx) Wednesday, 8:30 am to 5:30 pm
- SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm
- SC996 **Introduction to GPS Receivers** (Zhu) Tuesday, 8:30 am to 12:30 pm
- SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Ground/Air Multisensor Interoperability, Integration, and Networking for Persistent ISR III

Conference Chair: **Tien Pham**, U.S. Army Research Lab. (USA)

Conference Co-Chairs: **Michael A. Kolodny**, U.S. Army Research Lab. (USA); **Kevin L. Priddy**, Air Force Research Lab. (USA)

Program Committee: **Jacques Bédard**, Defence Research and Development Canada, Valcartier (Canada); **Robert Heathcock**, U.S. Defense Intelligence Agency (USA); **Jeff Houser**, U.S. Army Research Lab. (USA); **Gavin Pearson**, Defence Science and Technology Lab. (United Kingdom); **Stephen G. Perry**, MTC Services Corp (USA); **Ronald B. Sartain**, Primal Innovations (USA); **King K. Siu**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Raja Suresh**, General Dynamics Advanced Information Systems (USA); **Graeme P. van Voorthuijsen**, TNO Defence, Security and Safety (Netherlands); **Robert L. Williams**, Air Force Research Lab. (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 313 Mon. 1:30 to 4:40 pm

Sensor, Data, and Information Processing for Data-to-Decisions (D2D)

Session Chairs: **Tien Pham**, U.S. Army Research Lab. (USA);

Gavin Pearson, Defence Science and Technology Lab. (United Kingdom)

1:30 pm: **Ground/air multisensor interoperability, integration, and networking for persistent ISR: Introduction**, Tien Pham, U.S. Army Research Lab. (USA) [8389-01]

1:50 pm: **Data-to-decisions: a transdisciplinary approach to decision support efforts at ARL (Invited Paper)**, Barbara D. Broome, U.S. Army Research Lab. (USA) [8389-02]

2:30 pm: **Toward data-to-decision sensing environments to assess human intent from responses to stimuli**, Cartik Kothari, David J. Russomanno, Indiana Univ.-Purdue Univ. Indianapolis (USA) [8389-03]

2:50 pm: **Tasking and sharing sensing assets using controlled natural language**, Alun Preece, Diego Pizzocaro, Cardiff Univ. (United Kingdom); David Braines, David Mott, IBM United Kingdom Ltd. (United Kingdom) [8389-04]

Coffee Break 3:10 to 3:40 pm

3:40 pm: **Dynamic management of layered ISR systems**, Gavin Pearson, Defence Science and Technology Lab. (United Kingdom) [8389-05]

4:00 pm: **Distributed network application and framework for quality of information processing**, Kelvin Marcus, Lisa M. Scott, Trevor J. Cook, Andrew Toth, U.S. Army Research Lab. (USA) [8389-06]

4:20 pm: **A system architecture for exploiting mission information requirement and resource allocation**, Fangfei Chen, Thomas La Porta, The Pennsylvania State Univ. (USA); Diego Pizzocaro, Alun Preece, Cardiff Univ. (United Kingdom); Mani B. Srivastava, Univ. of California, Los Angeles (USA) [8389-07]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 2

Room: Conv. Ctr. 313 Tues. 8:00 to 10:00 am

Invited Government Session: Interoperability I

Session Chairs: **Michael A. Kolodny**, U.S. Army Research Lab. (USA); **Kevin L. Priddy**, Air Force Research Lab. (USA)

8:00 am: **Unattended ground sensors standards working group: focus on software architecture, wired/wireless interfaces, and user interfaces**, Robert Heathcock, U.S. Defense Intelligence Agency (USA); Colson Brasch, The MITRE Corp. (USA) [8389-08]

8:20 am: **Technology focus group efforts within the UGS standardization working group**, Jeff Houser, U.S. Army Research Lab. (USA) [8389-09]

8:40 am: **Unattended sensors community of practice (USCOP)**, Paul Helt, Under Secretary of Defense for Intelligence (USA) [8389-10]

9:00 am: **Standards-based sensor interoperability and networking**, Tammera Countryman, Defense Intelligence Agency (USA) [8389-11]

9:20 am: **Army's common operating environment (COE) sensor compute environment (CE) overview**, Clair E. Guthrie, U. S. Army (USA) [8389-12]

9:40 am: **Government and industry collaborative approach toward UGS interoperability**, Michael A. Kolodny, Jeff Houser, U.S. Army Research Lab. (USA) [8389-13]

Coffee Break 10:00 to 10:30 am

SESSION 3

Room: Conv. Ctr. 313 Tues. 10:30 to 11:50 am

Interoperability II

Session Chairs: **Kevin L. Priddy**, Air Force Research Lab. (USA); **Tien Pham**, U.S. Army Research Lab. (USA)

10:30 am: **Multisensor interoperability for persistent surveillance and FOB protection with multiple technologies during the TNT exercise at Camp Roberts, California**, Jonathan L. Chambers, Northrop Grumman-Xetron (USA); Naveen N. Murarka, Northrop Grumman Electronic Systems (USA) [8389-14]

10:50 am: **ITA/CWP and ICB technology demonstrator: a practical integration of disparate ISR/ISTAR assets and technologies**, Flavio Bergamaschi, IBM United Kingdom Ltd. (United Kingdom) [8389-15]

11:10 am: **An open and flexible interface proposal and proof-of-concept implementation to support service-orientated architectures and interoperability in the tactical environment**, Nicholas Peach, PB Partnership Ltd. (United Kingdom) [8389-16]

11:30 am: **A services-oriented architecture for deployable force protection**, Gordon J. Miller, Gregory Mayott, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8389-17]

Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 4

Room: Conv. Ctr. 313 Tues. 1:20 to 5:00 pm

Interoperability III: Terra Harvest

Session Chairs: **Robert Heathcock**, U.S. Defense Intelligence Agency (USA); **Jeff Houser**, U.S. Army Research Lab. (USA)

- 1:20 pm: **Terra harvest: ISR force multiplier**, Robert Heathcock, U.S. Defense Intelligence Agency (USA); Colson Brasch, The MITRE Corp. (USA) [8389-18]
- 1:40 pm: **Terra Harvest demonstration at Trident Spectre 2012**, Michael A. Kolodny, U.S. Army Research Lab. (USA). [8389-19]
- 2:00 pm: **Terra Harvest architectural overview**, Larry J. Tokarcik, Robert P. Winkler, U.S. Army Research Lab. (USA) [8389-20]
- 2:20 pm: **Terra Harvest software architecture**, David Humeniuk, Darren M. Landoll, L-3 Communications Nova Engineering (USA) [8389-21]
- 2:40 pm: **Terra Harvest Mission programming approach**, Jesse B. Kovach, U.S. Army Research Lab. (USA) [8389-22]
- Coffee/Exhibition Break. 3:00 to 4:00 pm
- 4:00 pm: **How to create a Terra Harvest compliant plug in**, Kevin Klawon, Joshua Gold, Nicholas Marcucci, Univ. of Dayton Research Institute (USA) [8389-23]
- 4:20 pm: **Interoperability testing for the Terra Harvest controller architecture**, Gary H. Stolovy, U.S. Army Research Lab. (USA). [8389-24]
- 4:40 pm: **Standard metrics for a plug-and-play tracker**, Jim Antonisse, Harris Corp. (USA); Darrell L. Young, Raytheon Intelligence & Information Systems (USA) [8389-25]

Wednesday 25 April

SESSION 5

Room: Conv. Ctr. 313 Wed. 8:00 to 11:50 am

Sensor and Information Processing for ISR

Session Chairs: **King K. Siu**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Ronald B. Sartain**, Primal Innovation (USA)

- 8:00 am: **A wireless near-IR retro-reflective profiling sensor**, Alex Galvis, David J. Russomanno, Cartik Kothari, Indiana Univ.-Purdue Univ. Indianapolis (USA) [8389-26]
- 8:20 am: **Unattended devices for determining intent and modifying behavior**, Ronald B. Sartain, Primal Innovation (USA) [8389-27]
- 8:40 am: **Soldier detection using unattended acoustic and seismic sensors**, Pierre Naz, Sébastien Hengy, Pascal Hamery, Institut Franco-Allemand de Recherches de Saint-Louis (France) [8389-28]
- 9:00 am: **Intent-based resource deployment in wireless sensor networks**, Geeth R. de Mel, Univ. of Aberdeen (United Kingdom); Tien Pham, U.S. Army Research Lab. (USA); Flavio Bergamaschi, IBM United Kingdom Ltd. (United Kingdom); Wamberto Vasconcelos, Timothy J. Norman, Univ. of Aberdeen (United Kingdom) [8389-29]
- 9:20 am: **A multimodal, temporal panorama approach for moving vehicle detection, reconstruction, and classification**, Tao Wang, Zhigang Zhu, The City College of New York (USA); Clark N. Taylor, Air Force Research Lab. (USA) [8389-30]
- 9:40 am: **Consensus of stochastic maps with nearest neighbor interactions**, Brandon M. Jones, Mark Campbell, Lang Tong, Cornell Univ. (USA). . . . [8389-31]
- Coffee Break 10:00 to 10:30 am

- 10:30 am: **Trust and obfuscation**, Murat Sensoy, Univ. of Aberdeen (United Kingdom); Chatschik Bisdikian, IBM Thomas J. Watson Research Ctr. (USA); Christopher Burnett, Nir Oren, Univ. of Aberdeen (United Kingdom); Mani B. Srivastava, Univ. of California, Los Angeles (USA); Timothy J. Norman, Univ. of Aberdeen (United Kingdom); Achille Fokoue, IBM Thomas J. Watson Research Ctr. (USA); Felipe Meneguzzi, Katia Sycara, Carnegie Mellon Univ. (USA); Lance M. Kaplan, U.S. Army Research Lab. (USA) [8389-32]
- 10:50 am: **Sharing protected sensory data in coalition environments**, John R. James, Frank Mabry, Kevin Huggins, U.S. Military Academy (USA). . . . [8389-33]
- 11:10 am: **Levy walks for autonomous search**, Arjuna Flenner, Katia Estabridis, Naval Air Warfare Ctr. Weapons Div. (USA) [8389-34]
- 11:30 am: **Source localization corrections for airborne acoustic platforms based on a climatological assessment of temperature and wind velocity profiles**, Vladimir E. Ostashev, National Oceanic and Atmospheric Administration (USA) and U. S. Army Cold Regions Research and Engineering Lab. (USA); Sylvain Cheinet, Institut Franco-Allemand de Recherches de Saint-Louis (France); Sandra L. Collier, Christian G. Reiff, David A. Ligon, U.S. Army Research Lab. (USA); David K. Wilson, U.S. Army Engineer Research and Development Ctr. (USA); John M. Noble, William Clyde K. Alberts II, U.S. Army Research Lab. (USA) [8389-35]
- Lunch/Exhibition Break 11:50 am to 1:40 pm

SESSION 6

Room: Conv. Ctr. 313 Wed. 1:40 to 3:20 pm

Wide-Area Persistent ISR and Networked Systems I

Note room change.

Joint Session with Conference 8405

- Session Chairs:* **Raja Suresh**, General Dynamics Advanced Information Systems (USA); **Tien Pham**, U.S. Army Research Lab. (USA)
- 1:40 pm: **DARPA's HARDI program for a wide field of view, VIS-NIR-SWIR detector based on a curved focal plane array** (*Invited Paper*), Devanand K. Shenoy, Defense Advanced Research Projects Agency (USA) [8405-16]
 - 2:10 pm: **Advanced thermal management technologies for defense electronics** (*Invited Paper*), Avram Bar-Cohen, Univ. of Maryland, College Park (USA); Kristen Bloshock, System Planning Corp. (USA) [8405-17]
 - 2:40 pm: **An architecture for distributed video applications based on declarative networking**, Xiping Wang, Cesar Gonzales, Jorge Lobo, Seraphin Calo, Dinesh Verma, IBM Thomas J. Watson Research Ctr. (USA) [8389-36]
 - 3:00 pm: **From information needs to information gathering: a system optimization perspective to ISR synchronization**, Moises Sudit, Hector Ortiz-Pena, Michael Moskal, CUBRC (USA); James Fink, Daniel Tuttle, Timothy Hanratty, Eric Heilman, Michael Dawson, U.S. Army Intelligence Ctr. (USA) [8389-37]
 - Coffee Break 3:20 to 4:00 pm

SESSION 7

Room: Conv. Ctr. 313 Wed. 4:00 to 5:20 pm

Wide-Area Persistent ISR and Networked Systems II

Note room change.

Joint Session with Conference 8405

- Session Chairs:* **Tien Pham**, U.S. Army Research Lab. (USA); **Raja Suresh**, General Dynamics Advanced Information Systems (USA)
- 4:00 pm: **Wide area, persistent surveillance video with no gimbal**, Geoffrey Egnal, Argusight, Inc. (USA) [8405-18]
 - 4:20 pm: **Low-latency situational awareness for UxV platforms**, David Berends, SRI International Sarnoff (USA) [8389-38]
 - 4:40 pm: **LEAPS and WFPAC status**, Augustus S. Moore, Geoff Hazel, Bryan Schulz, Logos Technologies, Inc. (USA) [8405-19]
 - 5:00 pm: **Acoustic data analysis and scenario overwatch from an aerostat at the NATO SET-153 field experiment**, Christian G. Reiff, U.S. Army Research Lab. (USA) [8389-39]
 - 5:20 pm: **Kestrel aerostat-based wide area persistent surveillance**, David R. Lubner, Logos Technologies, Inc. (USA) [8405-20]

Thursday 26 April

SESSION 8

Room: Conv. Ctr. 313 Thurs. 8:00 to 11:30 am

Networked Sensing, Distributed Processing, and Data Fusion for ISR

Session Chairs: **Kevin L. Priddy**, Air Force Research Lab. (USA); **King K. Siu**, U.S. Army Armament Research, Development and Engineering Ctr. (USA)

- 8:00 am: **A decentralized approach for multi-UAV, multitarget tracking and surveillance**, Emrah Adamey, Umit Ozguner, The Ohio State Univ. (USA) [8389-40]
- 8:20 am: **Wide-area littoral discreet observation: success at the tactical edge**, Andrew P. Ladas, U.S. Army Research Lab. (USA); Sue D. Toth, Air Force Research Lab. (USA) [8389-41]
- 8:40 am: **Autonomous UAV persistent surveillance using bio-inspired strategies**, Jerry A. Burman, Teledyne Scientific Co. (USA); Joao P. Hespanha, Upamanyu Madhow, Univ. of California, Santa Barbara (USA); Tien Pham, U.S. Army Research Lab. (USA) [8389-42]
- 9:00 am: **Cooperative layered sensing: a factor analysis on finding elusive mobile targets**, Christopher K. Curtis, Air Force Research Lab. (USA); John M. Colombi, Air Force Institute of Technology (USA) [8389-43]
- 9:20 am: **Performance-based dynamic team formation in multi-agent auctions**, Charles E. Pippin, Georgia Tech Research Institute (USA); Henrik I. Christensen, Georgia Institute of Technology (USA) [8389-44]
- 9:40 am: **Performance modeling of a feature-aided tracker**, George S. Goley, Adam R. Nolan, Etegent Technologies, Ltd. (USA) [8389-45]
- Coffee Break 10:00 to 10:30 am
- 10:30 am: **Threshold considerations in distributed detection in a network of sensors**, Gene T. Whipps, U.S. Army Research Lab. (USA); Emre Ertin, Randolph L. Moses, The Ohio State Univ. (USA) [8389-46]
- 10:50 am: **Creation of a wide-area-motion imagery capture system for small UAVs**, Clark N. Taylor, Daniel Uppenkamp, James Stadler, Air Force Research Lab. (USA) [8389-47]
- 11:10 am: **Indoor situational awareness exploiting robotic platforms**, Michele D'Urso, Aniello Buonanno, Giancarlo Prisco, SELEX Sistemi Integrati S.p.A. (Italy); Flavio Meliaddò, Consorzio SESM (Italy); Maurizio Felaco, SELEX Sistemi Integrati S.p.A. (Italy) [8389-48]
- Lunch/Exhibition Break 11:30 am to 1:20 pm

SESSION 9

Room: Conv. Ctr. 313 Thurs. 1:00 to 4:10 pm

Social Networking Innovations in Persistent ISR

Session Chairs: **Gavin Pearson**, Defence Science and Technology Lab. (United Kingdom); **Robert L. Williams**, Air Force Research Lab. (USA)

- 1:00 pm: **Why social network analysis is important to Air Force applications**, Paul R. Havig II, John P. McIntire, Eric E. Geiselman, Air Force Research Lab. (USA) [8389-50]
- 1:20 pm: **Persistent ISR: the social network analysis connection**, Elizabeth K. Bowman, U.S. Army Research Lab. (USA) [8389-51]
- 1:40 pm: **Visualizing weighted networks: a performance comparison of adjacency matrices versus node-link diagrams**, John P. McIntire, Air Force Research Lab. (USA); O. Isaac Osesina, Cecilia Bartley, M. Eduard Tudoreanu, Univ. of Arkansas at Little Rock (USA); Paul R. Havig II, Eric E. Geiselman, Air Force Research Lab. (USA) [8389-52]
- 2:00 pm: **Methods for extracting social network data from chatroom logs**, O. Isaac Osesina, Univ. of Arkansas at Little Rock (USA); John P. McIntire, Paul R. Havig, Eric E. Geiselman, Air Force Research Lab. (USA); Cecilia Bartley, M. Eduard Tudoreanu, Univ. of Arkansas at Little Rock (USA) [8389-53]
- 2:20 pm: **Identifying rumors and their sources in social networks**, Eunsoo Seo, Univ. of Illinois at Urbana-Champaign (USA); Prasant Mohapatra, Univ. of California, Davis (USA); Tarek F. Abdelzaher, Univ. of Illinois at Urbana-Champaign (USA) [8389-54]
- 2:40 pm: **Increasing situational awareness using smartphones**, Sanjay Kumar Boddhu, MetaCarta, a Division of Qbase (USA); Robert L. Williams, Tec^Edge Innovation and Collaboration Ctr. (USA) and Air Force Research Lab. (USA) [8389-55]
- Coffee Break 3:00 to 3:30 pm
- 3:30 pm: **Cyber security and data collection approaches for smartphone sensor systems**, Jules White, Virginia Polytechnic Institute and State Univ. (USA) [8389-56]
- 3:50 pm: **Social network innovations in persistent surveillance: an avatar's perspective**, Robert L. Williams, Belinda McKinney, Air Force Research Lab. (USA) [8389-57]

PANEL DISCUSSION

Room: Conv. Ctr. 313 Thurs. 4:30 to 5:30 pm

Social Networking Innovations in Persistent ISR

Panel Moderator: **Robert Williams**, Air Force Research Lab. (USA)

Social networks are becoming a major force for information gathering, interpretation and sharing in a largely open environment. Whereas Persistent ISR has traditionally focused on more conventional sensor-based technologies operating in the electromagnetic and acoustic spectrums, it is clear that the emergence of social networks has created new opportunities and technology challenges for expanded Persistent ISR capabilities. This panel will consider potential social network innovations for Persistent ISR and discuss areas of promising future research.

Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XVIII

Conference Chairs: **Sylvia S. Shen**, The Aerospace Corp. (USA); **Paul E. Lewis**, National Geospatial-Intelligence Agency (USA)

Program Committee: **Gail P. Anderson**, Air Force Research Lab. (USA); **Hsiao-hua K. Burke**, MIT Lincoln Lab. (USA); **Chen-I Chang**, Univ. of Maryland, Baltimore County (USA); **Eustace L. Dereniak**, College of Optical Sciences, The Univ. of Arizona (USA); **Michael T. Eismann**, Air Force Research Lab. (USA); **Glenn E. Healey**, Univ. of California, Irvine (USA); **James R. Irons**, NASA Goddard Space Flight Ctr. (USA); **Fred A. Kruse**, Naval Postgraduate School (USA); **Giovanni B. Marchisio**, DigitalGlobe, Inc (USA); **David W. Messinger**, Rochester Institute of Technology (USA); **Alan P. Schaum**, U.S. Naval Research Lab. (USA); **James Theiler**, Los Alamos National Lab. (USA); **Grady H. Tuell**, Georgia Tech Research Institute (USA); **Miguel Velez-Reyes**, Univ. de Puerto Rico Mayagüez (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 327 Mon. 8:20 to 10:10 am

Detection, Identification, and Quantification I

Session Chair: **Sylvia S. Shen**, The Aerospace Corp. (USA)

8:20 am: **Progress in the theory of continuum fusion (Invited Paper)**, Alan P. Schaum, U.S. Naval Research Lab. (USA) [8390-01]

8:50 am: **Clairvoyance and confusion: some remarks on the composite hypothesis testing problem**, James Theiler, Los Alamos National Lab. (USA) [8390-02]

9:10 am: **A hyperspectral anomaly detector based on maximized subspace model in local mode**, Edisanter Lo, Susquehanna Univ. (USA) [8390-03]

9:30 am: **Kernel sparse representation for hyperspectral 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) [8390-04]

9:50 am: **Parameter estimation for support vector anomaly detection in hyperspectral imagery**, Reuven Meth, James Ahn, SET Corp. (USA); Amit Banerjee, Radford Juang, Philippe Burlina, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8390-05]

Coffee Break 10:10 to 10:40 am

SESSION 2

Room: Conv. Ctr. 327 Mon. 10:40 am to 12:00 pm

Multisensor Data Fusion I

Session Chair: **Grady H. Tuell**, Georgia Tech Research Institute (USA)

10:40 am: **Leveraging lidar data to aid in HSI target detection in the radiance domain**, Emmett Ientilucci, Rochester Institute of Technology (USA); Peter Kopacz, ITT Corp. Geospatial Systems (USA) [8390-06]

11:00 am: **Multisensor analysis of a simultaneously acquired LiDAR and VISNIR hyperspectral data set**, Paul Gader, Ryan Close, Univ. of Florida (USA); Alina Zare, Univ. of Missouri-Columbia (USA); Dmitri Dranishnikov, Univ. of Florida (USA) [8390-07]

11:20 am: **Blob-level active passive data fusion for Benthic classification**, Joong Yong Park, Hemanth Kalluri, Abhinav Mathur, Vinod Ramnath, Minsu Kim, Jennifer Aitken, Viktor Feygels, Optech International, Inc. (USA); Grady H. Tuell, Georgia Tech Research Institute (USA) [8390-08]

11:40 am: **Characterization of aquatic benthic reflectance using fused SHOALS and CASI airborne data and in situ spectral data**, Jennifer Aitken, Joong Yong Park, Molly K. Reif, Minsu Kim, Optech International, Inc. (USA) [8390-09]

Lunch Break 12:00 to 1:00 pm

SESSION 3

Room: Conv. Ctr. 327 Mon. 1:00 to 3:00 pm

Spectral Methodologies and Applications

Session Chair: **Miguel Velez-Reyes**, Univ. de Puerto Rico Mayagüez (USA)

1:00 pm: **An automatic detection software for differential reflection spectroscopy**, Seniha E. Yuksel, Thierry A. Dubroca, Rolf E. Hummel, Paul Gader, Univ. of Florida (USA) [8390-10]

1:20 pm: **A multitemporal analysis approach for land cover analysis in support of nuclear incident response**, Shagan Sah, Jan van Aardt, Donald McKeown, Rochester Institute of Technology (USA) [8390-11]

1:40 pm: **Man-made activity detection in hyperspectral imaging: performance analysis of different algorithms**, Roeie Enbar, Gil Sharon, Stanley R. Rotman, Ben-Gurion Univ. of the Negev (Israel); Ariel Schlamm, David Messinger, Rochester Institute of Technology (USA) [8390-12]

2:00 pm: **Measurements of laminar flames with mid- and long-wave infrared imaging Fourier-transform spectrometers**, Michael Rhohey, Kevin C. Gross, Air Force Institute of Technology (USA) [8390-13]

2:20 pm: **EO-1 Hyperion spectral time series for vegetation assessment and system comparison**, Petya K. E. Campbell, Elizabeth M. Middleton, NASA Goddard Space Flight Ctr. (USA) [8390-14]

2:40 pm: **Methods for estimating forest stem volumes by tree species using digital surface model and CIR images taken from light UAS**, Heikki Salo, Ismo J. Pellikka, Ville Tirronen, Univ. of Jyväskylä (Finland); Sakari Tuominen, Andras Balazs, Finnish Forest Research Institute (Finland); Jan Heikkilä, PIEngeering Ltd. (Finland); Heikki Saari, VTT Technical Research Ctr. of Finland (Finland) [8390-15]

Coffee Break 3:00 to 3:30 pm

SESSION 4

Room: Conv. Ctr. 327 Mon. 3:30 to 4:50 pm

Modeling and Simulation

Session Chair: **David Messinger**, Rochester Institute of Technology (USA)

3:30 pm: **DIRSIG 5: core design and implementation**, Adam A. Goodenough, Scott D. Brown, Rochester Institute of Technology (USA) [8390-16]

3:50 pm: **Parking lot process model incorporated DIRSIG scene simulation**, Jiangqin Sun, David Messinger, Rochester Institute of Technology (USA) [8390-17]

4:10 pm: **Geo-accurate primitive extraction from three-dimensional, image-derived point clouds**, David R. Nilosek, Carl Salvaggio, Rochester Institute of Technology (USA) [8390-18]

4:30 pm: **Evaluation of image collection requirements for 3D reconstruction using photogrammetry techniques on sparse overhead data**, Erin Ontiveros, Rochester Institute of Technology (USA) [8390-19]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 5

Room: Conv. Ctr. 327 Tues. 8:20 to 10:20 am

Commercial Spectral Remote Sensing: WorldView-2 and Its Applications I

Session Chair: Giovanni Marchisio, DigitalGlobe Inc. (USA)

8:20 am: **WorldView-2 and the evolution of the DigitalGlobe Remote Sensing Satellite Constellation** (*Invited Paper*), Neal T. Anderson, Giovanni B. Marchisio, DigitalGlobe, Inc. (USA) [8390-20]

9:00 am: **Improving the automated detection of refugee/IDP dwellings using the multispectral bands of the WorldView-2 satellite**, Thomas Kemper, European Commission Joint Research Ctr. (Italy); Malgorzata Jenerowicz, Space Research Ctr. (Poland); Martino Pesaresi, Pierre Soille, European Commission Joint Research Ctr. (Italy) [8390-21]

9:20 am: **Using WorldView-2 Vis-NIR MSI imagery to support land mapping and feature extraction using normalized difference index ratios**, Antonio Wolf, Ball Corp. (USA) [8390-22]

9:40 am: **Mapping urban vegetation cover using WorldView-2 imagery**, François Cavayas, Yuddy Ramos, André Boyer, Univ. de Montréal (Canada) [8390-23]

10:00 am: **Automating nearshore bathymetry extraction from wave motion in satellite optical imagery**, Steven Mancini, National Geospatial-Intelligence Agency (USA); Richard C. Olsen, Naval Postgraduate School (USA); Ronald Abileah, jOmegak (USA) [8390-100]

Coffee Break 10:20 to 10:50 am

SESSION 6

Room: Conv. Ctr. 327 Tues. 10:50 am to 12:30 pm

Advancements in Spectral Sensor Technologies

Session Chair: Paul E. Lewis, National Geospatial-Intelligence Agency (USA)

10:50 am: **A LWIR hyperspectral imager using a Sagnac interferometer and cooled HgCdTe detector array**, Paul G. Lucey, Tim Williams, Univ. of Hawai'i (USA); John Hinrichs, Spectrum Photonics, Inc. (USA) [8390-25]

11:10 am: **A compact LWIR hyperspectral system employing a microbolometer array and a variable gap Fabry-Perot interferometer employed as a Fourier transform spectrometer**, Paul G. Lucey, Univ. of Hawai'i (USA); John Hinrichs, Jason Akagi, Spectrum Photonics, Inc. (USA) [8390-26]

11:30 am: **Spectral polarimetric imaging in the infrared**, David B. Chenault, Joseph L. Pezzaniti, John S. Harchanko, Polaris Sensor Technologies, Inc. (USA) [8390-27]

11:50 am: **Snapshot hyperspectral fovea vision system**, Jason M. Kriesel, Nahum Gat, Opto Knowledge Systems, Inc. (USA); Sheela Nagaraj, Venkataraman Swaminathan, U.S. Army Armament Research, Development and Engineering Ctr. (USA) [8390-28]

12:10 pm: **Combination of a near-infrared, dispersive spectral imager and of a visible static Fourier transform spectral imager**, Yann Ferrec, ONERA (France) [8390-29]

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

SESSION 7

Room: Conv. Ctr. 327 Tues. 1:30 to 3:30 pm

Atmospheric Correction Methodologies

Session Chair: Gail P. Anderson, Air Force Research Lab. (USA)

1:30 pm: **High-speed atmospheric correction for spectral image processing**, Timothy Perkins, Steven M. Adler-Golden, Spectral Sciences, Inc. (USA); Patrice Cappelaere, Vigtel Corp. (USA); Daniel Mandl, NASA Goddard Space Flight Ctr. (USA) [8390-30]

1:50 pm: **Atmospheric compensation for WorldView-2 satellite and in-water component retrieval**, Javier A. Concha, Aaron Gerace, Rochester Institute of Technology (USA) [8390-31]

2:10 pm: **An automatic atmospheric compensation algorithm for very high-spatial resolution imagery**, Fabio Pacifici, DigitalGlobe, Inc. (USA) [8390-32]

2:30 pm: **Atmospheric correction of the CASI hyperspectral image using the scattering angle by the direct solar beam**, Minsu Kim, Joong Yong Park, Jennifer Aitken, Optech International, Inc. (USA) [8390-33]

2:50 pm: **A comparison of QUAC and covariance equalization for atmospheric, solar angle, and look angle compensation in airborne multi- and hyperspectral SWIR target detection**, Michael K. Yezzbacher, Eric C. Allman, Brian J. Daniel, Alan P. Schaum, U.S. Naval Research Lab. (USA) [8390-34]

3:10 pm: **Atmospheric correction of short-wave hyperspectral imagery using a fast, full-scattering 1DVar retrieval scheme**, Jean-Claude Thelen, Stephan Havemann, Jonathan P. Taylor, Met Office (United Kingdom) [8390-35]

Coffee Break 3:30 to 4:00 pm

SESSION 8

Room: Conv. Ctr. 327 Tues. 4:00 to 5:20 pm

Spectral Signatures, Special Libraries, and Applications I

Session Chair: Fred A. Kruse, Naval Postgraduate School (USA)

4:00 pm: **Collection and quality control of spectral signatures in the field**, Brian Curtiss, ASD, Inc. (USA) [8390-36]

4:20 pm: **Spectral library generation for hyperspectral archaeological validation**, Kelly Canham, William Middleton, David Messinger, Nina G. Raqueno, Rochester Institute of Technology (USA) [8390-37]

4:40 pm: **Point source emissions mapping using airborne visible/infrared imaging spectrometer data**, Andrew K. Thorpe, Dar A. Roberts, Univ. of California, Santa Barbara (USA); Phillip E. Dennison, The Univ. of Utah (USA); Eliza S. Bradley, Christopher C. Funk, Univ. of California, Santa Barbara (USA) [8390-38]

5:00 pm: **Spectroscopic remote sensing for material identification, vegetation characterization, and mapping**, Raymond F. Kokaly, U.S. Geological Survey (USA) [8390-39]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Application of probabilistic graphical models for feature-based detection of invasive alien plants from WorldView-2 satellite imagery, Wisdom M. Dlamini, Swaziland National Trust Commission (Swaziland) [8390-92]

DSP design for real-time hyperspectral target detection based on spatial-spectral information extraction, Wei Yang, Bing Zhang, Lianru Gao, Yuanfeng Wu, Ctr. for Earth Observation and Digital Earth (China) [8390-93]

A target segmentation algorithm based on multivariate statistics and RX anomaly detection, Qiangdong Guo, Bing Zhang, Lianru Gao, Xu Sun, Wenjuan Zhang, Ctr. for Earth Observation and Digital Earth (China) [8390-94]

Vehicle detection in WorldView-2 satellite imagery based on Gaussian modeling and contextual learning, Bichuan Shen, Chi-Hau Chen, Univ. of Massachusetts Dartmouth (USA); Giovanni Marchisio, DigitalGlobe, Inc. (USA) [8390-95]

Data-driven ultrasonic signal analysis using empirical mode decomposition for nondestructive material evaluation, Bichuan Shen, Chi-Hau Chen, Univ. of Massachusetts Dartmouth (USA) [8390-96]

Developing high-resolution clutter for wireless network propagation using WorldView-2 imagery, Batsirai B. Gwata, ComputaMaps (South Africa) [8390-97]

New feature for evaluation of supervised classification, Antoine Masse, Danielle Ducrot, Ctr. d'Etudes Spatiales de la Biosphère (France); Philippe Marthon, Ecole Nationale Supérieure d'Electrotechnique, Electronique, Informatique, Hydraulique et des Téléco (France) [8390-98]

Wednesday 25 April

SESSION 9

Room: Conv. Ctr. 327 Wed. 8:10 to 10:30 am

Spectral Data Analysis Methodologies I

Session Chair: Miguel Velez-Reyes, Univ. de Puerto Rico Mayagüez (USA)

8:10 am: **Data model, LUT-based change and anomaly detection for real-time multispectral image characterization**, Holger M. Jaenisch, Licht Strahl Engineering, Inc. (USA) and Johns Hopkins Univ. (USA); James W. Handley, Licht Strahl Engineering, Inc. (USA) [8390-40]

8:30 am: **Extended development of model-based change detection**, Joseph Meola, Air Force Research Lab. (USA) [8390-41]

8:50 am: **Developing a portable GPU library for hyperspectral image processing**, Gabriel J. Perez-Irizarry, Francisco De La Cruz-Sanchez, Nayda G. Santiago-Santiago, Miguel Velez-Reyes, Univ. de Puerto Rico Mayagüez (USA) [8390-42]

9:10 am: **Development of an efficient, automated hyperspectral processing system using embedded computing**, Matthew S. Brown, Eli Glaser, Joe Curreri, Scott Grassinger, Mark Z. Salvador, Logos Technologies, Inc. (USA) ... [8390-43]

9:30 am: **Integrating spectral preprocessing, spatial subband decomposition, and linear prediction to accomplish lossy ultraspectral image compression**, Rolando Herrero, Vinay K. Ingle, Northeastern Univ. (USA) [8390-44]

9:50 am: **Hyperspectral imaging using compressed sensing**, Gabriel Ramirez, Vidya B. Manian, Univ. de Puerto Rico Mayagüez (USA) [8390-45]

10:10 am: **Computational modeling of skin reflectance spectra for biological parameter estimation through machine learning**, Saurabh Vyas, The Johns Hopkins Univ. Applied Physics Lab. (USA); Hien Van Nguyen, Univ. of Maryland, College Park (USA); Amit Banerjee, The Johns Hopkins Univ. Applied Physics Lab. (USA); Luis Garza, The Johns Hopkins Univ. (USA); Philippe Burlina, The Johns Hopkins Univ. Applied Physics Lab. (USA); Rama Chellappa, Univ. of Maryland, College Park (USA) [8390-99]

Coffee Break 10:30 to 11:00 am

SESSION 10

Room: Conv. Ctr. 327 Wed. 11:00 am to 12:20 pm

Spectral Signatures, Special Libraries, and Applications II

Session Chair: Fred A. Kruse, Naval Postgraduate School (USA)

11:00 am: **Hyperspectral measurements of natural signatures: pedestrians**, Jared Herweg, John P. Kerekes, Rochester Institute of Technology (USA); Michael T. Eismann, Air Force Research Lab. (USA) [8390-47]

11:20 am: **Linking goniometer measurements to hyperspectral and multisensor imagery for retrieval of beach properties and coastal characterization**, Charles Bachmann, Deric J. Gray, Andrei Abelev, U.S. Naval Research Lab. (USA); William Philpot, Cornell Univ. (USA); Marcos Montes, Robert Fusina, U.S. Naval Research Lab. (USA); Joseph Musser, Stephen F. Austin State Univ. (USA); Rong-Rong Li, Michael Vermillion, Geoffrey B. Smith, Daniel Korwan, Charlotte Snow, David Miller, Joan Gardner, Mark Sletten, U.S. Naval Research Lab. (USA); Georgi Georgiev, NASA Goddard Space Flight Ctr. (USA); Barry Truitt, Marcus Killmon, The Nature Conservancy (USA); Jon Sellars, Jason Woolard, Christopher Parrish, National Oceanic and Atmospheric Administration (USA); Arthur Schwarzschild, Univ. of Virginia (USA) [8390-48]

11:40 am: **High-spatial and high-spectral thermal infrared remote sensing at the Jet Propulsion Laboratory**, Simon J. Hook, Jet Propulsion Lab. (USA) [8390-49]

12:00 pm: **Spectral-feature-based analysis of reflectance and emission spectral libraries and imaging spectrometer data**, Fred A. Kruse, Naval Postgraduate School (USA) [8390-50]

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

SESSION 11

Room: Conv. Ctr. 327 Wed. 1:20 to 3:00 pm

Commercial Spectral Remote Sensing: WorldView-2 and Its Applications II

Session Chair: Giovanni Marchisio, DigitalGlobe, Inc. (USA)

1:20 pm: **Automated tracking of flooding using WorldView-2 imagery**, Joshua Doubleday, Steve Chien, Jet Propulsion Lab. (USA) [8390-51]

1:40 pm: **Automatic identification of volcanic ash plumes in multilook multispectral WorldView-2 imagery**, David R. Thompson, Steve Chien, Jet Propulsion Lab. (USA) [8390-52]

2:00 pm: **Using multi-angle WorldView-2 imagery to determine ocean depth near the island of Oahu, Hawaii**, Krista R. Lee, Richard C. Olsen, Fred A. Kruse, Naval Postgraduate School (USA) [8390-53]

2:20 pm: **Shallow water benthic mapping with WV02**, Grzegorz Miecznik, DigitalGlobe, Inc. (USA) [8390-54]

2:40 pm: **Refinement of a method for identifying probable archaeological sites from remotely sensed data**, James C. Tilton, NASA Goddard Space Flight Ctr. (USA); Douglas C. Comer, Cultural Site Research and Management (USA); Carey E. Priebe, Daniel Sussman, The Johns Hopkins Univ. (USA) [8390-55]

Coffee/Exhibition Break 3:00 to 4:00 pm

SESSION 12

Room: Conv. Ctr. 327 Wed. 4:00 to 5:20 pm

Spectral Unmixing

Session Chair: Michael T. Eismann, Air Force Research Lab. (USA)

4:00 pm: **Using physics-based macroscopic and microscopic mixture models for hyperspectral pixel unmixing**, Ryan Close, Paul Gader, Joseph N. Wilson, Univ. of Florida (USA) [8390-56]

4:20 pm: **Priors in sparse recursive decompositions of hyperspectral imagery**, Nicolas Gillis, Univ. of Waterloo (Canada); Robert J. Plemmons, Wake Forest Univ. (USA); Qiang Zhang, Wake Forest Univ. School of Medicine (USA) [8390-57]

4:40 pm: **Incorporating local information in unsupervised hyperspectral unmixing**, Miguel Goenaga-Jimenez, Miguel Velez-Reyes, Univ. de Puerto Rico Mayagüez (USA) [8390-58]

5:00 pm: **Endmember extraction for hyperspectral image unmixing using multiscale segmentation**, María C. Torres-Madronero, Miguel Velez-Reyes, Univ. de Puerto Rico Mayagüez (USA) [8390-59]

Thursday 26 April

SESSION 13

Room: Conv. Ctr. 327 Thurs. 8:20 to 10:00 am

Clustering and Classification

Session Chair: Michael T. Eismann, Air Force Research Lab. (USA)

8:20 am: **A spectral image clustering algorithm based on ant colony optimization**, Luca W. Ashok, Univ. of Rochester (USA); David W. Messinger, Rochester Institute of Technology (USA) [8390-60]

8:40 am: **Hyperspectral image segmentation using spatial-spectral graphs**, David B. Gillis, Jeffrey H. Bowles, U.S. Naval Research Lab. (USA) [8390-61]

9:00 am: **Kernel-based joint spectral and spatial exploitation using a Hilbert space embedding for hyperspectral classification**, Prudhvi Gurrum, Heesung Kwon, U.S. Army Research Lab. (USA) [8390-62]

9:20 am: **Automatically enumerating data clusters using pixel codensity**, Ryan A. Mercovich, Rochester Institute of Technology (USA) [8390-63]

9:40 am: **Crop classification in Afghanistan using high-resolution, multispectral imagery**, Ranga R. Vatsavai, Budhendra Bhaduri, Oak Ridge National Lab. (USA) [8390-64]

Coffee Break 10:00 to 10:30 am

Conference 8390 · Room: Conv. Ctr. 327

SESSION 14

Room: Conv. Ctr. 327 Thurs. 10:30 am to 12:10 pm

Commercial Spectral Remote Sensing: WorldView-2 and Its Applications III

Session Chair: Giovanni Marchisio, DigitalGlobe, Inc. (USA)

- 10:30 am: **Feature extraction, anomaly, and change detection on WorldView-2 imagery by hierarchical image segmentation: a study**, Lakshman Prasad, James Theiler, Los Alamos National Lab. (USA) [8390-65]
- 10:50 am: **Multispectral land-cover model portability analysis using multi-angle very high-spatial-resolution data**, Nathan Longbotham, Univ. of Colorado at Boulder (USA); Fabio Pacifici, DigitalGlobe, Inc. (USA); William J. Emery, Univ. of Colorado at Boulder (USA) [8390-66]
- 11:10 am: **An automated approach for constructing road network graph from multispectral images**, Weihua Sun, David Messenger, Rochester Institute of Technology (USA) [8390-67]
- 11:30 am: **Fusing stereo and multispectral data from WorldView-2 for urban modeling**, Thomas Krauss, Peter Reinartz, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) [8390-68]
- 11:50 am: **Detection of compound structures using a Gaussian mixture model with spectral and spatial constraints**, Caglar Ari, Selim Aksoy, Bilkent Univ. (Turkey) [8390-69]
- Lunch/Exhibition Break 12:10 to 1:10 pm

SESSION 15

Room: Conv. Ctr. 327 Thurs. 1:10 to 3:30 pm

Spectral Data Analysis Methodologies II

Session Chair: David Messenger,
Rochester Institute of Technology (USA)

- 1:10 pm: **Assessing the impact of background spectral graph construction techniques on the topological anomaly detection algorithm**, Amanda K. Ziemann, David Messenger, James A. Albano, William Basener, Rochester Institute of Technology (USA) [8390-70]
- 1:30 pm: **Anomaly and target detection by means of non parametric density estimation**, Gil A. Tidhar, Stanley R. Rotman, Ben-Gurion Univ. of the Negev (Israel) [8390-71]
- 1:50 pm: **Target detection in hyperspectral imagery with singular covariance matrices**, Nir Gorelik, Dan G. Blumberg, Stanley R. Rotman, Ben-Gurion Univ. of the Negev (Israel) [8390-72]
- 2:10 pm: **Simultaneous spectral/spatial detection of edges for hyperspectral imagery: the HySPADE algorithm revisited**, Ronald G. Resmini, The MITRE Corp. (USA) [8390-73]
- 2:30 pm: **Autonomous target-dependent waveband selection for tracking in performance-driven hyperspectral sensing**, Sabino M. Gadaleta, Numerica Corp. (USA); John P. Kerekes, Rochester Institute of Technology (USA); Kyle M. Tarplee, Numerica Corp. (USA) [8390-74]
- 2:50 pm: **Application specific band selection with multivariate methods of analysis for a-Si:H multispectral photodiodes**, Christian Merfort, Andreas Babilich, Univ. Siegen (Germany); Oliver Schwaneberg, Hochschule Bonn-Rhein-Sieg (Germany); Krystian Watty, Markus Boehm, Univ. Siegen (Germany) [8390-75]
- 3:10 pm: **A new compact representation of morphological profiles: report on first massive VHR image data processing at the JRC**, Martino Pesaresi, Georgios Ouzounis, Lionel Gueguen, European Commission Joint Research Ctr. (Italy) [8390-76]
- Coffee Break 3:30 to 4:00 pm

SESSION 16

Room: Conv. Ctr. 327 Thurs. 4:00 to 5:20 pm

Multisensor Data Fusion II

Session Chair: Grady H. Tuell, Georgia Tech Research Institute (USA)

- 4:00 pm: **Remote sensing of shorelines using data fusion of hyperspectral and multispectral imagery aquired from mobile and fixed platforms**, Charles R. Bostater, Jr., Florida Institute of Technology (USA) [8390-77]
- 4:20 pm: **Integration of heterogeneous data for classification in remote sensing imagery**, John J. Benedetto, Wojciech Czaja, Julia Dobrosotskaya, Timothy Doster, Kevin Duke, Univ. of Maryland, College Park (USA); David Gillis, U.S. Naval Research Lab. (USA) [8390-78]
- 4:40 pm: **SpectTIR hyperspectral airborne Rochester experiment data collection campaign**, Jared Herweg, John P. Kerekes, Rochester Institute of

Technology (USA); Oliver Weatherbee, SpecTIR, LLC (USA); David Messenger, Jan van Aardt, Emmett Ientilucci, Zoran Ninkov, Carl Salvaggio, Nina G. Raqueno, Jason Faulring, Rochester Institute of Technology (USA); Joseph Meola, Air Force Research Lab. (USA) [8390-79]

5:00 pm: **IMAGESEER: images for science, education, experimentation and research: a NASA database of benchmark images for image processing teaching and research**, Jacqueline J. Le Moigne, Thomas G. Grubb, Barbara C. Milner, NASA Goddard Space Flight Ctr. (USA) [8390-80]

Friday 27 April

SESSION 17

Room: Conv. Ctr. 327 Fri. 8:20 to 10:20 am

Spectral Sensor Characterization and Calibration

Session Chair: Paul E. Lewis,
National Geospatial-Intelligence Agency (USA)

- 8:20 am: **Using DIRSIG to identify uniform sites and demonstrate the utility of the side-sliiter calibration technique for Landsat's new pushbroom sensors**, Aaron Gerace, John R. Schott, Scott D. Brown, Michael G. Gartley, Rochester Institute of Technology (USA) [8390-81]
- 8:40 am: **On-orbit radiometric calibration of Earth-observing sensors using the radiometric calibration test site (RadCaTS)**, Jeffrey S. Czaplá-Myers, Nathan P. Leisso, Nikolaus J. Anderson, Stuart F. Biggar, College of Optical Sciences, The Univ. of Arizona (USA) [8390-82]
- 9:00 am: **Tracking nonuniformity in the thermal infrared sensor through pre-launch measurements and simulated on-orbit data**, Matthew Montanaro, Sigma Space Corp. (USA) and NASA Goddard Space Flight Center (USA); Aaron D. Gerace, Rochester Institute of Technology (USA) [8390-83]
- 9:20 am: **Evaluation of nighttime imaging limits of visible near-infrared earth observation platforms**, Aaron D. Gerace, Michael G. Gartley, Rochester Institute of Technology (USA) [8390-84]
- 9:40 am: **Simulation and experimental results of a chromotomographic hyperspectral imager**, Chad Su'e, Michael Hawks, Bella Yao, Air Force Institute of Technology (USA) [8390-85]
- 10:00 am: **Tradeoff between misregistration and resampling in design of spectral imaging sensors**, Torbjorn Skauli, Norwegian Defence Research Establishment (Norway) [8390-86]
- Coffee Break 10:20 to 10:50 am

SESSION 18

Room: Conv. Ctr. 327 Fri. 10:50 am to 12:30 pm

Detection, Identification, and Quantification II

Session Chair: Sylvia S. Shen, The Aerospace Corp. (USA)

- 10:50 am: **Euclidean commute time distance embedding and its application to spectral anomaly detection**, James A. Albano, David Messenger, Rochester Institute of Technology (USA) [8390-87]
- 11:10 am: **Statistical methods for chemical plume identification and false alarm mitigation**, Andrew Lai, Northeastern Univ. (USA); Steven Golowich, Dimitris Manolakis, MIT Lincoln Lab. (USA) [8390-88]
- 11:30 am: **Algorithms for remote quantification of chemical plumes: a comparative study**, Sidi Niu, Northeastern Univ. (USA); Steven Golowich, Dimitris Manolakis, MIT Lincoln Lab. (USA) [8390-89]
- 11:50 am: **Comparative evaluation of hyperspectral anomaly detectors in different types of background**, Dirk C. Borghys, Royal Belgian Military Academy (Belgium); Ingebjörg Kåsen, Norwegian Defence Research Establishment (Norway); Véronique Achard, ONERA (France); Christiaan Perneel, Royal Belgian Military Academy (Belgium) [8390-90]
- 12:10 pm: **Target detection in hyperspectral images: a comparative study of ICA and other algorithms**, Kailash C. Tiwari, Bharati Vidyapeeth's College of Engineering (India); Manoj K. Arora, Dharmendra P. Singh, Indian Institute of Technology Roorkee (India) [8390-91]

Courses of Related Interest

- SC194 **Multispectral and Hyperspectral Image Sensors** (Lomheim) Tuesday, 1:30 to 5:30 pm
- SC995 **Target Detection Algorithms for Hyperspectral Imagery** (Nasrabadi) Thursday, 8:30 am to 5:30 pm
- SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Wednesday, 8:30 am to 5:30 pm
- SC158 **Fundamentals of Automatic Target Recognition** (Sadjadi) Wednesday, 8:30 am to 5:30 pm
- See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Automatic Target Recognition XXII

Conference Chairs: **Firooz A. Sadjadi**, Lockheed Martin Maritime Systems & Sensors (USA); **Abhijit Mahalanobis**, Lockheed Martin Missiles and Fire Control (USA)

Program Committee: **Mohammad Showkat Alam**, Univ. of South Alabama (USA); **Farid Amoozegar**, Jet Propulsion Lab. (USA); **Mahmood R. Azimi-Sadjadi**, Colorado State Univ. (USA); **David P. Casasent**, Carnegie Mellon Univ. (USA); **Leon Cohen**, Hunter College (USA); **Frederick D. Garber**, Wright State Univ. (USA); **Guillermo C. Gaunaud**, Consultant (USA); **Izidor Gertner**, The City College of New York (USA); **Patti S. Gillespie**, U.S. Army Research Lab. (USA); **Riad I. Hammoud**, Delphi Corp. (USA); **Bahram Javidi**, Univ. of Connecticut (USA); **Ismail I. Jouny**, Lafayette College (USA); **Behzad Kamgar-Parsi**, U.S. Naval Research Lab. (USA); **Timothy J. Klausutis**, Air Force Research Lab. (USA); **Wolfgang Kober**, Data Fusion Corp. (USA); **Aaron D. Lanterman**, Georgia Institute of Technology (USA); **Randolph L. Moses**, The Ohio State Univ. (USA); **Robert R. Muise**, Lockheed Martin Missiles and Fire Control (USA); **Nasser M. Nasrabadi**, U.S. Army Research Lab. (USA); **Les Novak**, Scientific Systems Co., Inc. (USA); **Joseph A. O'Sullivan**, Washington Univ. in St. Louis (USA); **Mubarak Ali Shah**, Univ. of Central Florida (USA); **Alan J. Van Nevel**, Naval Air Warfare Ctr. Aircraft Div. (USA); **Bradley C. Wallet**, Automated Decisions LLC (USA); **Edmund G. Zelnio**, Air Force Research Lab. (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 328 Mon. 8:30 to 10:10 am

IR-Based ATR

Session Chair: **Firooz A. Sadjadi**, Lockheed Martin Maritime Systems & Sensors (USA)

8:30 am: **Hybrid methodology for the detection, tracking, and classification of humans in difficult infrared video imagery**, James R. Bonick, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8391-01]

8:50 am: **Improving FLIR ATR performance in a turbulent atmosphere with a moving platform**, Bruce J. Schachter, Dustin D. Baumgartner, Northrop Grumman Electronic Systems (USA) [8391-02]

9:10 am: **Time series modeling for automatic target recognition**, Andre U. Sokolnikov, Visual Solutions and Applications (USA) [8391-03]

9:30 am: **Robust automatic target recognition in FLIR imagery**, Yusuf Soyman, Roketsan A.S. (Turkey) [8391-05]

9:50 am: **Seeing through degraded visual environment**, Firooz A. Sadjadi, Lockheed Martin Maritime Systems & Sensors (USA) [8391-06]

Coffee Break 10:10 to 10:40 am

SESSION 2

Room: Conv. Ctr. 328 Mon. 10:40 am to 12:00 pm

Advances in Radar-Based ATR I

Session Chair: **Abhijit Mahalanobis**, Lockheed Martin Missiles and Fire Control (USA)

10:40 am: **TBD (Keynote Presentation)**, Jennifer C. Ricklin, Air Force Research Lab. (USA) [8391-07]

11:20 am: **Detection of dielectric objects using polarimetric invariants in forward-looking ground penetrating radar**, Cornell S. Chun, Ethan H. Y. Chun, Physics Innovations Inc. (USA) [8391-08]

11:40 am: **Analysis of vehicle vibration sources for automatic differentiation between gas and diesel piston engines**, Kevin J. Sigmund, Stuart Shelley, Etegent Technologies, Ltd. (USA) [8391-09]

Lunch Break 12:00 to 1:30 pm

SESSION 3

Room: Conv. Ctr. 328 Mon. 1:30 to 2:30 pm

Advances in Radar-Based ATR II

Session Chair: **Charles F. Hester**, U.S. Army Research, Development and Engineering Command (USA)

1:30 pm: **Locating emitters using a cross-spectral cross-ambiguity function (CSCAF)**, Douglas J. Nelson, National Security Agency (USA) [8391-10]

1:50 pm: **Radar target recognition using non-cooperative scatterer matching game**, Ismail I. Jouny, Lafayette College (USA) [8391-11]

2:10 pm: **Maritime target identification in flash-ladar imagery**, Walter Armbruster, Marcus Hammer, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [8391-12]

SESSION 4

Room: Conv. Ctr. 328 Mon. 2:30 to 3:30 pm

Advances in Acoustic Processing

Session Chair: **Leon Cohen**, Hunter College (USA)

2:30 pm: **Dispersion-invariant features for classification of objects from their acoustic backscatter in a range-dependent channel**, Vikram T. Gomatam, Patrick J. Loughlin, Univ. of Pittsburgh (USA) [8391-13]

2:50 pm: **Relating two probability distributions and an application to the Rayleigh distribution**, Leon Cohen, Hunter College (USA) [8391-14]

3:10 pm: **The scintillation index for reverberation noise**, Leon Cohen, Affa Ahmad, Hunter College (USA) [8391-15]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 5

Room: Conv. Ctr. 328 Tues. 8:00 to 11:30 am

Advances in Algorithms for ATR I

Session Chair: Bruce J. Schachter,
Northrop Grumman Electronic Systems (USA)

8:00 am: **Automated recognition challenges for wide-area motion imagery**
(Invited Paper), Kevin L. Priddy, Air Force Research Lab. (USA) [8391-16]

8:40 am: **ATR solutions for a single class using affine transformations on a union of subspaces model**, Charles F. Hester, U.S. Army Research, Development and Engineering Command (USA) [8391-17]

9:00 am: **Spatio-temporal features for tracking and quadruped/biped discrimination**, Rick Rickman, David C. Bamber, Waterfall Solutions Ltd. (United Kingdom) [8391-18]

9:20 am: **Robust model-based object recognition using a dual-hierarchy graph**, Isaac Weiss, Univ. of Maryland, College Park (USA) [8391-19]

9:40 am: **Improved watercraft detection in short-wave infrared imagery using tailored sparse representations**, Colin C. Olson, Sotera Defense Solutions, Inc. (USA); K. P. Judd, U.S. Naval Research Lab. (USA); Krishnan Chander, A. J. Smith, V Systems, Inc. (USA); Max Conant, Jonathan Nichols, U.S. Naval Research Lab. (USA) [8391-20]

Coffee Break 10:00 to 10:30 am

10:30 am: **Multicue object detection and tracking for security in complex environments**, Unaiza Ahsan, Sohail Abdul Sattar, NED Univ. of Engineering and Technology (Pakistan); Humera Noor, Technische Univ. München (Germany); Munzir Zafar, Georgia Institute of Technology (USA) [8391-21]

10:50 am: **High-range-resolution (HRR) ATR via non-negative matrix approximations**, Vahid R. Riasati, MacAulay-Brown, Inc. (USA); Umamahesh Srinivas, Vishal Monga, Pennsylvania State Univ. (USA) [8391-22]

11:10 am: **Sensor agnostic object recognition using a map seeking circuit**, Timothy L. Overman, Lockheed Martin Space Systems Co. (USA); Michael Hart, Hart Scientific Consulting International L.L.C. (USA) [8391-23]

Award Presentation
Room: Conv. Ctr. 328 Tues. 11:30 am to 12:00 pm
Best Student Paper Award
Sponsored by:


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

SESSION 6

Room: Conv. Ctr. 328 Tues. 1:00 to 2:40 pm

Advances in Algorithms for ATR II

Session Chair: Izidor Gertner, The City College of New York (USA)

1:00 pm: **Image reconstruction and target acquisition through compressive sensing**, Matthew M. Suttinger, Univ. of Central Florida (USA); Robert R. Muise, Lockheed Martin Missiles and Fire Control (USA) [8391-24]

1:20 pm: **The incredible shrinking covariance estimator**, James Theiler, Los Alamos National Lab. (USA) [8391-25]

1:40 pm: **Design and implementation of a wireless geophone sensor node for target detection and classification**, Mussab Zubair, Klaus Hartmann, Univ. Siegen (Germany) [8391-26]

2:00 pm: **Feature-level fusion of multiple target detection results in hyperspectral image based on RX detector**, Xu Sun, Bing Zhang, Ctr. for Earth Observation and Digital Earth (China); Lina Yang, Institute of Remote Sensing Applications (China); Lianru Gao, Wenjuan Zhang, Ctr. for Earth Observation and Digital Earth (China) [8391-27]

2:20 pm: **A method for constructing an orthonormal basis from Gaussian**, Izidor Gertner, The City College of New York (USA) [8391-28]

Presentation of Interest to ATR Attendees
Room: Conv. Ctr. 326 Tues. 2:40 pm

This presentation is part of Conference 8384: Three-Dimensional Imaging, Visualization, and Display 2012.

2:40 pm: **Multiple objects tracking in unknown background using Bayesian estimation in 3D space**, Yige Zhao, Bahram Javidi, Univ. of Connecticut (USA) [8384-13]

Courses of Related Interest

- SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Wednesday, 8:30 am to 5:30 pm
 - SC158 **Fundamentals of Automatic Target Recognition** (Sadjadi) Wednesday, 8:30 am to 5:30 pm
- See *Course Materials Desk*, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Signal Processing, Sensor Fusion, and Target Recognition XXI

Conference Chair: **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA)

Program Committee: **Mark G. Alford**, Air Force Research Lab. (USA); **William D. Blair**, Georgia Tech Research Institute (USA); **Erik P. Blasch**, Air Force Research Lab. (USA); **Mark J. Carlotto**, General Dynamics Advanced Information Systems (USA); **Kuo-Chu Chang**, George Mason Univ. (USA); **Chee-Yee Chong**, BAE Systems (USA); **Marvin N. Cohen**, Georgia Tech Research Institute (USA); **Frederick E. Daum**, Raytheon Co. (USA); **Mohammad Farooq**, AA Scientific Consultants Inc. (Canada); **Charles W. Glover**, Oak Ridge National Lab. (USA); **I. R. Goodman**, Consultant (USA); **Lynne L. Grewe**, California State Univ., East Bay (USA); **David L. Hall**, The Pennsylvania State Univ. (USA); **Michael L. Hinman**, Air Force Research Lab. (USA); **Kenneth Hintz**, George Mason Univ. (USA); **Jon S. Jones**, Air Force Research Lab. (USA); **Thiagalingam Kirubarajan**, McMaster Univ. (Canada); **Martin E. Liggins II**, The MITRE Corp. (USA); **James Llinas**, Univ. at Buffalo (USA); **Ronald P. Mahler**, Lockheed Martin Maritime Systems & Sensors (USA); **Raj P. Malhotra**, Air Force Research Lab. (USA); **Alastair D. McAulay**, Lehigh Univ. (USA); **Raman K. Mehra**, Scientific Systems Co., Inc. (USA); **Harley R. Myler**, Lamar Univ. (USA); **David Nicholson**, BAE Systems (United Kingdom); **Les Novak**, Scientific Systems Co., Inc. (USA); **John J. Salerno, Jr.**, Air Force Research Lab. (USA); **Andrew G. Tescher**, AGT Associates (USA); **Stelios C. A. Thomopoulos**, National Ctr. for Scientific Research Demokritos (Greece); **Wiley E. Thompson**, New Mexico State Univ. (USA); **Pierre Valin**, Defence Research and Development Canada, Valcartier (Canada)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 329 Mon. 8:30 to 10:10 am

Multisensor Fusion, Multitarget Tracking, and Resource Management I

Session Chairs: **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA); **Thiagalingam Kirubarajan**, McMaster Univ. (Canada); **Kenneth Hintz**, George Mason Univ. (USA)

8:30 am: **Bayesian filtering in electronic surveillance**, Stefano P. Coraluppi, Craig A. Carthel, Compunetix, Inc. (USA) [8392-01]

8:50 am: **Statistical efficiency of simultaneous target and sensors localization with position dependent noise**, Richard W. Osborne III, Yaakov Bar-Shalom, Univ. of Connecticut (USA); Lance M. Kaplan, Jemin George, U.S. Army Research Lab. (USA) [8392-02]

9:10 am: **Expected track length estimation using track break statistics**, Pablo O. Arambel, Lucas Finn, BAE Systems (USA) [8392-03]

9:30 am: **Multiple model tracking for multitarget multi-Bernoulli filters**, Darcy Dunne, Thiagalingam Kirubarajan, McMaster Univ. (Canada) [8392-04]

9:50 am: **Improved multitarget tracking in clutter with ambiguous Doppler measurements**, Gongjian Zhou, McMaster Univ. (Canada) and Harbin Institute of Technology (China); Michel Pelletier, FLIR Systems Ltd. (Canada); Thiagalingam Kirubarajan, McMaster Univ. (Canada) [8392-05]

Coffee Break 10:10 to 10:30 am

SESSION 2

Room: Conv. Ctr. 329 Mon. 10:30 am to 12:30 pm

Multisensor Fusion, Multitarget Tracking, and Resource Management II

Session Chairs: **Thiagalingam Kirubarajan**, McMaster Univ. (Canada); **Kenneth Hintz**, George Mason Univ. (USA); **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA)

10:30 am: **Overview of performance assessment of multitarget tracking algorithms**, Erik P. Blasch, Air Force Research Lab. (USA); Chun Yang, Sigtem Technology, Inc. (USA); Ivan Kadar, Interlink Systems Sciences, Inc. (USA); Genshe Chen, I-Fusion Technologies, Inc. (USA); Li Bai, Temple Univ. (USA) [8392-06]

10:50 am: **Evaluation of tracking methods for maritime surveillance**, Yvonne Fischer, Marcus Baum, Karlsruhe Institut für Technologie (Germany); Fabian Flohr, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Uwe Hanebeck, Karlsruhe Institut für Technologie (Germany); Jürgen Beyerer, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) and Karlsruhe Institut für Technologie (Germany) [8392-07]

11:10 am: **Simulation of large-scale multitarget tracking scenarios using GPUs**, Yusuf Dinath, Ratnasingham Tharmarasa, McMaster Univ. (Canada); Eric Meger, exactEarth Ltd. (Canada); Pierre Valin, Defence Research and Development Canada, Valcartier (Canada); Thiagalingam Kirubarajan, McMaster Univ. (Canada) [8392-08]

11:30 am: **Utilizing information-based sensor management to reduce the power consumption of networked unattended ground sensors**, Kenneth Hintz, George Mason Univ. (USA) [8392-10]

11:50 am: **Dynamic optimization of ISR sensors using a risk-based reward function applied to ground- and space-surveillance scenarios**, Jonathan T. DeSena, Sean R. Martin, Jesse C. Clarke, Andrew J. Newman, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8392-09]

12:10 pm: **GMTI radar resource management: performance of monotone parameterized policies**, Bhashyam Balaji, Defence Research and Development Canada, Ottawa (Canada) [8392-11]

Lunch Break 12:30 to 1:30 pm

SESSION 3

Room: Conv. Ctr. 329 Mon. 1:30 to 4:40 pm

Multisensor Fusion Methodologies and Applications I

Session Chair: **Ronald Mahler**, Lockheed Martin Maritime Systems & Sensors (USA)

1:30 pm: **The random set approach for processing nontraditional measurements is rigorously Bayesian**, Ronald P. Mahler, Lockheed Martin Maritime Systems & Sensors (USA); Adel I. El-Fallah, Scientific Systems Co., Inc. (USA) [8392-12]

1:50 pm: **Spline probability hypothesis density filter**, Rajiv Sithiravel, Ratnasingham Tharmarasa, McMaster Univ. (Canada); Michael McDonald, Defence Research and Development Canada, Ottawa (Canada); Michel Pelletier, FLIR Systems Ltd. (Canada); Thiagalingam Kirubarajan, McMaster Univ. (Canada) [8392-13]

2:10 pm: **The classification-aided cardinalized probability hypothesis density (CA-CPHD) tracker**, Ramona Georgescu, Peter Willett, Univ. of Connecticut (USA) [8392-14]

2:30 pm: **Sensor management for tracking multiple ballistic missiles**, Adel I. El-Fallah, Aleksandar Zatezalo, Scientific Systems Co., Inc. (USA); Ronald P. Mahler, Lockheed Martin Maritime Systems & Sensors (USA); Raman K. Mehra, Scientific Systems Co., Inc. (USA) [8392-15]

2:50 pm: **Multiple model particle filter for missile tracking**, Aleksandar Zatezalo, Adel I. El-Fallah, Scientific Systems Co., Inc. (USA); Ronald P. Mahler, Lockheed Martin Maritime Systems & Sensors (USA); Raman K. Mehra, Scientific Systems Co., Inc. (USA) [8392-16]

Coffee Break 3:10 to 3:40 pm

3:40 pm: **Multivehicle decentralized fusion and tracking**, Adel I. El-Fallah, Aleksandar Zatezalo, Scientific Systems Co., Inc. (USA); Ronald P. Mahler, Lockheed Martin Maritime Systems & Sensors (USA); Raman K. Mehra, Scientific Systems Co., Inc. (USA) [8392-17]

4:00 pm: **Probability hypothesis density tracking for interacting vehicles in traffic**, R. K. Prasanth, Huy Hoang, BAE Systems (USA) [8392-18]

4:20 pm: **A comparison of 'clutter-agnostic' PHD/CPHD filters**, Ronald P. Mahler, Lockheed Martin Maritime Systems & Sensors (USA) [8392-19]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 4

Room: Conv. Ctr. 329 Tues. 8:00 to 10:20 am

Multisensor Fusion Methodologies and Applications II

Session Chairs: **Michael L. Hinman**, Air Force Research Lab. (USA);
Chee-Yee Chong, BAE Systems (USA);
Ivan Kadar, Interlink Systems Sciences, Inc. (USA)

8:00 am: **Spatial voting with data modeling for multiINT fusion and anomaly detection**, Holger M. Jaenisch, James W. Handley, Licht Strahl Engineering, Inc. (USA) [8392-20]

8:20 am: **Watercraft detection in cluttered littoral scenes using overcomplete target dictionaries**, Colin C. Olson, Sotera Defense Solutions, Inc. (USA); Jonathan Nichols, Leslie B. Smith, K. P. Judd, U.S. Naval Research Lab. (USA) [8392-21]

8:40 am: **Persistent maritime surveillance using multisensor feature association and classification**, Sebastiaan P. van den Broek, Piet B. W. Schwing, Ric Schleijsen, TNO Defence, Security and Safety (Netherlands) [8392-22]

9:00 am: **Target tracking using concurrent visible and infrared imageries**, Alex L. Chan, U.S. Army Research Lab. (USA); Stephen R. Schnelle, Rice Univ. (USA) [8392-23]

9:20 am: **Intelligent radiation sensor system**, Fredrick R. Facemire, Smiths Detection Edgewood (USA); Daniel Masi, Smiths Detection (USA); Steve Foote, Andy Gooden, Intelligent Optical Systems, Inc. (USA); Mark Cunningham, Lawrence Livermore National Lab. (USA); Jeffrey R. Johnson, Time Domain Corp. (USA) [8392-24]

9:40 am: **On the probability of detection for a 2D sensor array with correlated measurements**, Ghassan Maalouli, Raytheon Missile Systems (USA) . . [8392-25]

10:00 am: **Stochastic parsing of GMTI tracker data**, Bhashyam Balaji, Defence Research and Development Canada, Ottawa (Canada) [8392-26]

Coffee Break 10:20 to 10:40 am

SESSION 5

Room: Conv. Ctr. 329 Tues. 10:40 am to 12:20 pm

Multisensor Fusion Methodologies and Applications III

Session Chairs: **Erik Blasch**, Air Force Research Lab. (USA);
Chee-Yee Chong, BAE Systems (USA); **Michael L. Hinman**, Air Force Research Lab. (USA); **Kenneth Hintz**, George Mason Univ. (USA)

10:40 am: **A survey of visual analytics for knowledge discovery and content analysis**, Amir Shirkhodaie, Mohammad S. Habibi, Tennessee State Univ. (USA) [8392-27]

11:00 am: **A survey on acoustic signature recognition and classification techniques for persistent surveillance systems**, Amir Shirkhodaie, Amjad H. Alkilani, Tennessee State Univ. (USA) [8392-28]

11:20 am: **Multimodality sensor data fusion for robust tracking of group activities**, Vinayak Elangovan, Amjad H. Alkilani, Amir Shirkhodaie, Tennessee State Univ. (USA) [8392-29]

11:40 am: **Team activity analysis and recognition based on Kinect depth map and optical imagery techniques**, Vinayak Elangovan, Vinod K. Bandaru, Amir Shirkhodaie, Tennessee State Univ. (USA) [8392-30]

12:00 pm: **A goal-driven situation modeling approach for high-level information fusion**, Tian Xin, I-Fusion Technologies, Inc. (USA); Erik P. Blasch, Air Force Research Lab. (USA); Genshe Chen, DCM Research Resources, LLC (USA); Khanh D. Pham, Air Force Research Lab. (USA); Yaakov Bar-Shalom, Univ. of Connecticut (USA) [8392-31]

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

SESSION 6

Room: Conv. Ctr. 329 Tues. 1:20 to 3:20 pm

Multisensor Fusion Methodologies and Applications IV

Session Chairs: **Chee-Yee Chong**, BAE Systems (USA);
Michael L. Hinman, Air Force Research Lab. (USA);
Kenneth Hintz, George Mason Univ. (USA);
Ivan Kadar, Interlink Systems Sciences, Inc. (USA)

1:20 pm: **Fundamentals of distributed estimation and tracking**, Chee-Yee Chong, BAE Systems (USA) [8392-32]

1:40 pm: **Graphical models for tracking and fusion**, Chee-Yee Chong, BAE Systems (USA) [8392-33]

2:00 pm: **Particle filters with Coulomb's Law**, Frederick E. Daum, Jim Huang, Raytheon Co. (USA) [8392-34]

2:20 pm: **Feynman path integral discretization and its applications to nonlinear filtering**, Bhashyam Balaji, Defence Research and Development Canada, Ottawa (Canada) [8392-35]

2:40 pm: **Representations of stochastic relations via category theory**, Mark E. Oxley, Air Force Institute of Technology (USA); Jared L. Culbertson, Air Force Research Lab. (USA); Kirk E. Sturtz, Universal Mathematics (USA) [8392-36]

3:00 pm: **Feature fusion of detection systems via their ROC functions**, Mark E. Oxley, James A. Fitch, Christine M. Schubert Kabban, Air Force Institute of Technology (USA) [8392-37]

Coffee Break 3:20 to 3:50 pm

SESSION 7

Room: Conv. Ctr. 329 Tues. 3:50 to 5:50 pm

Multisensor Fusion Methodologies and Applications V

Session Chairs: **Kenneth Hintz**, George Mason Univ. (USA);
Michael L. Hinman, Air Force Research Lab. (USA);
Chee-Yee Chong, BAE Systems (USA);
Erik Blasch, Air Force Research Lab. (USA)

3:50 pm: **Label fusion of classification systems via their ROC functions**, James A. Fitch, Mark E. Oxley, Christine M. Schubert Kabban, Air Force Institute of Technology (USA) [8392-38]

4:10 pm: **Immune allied genetic algorithm for structure learning of Bayesian network**, Qin Song, Feng Lin, Zhejiang Univ. (China); Wei Sun, Kuo-Chu Chang, George Mason Univ. (USA) [8392-39]

4:30 pm: **Structure learning of Bayesian network using a chaos hybrid genetic algorithm**, Jiajie Shen, Feng Lin, Zhejiang Univ. (China); Wei Sun, Kuo-Chu Chang, George Mason Univ. (USA) [8392-40]

4:50 pm: **Fundamentals of Dempster-Shafer theory (Invited Paper)**, Joseph S. J. Peri, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8392-42]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Fast diagnosis of emergency situation by telemetry data processing with topological methods, Victor F. Dailyudenko, The United Institute of Informatics Problems (Belarus) [8392-62]

Impact point prediction for thrusting projectiles in the presence of wind, Ting Yuan, Yaakov Bar-Shalom, Peter Willett, Univ. of Connecticut (USA); David F. Hardiman, U.S. Army Research, Development and Engineering Command (USA) [8392-63]

SESSION 9

Room: Conv. Ctr. 329 Wed. 10:30 am to 12:30 pm

Signal and Image Processing, and Information Fusion Applications II

Session Chairs: **Alastair D. McAulay**, Lehigh Univ. (USA);
Lynne L. Grewe, California State Univ., East Bay (USA);
Mark G. Alford, Air Force Research Lab. (USA)

10:30 am: **Adaptive optics to enhance target recognition**, Alastair D. McAulay, Lehigh Univ. (USA) [8392-49]

10:50 am: **Detection, classification, and tracking of compact objects in video imagery**, Mark J. Carlotto, General Dynamics Advanced Information Systems (USA) [8392-50]

11:10 am: **Adaptive polarimetric change detection and interpretation based on supervised ground-cover classification using SAR and optical imagery**, Mohsen Ghazel, Jennifer Busler, Vinay Kotamraju, MacDonald, Dettwiler and Associates Ltd. (Canada); Guy Aubé, Canadian Space Agency (Canada); Corey Froese, Alberta Geological Survey (Canada) [8392-51]

11:30 am: **A novel algorithm for multimodal scene-matching, image registration, and object matching**, Richard Seely, Scott Page, Waterfall Solutions Ltd. (United Kingdom) [8392-52]

11:50 am: **Near real-time face detection and recognition using a wireless camera network**, Francesco Nicolo, Srikanth Parupati, Vinod Kulathumani, Natalia A. Schmid, West Virginia Univ. (USA) [8392-53]

12:10 pm: **Target tracking and surveillance by fusing stereo and RFID information**, Rana H. Raza, George C. Stockman, Michigan State Univ. (USA) [8392-54]

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

SESSION 10

Room: Conv. Ctr. 329 Wed. 1:30 to 3:30 pm

Signal and Image Processing, and Information Fusion Applications III

Session Chairs: **Mark G. Alford**, Air Force Research Lab. (USA);
Alastair D. McAulay, Lehigh Univ. (USA);
Lynne L. Grewe, California State Univ., East Bay (USA)

1:30 pm: **Challenge problem for ladar recognition confidence**, Adam R. Nolan, Etegent Technologies, Ltd. (USA) [8392-55]

1:50 pm: **Detection of slow-moving targets in sea clutter by HRR generalized detector**, Vyacheslav P. Tuzlukov, Kyungpook National Univ. (Korea, Republic of) [8392-60]

2:10 pm: **Morphological detectors for radar ELINT applications**, Jean-Francois Rivest, Sreeraman Rajan, Defence Research and Development Canada, Ottawa (Canada) [8392-56]

2:30 pm: **Support vector machines classification using direct eigenvector data reduction**, Vahid R. Riasati, MacAulay-Brown, Inc. (USA) [8392-57]

2:50 pm: **Detection of unusual trajectories using classificatory decomposition**, Tomasz G. Smolinski, Trevor Newell, Samantha McDaniel, Dragoljub Pokrajac, Delaware State Univ. (USA) [8392-58]

3:10 pm: **Fast methods for fusing visible/IR images and colorizing IR image with natural color appearance under sea-sky scene**, Lingxue Wang, Rongqi Chen, Bei Zhang, Yue Gao, Beijing Institute of Technology (China) [8392-61]

Courses of Related Interest

- SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Wednesday, 8:30 am to 5:30 pm
- SC158 **Fundamentals of Automatic Target Recognition** (Sadjadi) Wednesday, 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
- SC1070 **Radar Waveforms and Signal Processing** (Welstead) Thursday, 8:30 am to 12:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Invited Panel Discussion
Hilton: Holiday Ballroom 1 Tues. 7:30 to 9:45 pm

Real-World Issues and Challenges in Social/Cultural Modeling with Applications to Information Fusion

Panel Moderators: **John J. Salerno, Jr.**, Air Force Research Lab. (USA);
Ivan Kadar, Interlink Systems Sciences, Inc. (USA)

Panelists: **Erik Blasch**, Air Force Research Lab. (USA);
Mica Endsley, SA Technologies (USA);

Laurie H. Fenstermacher, Air Force Research Lab. (USA);

Lynne L. Grewe, California State Univ., East Bay (USA);

Ivan Kadar, Interlink Systems Sciences, Inc. (USA);

John J. Salerno, Jr., Air Force Research Lab. (USA);

Shanchieh Jay Yang, Rochester Institute of Technology (USA)

Panel Organizers: **John J. Salerno, Jr.**, Air Force Research Lab. (USA);
Ivan Kadar, Interlink Systems Sciences, Inc. (USA);

The panel will address salient real-world issues and challenges in bringing the human aspect into the fusion area. A number of invited experts will discuss their ideas, research and identify current challenges in bringing such information to the assessment process. Accurate situation assessment cannot be accomplished without bringing the human into the picture. For a long time the fusion community modeled physical systems and attempted to use this evidence to understand the current situation and the impact and project this situation to forecast potential impacts or threats. The human cannot be left out of this understanding since it is the human performing the actions. The objective of this panel is to bring to the attention of the fusion community, the role of social/cultural modeling, the challenges and its potential benefits. 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.

Wednesday 25 April

SESSION 8

Room: Conv. Ctr. 329 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 (USA);
Alastair D. McAulay, Lehigh Univ. (USA);
Mark G. Alford, Air Force Research Lab. (USA)

8:00 am: **Adaptive data reduction with improved information association**, Vahid R. Riasati, MacAulay-Brown, Inc. (USA) [8392-43]

8:20 am: **Combined use of backscattered and transmitted images in x-ray personnel screening systems**, Brian H. Tracey, Tufts Univ. (USA); Markus Schiefele, American Science and Engineering, Inc. (USA); Eric L. Miller, Tufts Univ. (USA); Omar Al-Kofani, Christopher V. Alvino, American Science and Engineering, Inc. (USA) [8392-44]

8:40 am: **A comparison of Landolt C and triangle resolution targets using the synthetic observer approach to sensor resolution assessment**, Alan R. Pinkus, David W. Dommett, Air Force Research Lab. (USA); H. Lee Task, Task Consulting (USA) [8392-45]

9:00 am: **Automatic multicamera calibration for deployable positioning systems**, Maria Axelsson, Mikael Karlsson, Staffan Rudner, Swedish Defence Research Agency (Sweden) [8392-46]

9:20 am: **Extended motion adaptive signal integration technique for real-time image enhancement**, David C. Zhang, SRI International Sarnoff (USA) [8392-47]

9:40 am: **Image search engine development**, Peter L. Cho, Michael Yee, MIT Lincoln Lab. (USA) [8392-48]

Coffee Break 10:00 to 10:30 am

Signal and Data Processing of Small Targets 2012

Conference Chair: **Oliver E. Drummond**, Consulting Engineer (USA)

Conference Co-Chair: **Richard D. Teichgraber**, Consulting Engineer (USA)

Program Committee: **Liyi Dai**, U.S. Army Research Office (USA); **Darren K. Emge**, U.S. Army Edgewood Chemical Biological Ctr. (USA); **Denise E. Jones**, U.S. Army Space and Missile Defense Command (USA); **Rabinder N. Madan**, Office of Naval Research (USA); **Karla K. Priestersbach**, Missile Defense Agency (USA); **Steven W. Waugh**, Defense Threat Reduction Agency (USA)

Conference Location Will Alternate Each Year

In the year 2012, this conference is located in Baltimore. Thereafter, it will alternate between San Diego in the summer in the odd years, and Baltimore in the spring in the even years.

Internet Web Posting

Program changes, workshop announcements, and the latest information about this conference will be posted on the Internet World Wide Web new site
HYPERLINK <http://odrummond.com>

Wednesday 25 April

SESSION 1

Room: Conv. Ctr. 330 Wed. 1:30 to 5:00 pm

Signal and Chem/Bio Processing

Session Chairs: **Darren K. Emge**, U.S. Army Edgewood Chemical Biological Ctr. (USA); **Steven W. Waugh**, Defense Threat Reduction Agency (USA)

1:30 pm: **Muzzle flash detection using thermoelectrically cooled linear arrays**, Mehmet Can Ertem, Roger B. Pierson, Eric Heidhausen, Bray A. Besse, Thomas Pierce, Univ. Research Foundation (USA); Jonathan Kane, Computer Optics, Inc. (USA) [8393-01]

1:55 pm: **Detecting clustered chemical/biological signals in noisy sensor feeds using adaptive fusion**, Scott Lundberg, Numerica Corp. (USA) . . . [8393-02]

2:20 pm: **Variable basis function least squares for chemical classification of surface enhanced Raman spectroscopy (SERS) data**, Darren K. Emge, U.S. Army Edgewood Chemical Biological Ctr. (USA); Steven Kay, The Univ. of Rhode Island (USA) [8393-03]

2:45 pm: **Investigation of kinematic features for dismount detection and tracking**, Ranga Narayanaswami, Anastasia Tyurina, David Diel, Raman K. Mehra, Scientific Systems Co., Inc. (USA); Janice Chinn, Air Force Research Lab. (USA) [8393-04]

Coffee/Exhibition Break. 3:10 to 4:10 pm

4:10 pm: **VNIR data processing of small (human) targets**, Dalton S. Rosario, U.S. Army Research Lab. (USA) [8393-05]

4:35 pm: **Multichannel adaptive generalized detector based on parametric Rao test**, Vyacheslav P. Tuzlukov, Kyungpook National Univ. (Korea, Republic of) [8393-06]

Thursday 26 April

SESSION 2

Room: Conv. Ctr. 330 Thurs. 8:30 am to 12:00 pm

Signal and Track Processing

Session Chairs: **Liyi Dai**, U.S. Army Research Office (USA); **Richard D. Teichgraber**, Consultant (USA)

8:30 am: **A mathematical model for MIMO signal and SAR image**, Alex Martinez, Yufeng Cao, Zhijun Qiao, The Univ. of Texas-Pan American (USA) [8393-28]

8:55 am: **Space-time signal processing for distributed pattern detection in sensor networks**, Randy C. Paffenroth, Philip C. Du Toit, Numerica Corp. (USA); Louis L. Scharf, Anura P. Jayasumana, Vidarshana Banadara, Colorado State Univ. (USA) [8393-08]

9:20 am: **Physics and particle filters**, Frederick E. Daum, Jim Huang, Raytheon Co. (USA) [8393-09]

9:45 am: **Conference overview (Presentation Only)**, Oliver E. Drummond, Consultant (USA) [8393-10]

Coffee Break 10:10 to 10:45 am

10:45 am: **Lagrangian relaxation approaches to closed-loop scheduling of track updates**, Kruger A. B. White, Jason L. Williams, Defence Science and Technology Organisation (Australia) [8393-11]

11:10 am: **Extrapolating target tracks**, James R. Van Zandt, The MITRE Corp. (USA) [8393-12]

11:35 am: **The study on infrared small target tracking technology under complex background**, Lei Liu, Nanjing Univ. of Science & Technology (China); Xin Wang, Hohai Univ. (China); Jilu Chen, Tao Pan, Nanjing Univ. of Science & Technology (China) [8393-13]

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

SESSION 3

Room: Conv. Ctr. 330 Thurs. 1:30 to 5:00 pm

Sensor Data Fusion Processing

Session Chairs: **Rabinder N. Madan**, Office of Naval Research (USA); **Denise E. Jones**, U.S. Army Space and Missile Defense Command (USA)

1:30 pm: **Particle filter tracking for very long-range radars**, Kevin Romeo, Peter Willett, Yaakov Bar-Shalom, Univ. of Connecticut (USA) [8393-32]

1:55 pm: **The PMHT for fused tracking**, Darin T. Dunham, Vectraxx, Inc. (USA); Peter Willett, Univ. of Connecticut (USA); Terry Ogle, Vectraxx, Inc. (USA) [8393-15]

2:20 pm: **Ambiguous data association and entangled attribute estimation**, David J. Trawick, Philip C. Du Toit, Randy C. Paffenroth, Greg J. Norgard, Numerica Corp. (USA) [8393-16]

2:45 pm: **Measurement level AIS/radar fusion for multitarget tracking**, Biruk K. Habtemariam, Ratnasingham Tharmarasa, McMaster Univ. (Canada); Eric Meger, exactEarth Ltd. (Canada); Thiagalingam Kirubarajan, McMaster Univ. (Canada) [8393-17]

3:10 pm: **Maximum likelihood probabilistic data association (ML-PDA) tracker implemented in delay-dime/bearing space applied to multistatic sonar data sets**, Steven Schoenecker, Naval Undersea Warfare Ctr. (USA); Peter Willett, Yaakov Bar-Shalom, Univ. of Connecticut (USA) [8393-18]

Coffee Break 3:35 to 4:10 pm

4:10 pm: **Self-organizing radar resource management in constrained multisensor networks with variable, per-node implementations**, Brad S. Weir, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8393-19]

4:35 pm: **Information-based data prioritization in distributed tracking systems**, Nicholas Coult, Aubrey Poore, James N. Knight, Woody Leed, Scott Danford, Numerica Corp. (USA) [8393-20]

POSTERS—THURSDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Oral Standby/Poster Presentations

Three plot correlation-based small infrared target detection in dense sun-glint environment for infrared search and track, Sungho Kim, Yeungnam Univ. (Korea, Republic of); Taek Lyul Song, Hanyang Univ. (Korea, Republic of); Byungjin Choi, Samsung Thales Co., Ltd. (Korea, Republic of); Boo-Hwan Lee, Agency for Defense Development (Korea, Republic of) [8393-29]

A fast coalescence-avoiding JPDAF, Kevin Romeo, David Crouse, Yaakov Bar-Shalom, Peter Willett, Univ. of Connecticut (USA) [8393-31]

Poster Presentations

Room: Conv. Ctr. Hall A Thurs. 6:00 to 7:30 pm

A survey of maneuvering target tracking, part VIc: approximate nonlinear density filtering in discrete time, Xiao-Rong Li, Vesselin Jilkov, The Univ. of New Orleans (USA) [8393-33]

Friday 27 April

SESSION 4

Room: Conv. Ctr. 330 Fri. 8:30 am to 12:00 pm

Target Track Processing

Session Chairs: **Karla K. Priestersbach**, Missile Defense Agency (USA); **Oliver E. Drummond**, CyberRnD, Inc. (USA)

8:30 am: **Exploratory joint and separate tracking of geographically related time series**, Balakumar Balasingam, Peter Willett, Univ. of Connecticut (USA); Georgiy M. Levchuk, Jared Freeman, Aptima, Inc. (USA) [8393-21]

8:55 am: **Estimating trackability**, James R. Van Zandt, The MITRE Corp. (USA) [8393-22]

9:20 am: **Prediction, tracking, and retrodiction for path-constrained targets**, Krishnan Krishanth, Ratnasingham Tharmarasa, McMaster Univ. (Canada); Pierre Valin, Defence Research and Development Canada, Valcartier (Canada); Eric Meger, exactEarth Ltd. (Canada); Thiagalingam Kirubarajan, McMaster Univ. (Canada) [8393-23]

9:45 am: **Data modeling for nonlinear track prediction of targets through obscurations**, Holger M. Jaenisch, Licht Strahl Engineering, Inc. (USA) and Johns Hopkins Univ. (USA); James W. Handley, Licht Strahl Engineering, Inc. (USA) [8393-24]

Coffee Break 10:10 to 10:45 am

10:45 am: **Stochastic data association in multitarget filtering**, Stefano P. Coraluppi, Craig A. Carthel, Compunetix, Inc. (USA) [8393-25]

11:10 am: **Histogram PMHT for correlated targets**, Samuel Davey, Neil Gordon, Defence Science and Technology Organisation (Australia) [8393-26]

11:35 am: **An approximate CPHD filter for superpositional sensors**, Ronald Mahler, Lockheed Martin Maritime Systems & Sensors (USA); Adel I. El-Fallah, Scientific Systems Co., Inc. (USA) [8393-27]

Courses of Related Interest

- SC1070 **Radar Waveforms and Signal Processing** (Welstead) Thursday, 8:30 am to 12:30 pm
- SC181 **Predicting Target Acquisition Performance of Electro-Optical Imagers** (Vollmerhausen) Wednesday, 8:30 am to 5:30 pm
- SC892 **Infrared Search and Track Systems** (Schwering) Thursday, 8:30 am to 5:30 pm
- SC158 **Fundamentals of Automatic Target Recognition** (Sadjadi) Wednesday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours



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Algorithms for Synthetic Aperture Radar Imagery XIX

Conference Chairs: **Edmund G. Zelnio**, Air Force Research Lab. (USA); **Frederick D. Garber**, Wright State Univ. (USA)

Program Committee: **David Blacknell**, Defence Science and Technology Lab. (United Kingdom); **Mujdat Cetin**, Sabanci Univ. (Turkey); **Gil J. Ettinger**, BAE Systems (USA); **Charles V. Jakowatz, Jr.**, Sandia National Labs. (USA); **Eric R. Keydel**, SAIC (USA); **Jian Li**, Univ. of Florida (USA); **Michael J. Minardi**, Air Force Research Lab. (USA); **Randolph L. Moses**, The Ohio State Univ. (USA); **Les Novak**, Scientific Systems Co., Inc. (USA); **Lee C. Potter**, The Ohio State Univ. (USA); **Brian Rigling**, Wright State Univ. (USA); **Timothy D. Ross**, Air Force Research Lab. (USA); **Michael A. Saville**, Air Force Institute of Technology (USA); **Gerard W. Titi**, BAE Systems (USA)

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 25 April

Conference Welcome

Room: Conv. Ctr. 328Wed. 8:40 to 8:50 am

Session Chair: **Edmund Zelnio**, Air Force Research Lab. (USA)

SESSION 1

Room: Conv. Ctr. 328Wed. 8:50 to 10:50 am

Image Formation

Session Chair: **Charles V. Jakowatz, Jr.**, Sandia National Labs. (USA)

8:50 am: **Approximation and bounding of distortion errors in polar format SAR imaging for squinted geometries**, Matt Horvath, Wright State Univ. (USA) and MacAulay-Brown, Inc. (USA); **Brian Rigling**, Wright State Univ. (USA) [8394-01]

9:00 am: **Dual format algorithm implementation with gotcha data**, LeRoy Gorham, Air Force Research Lab. (USA); **Brian Rigling**, Wright State Univ. (USA) [8394-02]

9:10 am: **A transformation between on-center and off-center point scatterers for circular SAR**, Linda J. Moore, Air Force Research Lab. (USA) [8394-03]

9:20 am: **Preliminary evaluation of SAR image compression performance using MatrixView on coherent change detection**, Arvind Thiagarajan, MatrixView Ltd. (Singapore); **LeRoy Gorham**, Air Force Research Lab. (USA) [8394-04]

9:30 am: **Complex synthetic aperture radar data compression using compressive sensing techniques**, Paul L. Poehler, SAIC (USA) [8394-05]

9:40 am: **Sparse and accurate SAR image reconstruction (Invited Paper)**, Duc Vu, Kexin Zhao, Jian Li, Univ. of Florida (USA) [8394-06]

Coffee Break 10:00 to 10:30 am

10:30 am: **Reconstruction of interrupted SAR imagery for persistent surveillance change detection (Invited Paper)**, Ivana Stojanovic, William C. Karl, Boston Univ. (USA); **Les Novak**, Scientific Systems Co., Inc. (USA) [8394-07]

SESSION 2

Room: Conv. Ctr. 328Wed. 10:50 to 11:40 am

Imaging Diversity

Session Chair: **Gerard W. Titi**, BAE Systems (USA)

10:50 am: **Flying blind: a challenge problem for SAR imaging without navigational data**, Brian Rigling, Wright State Univ. (USA) [8394-08]

11:00 am: **Autofocus algorithm for curvilinear SAR imaging**, Elizabeth H. Bleszynski, Marek K. Bleszynski, Thomas Jaroszewicz, Monopole Research (USA) [8394-09]

11:10 am: **Multistatic synthetic aperture radar interferometry**, Huseyin C. Yanik, Birsen Yazici, Rensselaer Polytechnic Institute (USA) [8394-10]

11:20 am: **Bistatic SAR coherence over nonplanar topographies**, Daniel B. Andre, Defence Science and Technology Lab. (United Kingdom); **Keith Morrison**, Cranfield Univ. (United Kingdom) [8394-11]

11:30 am: **Bistatic SAR imaging of the lunar surface using the Aerocibo Observatory transmitter and the lunar reconnaissance orbiter receiver**, Charles V. Jakowatz, Jr., Daniel E. Wahl, Sandia National Labs. (USA); **David A. Yocky**, Sandia National Labs (USA) [8394-12]

Lunch/Exhibition Break 11:40 am to 1:10 pm

POSTER SESSION. Wed. 1:10 to 3:30 pm

Coffee Break 3:30 to 4:00 pm

DISCUSSION/WORKSHOP. Wed. 4:00 to 5:00 pm

Thursday 26 April

Conference Welcome

Room: Conv. Ctr. 328Thurs. 8:20 to 8:30 am

Session Chair: **Edmund Zelnio**, Air Force Research Lab. (USA)

SESSION 3

Room: Conv. Ctr. 328Thurs. 8:30 to 10:00 am

Exploitation of Motion

Session Chair: **Lee C. Potter**, The Ohio State Univ. (USA)

8:30 am: **Passive synthetic aperture radar imaging of ground moving targets**, Steven Wacks, Birsen Yazici, Rensselaer Polytechnic Institute (USA) ... [8394-13]

8:40 am: **Three-channel processing for improved localization performance in SAR-based GMTI**, Ross W. Deming, U.S. Air Force (USA) [8394-14]

8:50 am: **Detection and tracking of prominent scatterers in SAR data**, Benjamin Shapo, Integrity Applications, Inc. (USA); **Mark Stuff**, Michigan Tech Research Institute (USA); **Christopher Kreucher**, Ron Majewski, Integrity Applications, Inc. (USA) [8394-15]

9:00 am: **Detection and imaging of multiple ground moving targets using ultra-narrowband continuous-wave SAR**, Ling Wang, Nanjing Univ. of Aeronautics and Astronautics (China); **Birsen Yazici**, Rensselaer Polytechnic Institute (USA) [8394-16]

- 9:10 am: **Separation of vibrating and static SAR object signatures via an orthogonal subspace transformation**, Matthew P. Pepin, Majeed M. Hayat, The Univ. of New Mexico (USA) [8394-17]
- 9:20 am: **A Bayesian method for polarimetric SAR calibration**, Emre Ertin, The Ohio State Univ. (USA) [8394-18]
- 9:30 am: **Extensions to persistent change detection in SAR imagery with posterior models**, Gregory E. Newstadt, Univ. of Michigan (USA) [8394-19]
- 9:40 am: **A synopsis of challenge problems** (*Invited Paper*), Brandy Gorham, Air Force Research Lab. (USA) [8394-20]
- Coffee Break 10:00 to 10:30 am

SESSION 4

Room: Conv. Ctr. 328 Thurs. 10:30 am to 12:10 pm

Image Exploitation

Session Chair: Michael A. Saville, Air Force Institute of Technology (USA)

- 10:30 am: **Wide angle SAR ATR challenge problem**, Kerry E. Dungan, High Performance Technologies, Inc. (USA); LeRoy Gorham, Steven M. Scarborough, Jason Parker, Air Force Research Lab. (USA); John Nehrbass, High Performance Technologies, Inc. (USA); Joshua N. Ash, The Ohio State Univ. (USA) . . [8394-21]
- 10:40 am: **Filtered back-projection type, direct-edge detection of real synthetic aperture radar images**, Noe Pena, Guillermo Garza, Zhijun Qiao, The Univ. of Texas-Pan American (USA) [8394-22]
- 10:50 am: **Region-based target detection approach for synthetic aperture radar images and its parallel implementation**, Osman Erman Okman, Can Demirkesen, Fatih Nar, SDT A.S. (Turkey); Mujdat Cetin, Sabanci Univ. (Turkey) [8394-23]
- 11:00 am: **Target DNA: characterization of angle-diverse radar signatures**, Emre Ertin, The Ohio State Univ. (USA) [8394-24]
- 11:10 am: **Simultaneous tracking and recognition performance model**, Bart Kahler, SAIC (USA) [8394-25]
- 11:20 am: **Classifying circular SAR images using sparsity**, Christopher Paulson, Univ. of Florida (USA); Edmund G. Zelnio, LeRoy Gorham, Air Force Research Lab. (USA); Dapeng Wu, Univ. of Florida (USA) [8394-27]
- 11:30 am: **Performance estimation of SAR using NIIRS techniques**, Adam R. Nolan, Etegent Technologies, Ltd. (USA) [8394-28]
- 11:40 am: **Combination of different SAR modalities for geospatial intelligence applications in a harbor environment**, Dirk C. Borghys, Michal Shimoni, Christiaan Perneel, Royal Belgian Military Academy (Belgium) [8394-30]
- 11:50 pm: **Robust 3D reconstruction using lidar and polarized image**, Prakash Duraisamy, Univ. of North Texas (USA); Mohammad Showkat Alam, Univ. of South Alabama (USA) [8394-31]
- Lunch/Exhibition Break 12:00 to 1:50 pm

POSTER SESSION Thurs. 1:50 to 3:30 pm

Coffee Break 3:30 to 4:00 pm

DISCUSSION/WORKSHOP Thurs. 4:00 to 5:00 pm

Courses of Related Interest

SC1070 **Radar Waveforms and Signal Processing** (Welstead) Thursday, 8:30 am to 12:30 pm
 See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Acquisition, Tracking, Pointing, and Laser Systems Technologies XXVI

Conference Chairs: **William E. Thompson**, New Mexico Institute of Mining and Technology (USA); **Paul F. McManamon**, Exciting Technology, LLC (USA)

Program Committee: **Paul J. Berger**, MIT Lincoln Lab. (USA); **Stanislav Gordeyev**, Univ. of Notre Dame (USA); **Dan C. Herrick**, Air Force Research Lab. (USA); **James M. Hilkert**, Alpha-Theta Technologies (USA); **Richard A. Hutchin**, Optical Physics Co. (USA); **Paul S. Idell**, The Boeing Co. (USA); **Eric J. Jumper**, Univ. of Notre Dame (USA); **Christopher J. Musial**, Boeing-SVS, Inc. (USA); **Kevin Probst**, Core Group, Inc. (USA); **Jim Riker**, Air Force Research Lab. (USA); **Michael C. Roggemann**, Michigan Technological Univ. (USA); **Glenn A. Tyler**, Optical Sciences Co. (USA); **Edward A. Watson**, Air Force Research Lab. (USA); **Matthew R. Whiteley**, MZA Associates Corp. (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 332 Mon. 8:30 to 11:10 am

Acquisition and Track Phase Array of Phased Arrays Development

Session Chair: **Paul F. McManamon**, Exciting Technology, LLC (USA)

8:30 am: **Constraining an optical phased array beam control study** (*Invited Paper*), Dan K. Marker, Wesley A. Green, Air Force Research Lab. (USA) [8395-01]

9:00 am: **Generation of laser beams with controllable space-varying coherence with fiber-array systems** (*Invited Paper*), Mikhail A. Vorontsov, Univ. of Dayton (USA); Valeriy V. Kolosov, Vadim V. Dudorov, V.E. Zuev Institute of Atmospheric Optics (Russian Federation) [8395-02]

9:30 am: **Active multi-aperture imaging through turbulence**, Nicholas J. Miller, Paul F. McManamon, David Shemano, Joseph W. Haus, Univ. of Dayton (USA) [8395-03]

9:50 am: **Real-time coherent phased array image synthesis and atmospheric compensation testing** (*Invited Paper*), Jeffrey J. Widiker, MZA Associates Corp. (USA); Nicholas J. Miller, Univ. of Dayton (USA); Matthew R. Whiteley, MZA Associates Corp. (USA) [8395-04]

Coffee Break 10:20 to 10:50 am

10:50 am: **Beam steering and focusing in a spatial heterodyne-based multi-aperture imager**, Gui Min Wu, Univ. of Dayton (USA) [8395-05]

SESSION 2

Room: Conv. Ctr. 332 Mon. 11:10 am to 12:10 pm

Aero-Optical I

Session Chair: **Eric J. Jumper**, Univ. of Notre Dame (USA)

11:10 am: **The Airborne Aero-Optics Laboratory (AAOL)** (*Invited Paper*), Eric J. Jumper, Stanislav Gordeyev, Michael A. Zenk, David A. Cavalieri, Univ. of Notre Dame (USA) [8395-06]

11:40 am: **Recent data from the AAOL** (*Invited Paper*), Nicholas DeLucca, Stanislav Gordeyev, Eric J. Jumper, Michael A. Zenk, David A. Cavalieri, Univ. of Notre Dame (USA) [8395-07]

Lunch Break 12:10 to 1:10 pm

SESSION 3

Room: Conv. Ctr. 332 Mon. 1:10 to 4:40 pm

Aero-Optical II

Session Chair: **Eric J. Jumper**, Univ. of Notre Dame (USA)

1:10 pm: **Spatial and temporal characterization of AAOL flight test data** (*Invited Paper*), David J. Goorskey, MZA Associates Corp. (USA) [8395-08]

1:40 pm: **AAOL wavefront data reduction approaches** (*Invited Paper*), Shaddy Abado, Stanislav Gordeyev, Eric J. Jumper, Univ. of Notre Dame (USA) [8395-09]

2:10 pm: **Identification, prediction, and control of aero-optical wavefronts** (*Invited Paper*), Azin Faghihi, Jonathan Tesch, James S. Gibson, Univ. of California, Los Angeles (USA) [8395-10]

2:40 pm: **Recent measurements of aero-optical effects caused by subsonic boundary layers** (*Invited Paper*), Adam E. Smith, Stanislav Gordeyev, Eric J. Jumper, Univ. of Notre Dame (USA) [8395-11]

Coffee Break 3:10 to 3:40 pm

3:40 pm: **Computational analysis of subsonic-boundary-layer aero-optics** (*Invited Paper*), Kan Wang, Meng Wang, Univ. of Notre Dame (USA) . . . [8395-12]

4:10 pm: **Aero-optical jitter estimation using higher-order wavefronts** (*Invited Paper*), Matthew R. Whiteley, David J. Goorskey, Richard Drye, MZA Associates Corp. (USA) [8395-13]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 4

Room: Conv. Ctr. 332 Tues. 8:00 to 11:30 am

Optical Beam Steering Components and Control Systems

Session Chair: Edward A. Watson, Air Force Research Lab. (USA)

8:00 am: **Polarization gratings for nonmechanical beam steering applications** (*Invited Paper*), Joseph R. Buck, Steve Serati, Lance Hosting, Roylenn Serati, Hugh Masterson, Boulder Nonlinear Systems (USA); Michael J. Escuti, Jihwan Kim, Matthew N. Miskiewicz, North Carolina State Univ. (USA) [8395-14]

8:30 am: **Progress on large-area polarization grating fabrication** (*Invited Paper*), Jihwan Kim, Ravi K. Komanduri, Yanming Li, Matthew N. Miskiewicz, Michael J. Escuti, North Carolina State Univ. (USA) [8395-15]

9:00 am: **Laboratory testing of a curved deformable mirror**, Marc T. Jacoby, Matthew T. Hunwardsen, Robert H. Brigham, Ronald F. Pollock, Cameron Austrheim-Smith, Chien C. Chen, Optical Physics Co. (USA) [8395-16]

9:20 am: **High-frame rate Shack Hartmann wavefront sensor based on flexible read-out technique for C-MOS image sensor**, Jiro Suzuki, Toshiyuki Ando, Mitsubishi Electric Corp. (Japan) [8395-17]

9:40 am: **Refractive beam shaping optics to improve operation of spatial light modulators**, Alexander V. Laskin, Vadim Laskin, AdlOptica Optical Systems GmbH (Germany). [8395-18]

Coffee Break 10:00 to 10:30 am

10:30 am: **Next-generation inductive transducers for position measurement**, Mark A. Howard, Zettlex UK Ltd. (United Kingdom) [8395-19]

10:50 am: **Geo-pointing and geo-locating line-of-sight kinematics and control techniques**, James M. Hilbert, Alpha-Theta Technologies (USA) [8395-20]

11:10 am: **Two-port internal model control for gyro-stabilized platform of electro-optical tracking system**, Yun Xia Xia, Qi Liang Bao, Zhi Jun Li, Qiongyan Wu, Institute of Optics and Electronics (China) [8395-21]

Lunch/Exhibition Break 11:30 am to 1:00 pm

SESSION 5

Room: Conv. Ctr. 332 Tues. 1:00 to 2:40 pm

Image and Signal Processing for Target Tracking Applications

Session Chair: William E. Thompson, New Mexico Institute of Mining and Technology (USA)

1:00 pm: **USAF/Navy high-energy laser (HEL) systems: HEL-generated extinction of multispectral algorithm efficiencies during missile staging and early midcourse (ascent cases: PRC DF-31; GHADR 110)**, Clifford A. Paiva, BSM Research Associates (USA) [8395-22]

1:20 pm: **Determination of feature generation methods for PTZ camera object tracking**, Daniel D. Doyle, Air Force Institute of Technology (USA) [8395-23]

1:40 pm: **Development and testing of the advanced integrated multisensor system (AIMS) for active and passive tracking and imaging**, Vladimir B. Markov, Anatoliy I. Khizhnyak, Stephen A. Kupiec, Advanced Systems & Technologies, Inc. (USA); Daniel Erwin, The Univ. of Southern California (USA) [8395-24]

2:00 pm: **Peak-seeking control techniques for stabilized antenna tracking**, Gunnar Ristroph, IJK Controls, LLC (USA) [8395-25]

2:20 pm: **Polynomial fitting adaptive Kalman filter tracking and choice of correlation coefficient**, Kyle Ausfeld, Zoran Ninkov, Rochester Institute of Technology (USA); J. Daniel Newman, Paul P. K. Lee, ITT Exelis Inc. (USA); Gregory J. Gosian, ITT Corp. (USA) [8395-26]

Courses of Related Interest

- SC160 Precision Stabilized Pointing and Tracking Systems (Hilkert) Monday, 8:30 am to 5:30 pm
- SC181 Predicting Target Acquisition Performance of Electro-Optical Imagers (Vollmerhausen) Wednesday, 8:30 am to 5:30 pm
- SC892 Infrared Search and Track Systems (Schwering) Thursday, 8:30 am to 5:30 pm
- SC158 Fundamentals of Automatic Target Recognition (Sadjadi) Wednesday, 8:30 am to 5:30 pm

See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Geospatial InfoFusion II

Conference Chairs: **Matthew F. Pellechia**, ITT Exelis Inc. (USA); **Richard J. Sorensen**, U.S. Air Force Aeronautical Systems Ctr. (USA)

Conference Co-Chairs: **Shiloh L. Dockstader**, ITT Exelis Inc. (USA); **Kannappan Palaniappan**, Univ. of Missouri-Columbia (USA); **Xuan Liu**, IBM Thomas J. Watson Research Ctr. (USA)

Program Committee: **Erik P. Blasch**, Air Force Research Lab. (USA); **Bernard V. Brower**, ITT Exelis Inc. (USA); **Filiz Bunyak**, Univ. of Missouri-Columbia (USA); **Rama Chellappa**, Univ. of Maryland, College Park (USA); **Hui Cheng**, SRI International Sarnoff (USA); **Brian J. Daniel**, U.S. Naval Research Lab. (USA); **James W. Davis**, The Ohio State Univ. (USA); **Larry S. Davis**, Univ. of Maryland, College Park (USA); **Paul B. Deignan**, L-3 Communications Integrated Systems (USA); **Emmanuel Duflos**, École Centrale de Lille (France); **Daniel Edwards**, National Geospatial-Intelligence Agency (USA); **Paul W. Fieguth**, Univ. of Waterloo (Canada); **Michael E. Gangl**, MacAulay-Brown, Inc. (USA); **Robert J. Gillen**, Univ. of Dayton Research Institute (USA); **Adel Hafiane**, Ecole Nationale Supérieure d'Ingénieurs (France); **Anthony J. Hoogs**, Kitware, Inc. (USA); **Yan Huang**, Univ. of North Texas (USA); **Holger E. Jones**, Lawrence Livermore National Lab. (USA); **Simon J. Julier**, Univ. College London (United Kingdom); **Frederick W. Koehler IV**, National Geospatial-Intelligence Agency (USA); **Boris Kovalerchuk**, Central Washington Univ. (USA); **Mohamed F. Mokbel**, Univ. of Minnesota, Twin Cities (USA); **Dennis Motsko**, National Geospatial-Intelligence Agency (USA); **Raghuveer M. Rao**, U.S. Army Research Lab. (USA); **Carlo Regazzoni**, Univ. degli Studi di Genova (Italy); **Gunasekaran Seetharaman**, Air Force Research Lab. (USA); **Philippe M. Vanheeghe**, École Centrale de Lille (France); **Pramod Kumar Varshney**, Syracuse Univ. (USA); **Darrell L. Young**, Raytheon Intelligence & Information Systems (USA); **John A. Richards**, Sandia National Labs. (USA); **Ranga Raju Vatsavai**, Oak Ridge National Lab. (USA); **Karmon M. Vongsy**, Air Force Research Lab. (USA); **Lexing Xie**, The Australian National Univ. (Australia); **Chengyang Zhang**, Terradata Corp. (USA)

Thursday 26 April

SESSION 1

Room: Conv. Ctr. 329 Thurs. 8:00 to 11:50 am

Architectures for Geospatial Collection Applications

Session Chairs: **Richard J. Sorensen**,

U.S. Air Force Aeronautical Systems Ctr. (USA);

Paul B. Deignan, L-3 Communications Integrated Systems (USA)

8:00 am: **Semantics for airborne video imagery ontology**, Alexander Mirzaoff, ITT Exelis Inc. (USA) [8396-01]

8:20 am: **Pipelined hardware design for infrared image processing**, Benjamin Fortener, Univ. of Dayton Research Institute (USA); Eric Balster, Univ. of Dayton (USA); William Turri, Univ. of Dayton Research Institute (USA). [8396-02]

8:40 am: **Feature fusion using ranking for object tracking in aerial imagery**, Sema Candemir, Filiz Bunyak, Kannappan Palaniappan, Univ. of Missouri-Columbia (USA); Guna Seetharaman, Air Force Research Lab. (USA) . . . [8396-03]

9:00 am: **Developments for a harmonized metadata model for improving cross-community geo-related search and retrieval**, Dietmar Böker, Peter Harant, Peter Watzka, Andreas Weigel, IABG mbH (Germany) [8396-04]

9:20 am: **Interactive target tracking for persistent wide-area surveillance**, Ilker Ersoy, Kannappan Palaniappan, Univ. of Missouri-Columbia (USA); Gunasekaran Seetharaman, Air Force Research Lab. (USA); Raghuveer M. Rao, U.S. Army Research Lab. (USA) [8396-05]

9:40 am: **A geometry based image search engine for advanced RADARSAT-1/2 GIS applications**, Vinay Kotamraju, Bernhard Rabus, MacDonald, Dettwiler and Associates Ltd. (Canada) [8396-06]

Coffee Break 10:00 to 10:30 am

10:30 am: **KOLAM: an extensible cross-platform architecture for visualization and tracking in wide-area motion imagery**, Joshua Fraser, Anoop Haridas, Univ. of Missouri-Columbia (USA); Gunasekaran Seetharaman, Air Force Research Lab. (USA); Kannappan Palaniappan, Univ. of Missouri-Columbia (USA) [8396-07]

10:50 am: **Autonomous cross-correlation of optical MTI for live inspection and tracking**, Jason A. Edelberg, Brian J. Daniel, Michael L. Wilson, John G. Howard, John N. Lee, U.S. Naval Research Lab. (USA); Mark Jensen, Troy Johnson, Scott A. Anderson, Chris Meadows, Space Dynamics Lab. (USA); Steve Frawley, Smart Logic, Inc. (USA). [8396-09]

11:10 am: **Optimizing sensor placement using predictive geospatial analytics, the physical environment, and surveillance constraints**, Greg Schmidt, Brandon Witham, Jason Valore, Ben Holland, Jason Dalton, GeoEye Analytics (USA) [8396-10]

11:30 am: **Cyberspace information models for integrated data harvesting, representation, and exploitation**, Reid B. Porter, Linn Collins, James Powell, Reid Rivenburgh, Los Alamos National Lab. (USA). [8396-11]

Lunch/Exhibition Break 11:50 am to 1:30 pm

PANEL DISCUSSION

Room: Conv. Ctr. 329 Thurs. 1:30 to 3:00 pm

The Role of Geospatial Information Fusion in Activity-based Intelligence Analysis

Panel Moderator: **Shiloh L. Dockstader**, ITT Exelis Inc. (USA)

Panelists: **Jim Antonisse**, Motion Imagery Standards Board; **Erik Blasch**, Fusion Technology Branch, Air Force Research Lab.; **Dan Edwards**, National Geospatial-Intelligence Agency; **Mike Groenert**, U.S. Army Night Vision and Electronic Sensors Directorate; **John Irvine**, Draper Lab.

Alternative Panelists: **James Llinas**, Univ. at Buffalo; **Kevin Priddy**, Air Force Research Lab.

One of the emerging trends within the defense and intelligence communities is increased prominence of activity-based intelligence (ABI) processing, exploitation, and dissemination (PED). Activity-based intelligence focuses on the understanding and analysis of spatio-temporal patterns, events, and characteristics and has proven to be an especially useful tool with applications ranging from asymmetric warfare mitigation to wide-area network discovery and infiltration. ABI also plays a key role in wide-area persistent surveillance (WAPS) and large-volume streaming data (LVSD) applications, offering methods and technologies that help address the overwhelming data management functions faced by these systems. However, the recent proliferation of airborne persistent surveillance systems has introduced a certain amount of ambiguity and lack of differentiation between WAPS and ABI PED analysis. True ABI analysis performs a comprehensive evaluation and integration of numerous structured and unstructured sources potentially including, but not limited to: GMTI, LIDAR, open source, financial, and social data and transactions.

We will assemble a group of panelists to review and assess the current state-of-the-art in ABI analysis and to further discuss the role that multi-source, multi-int fusion must play for ABI analysis to successfully address future defense and intelligence challenges. Specific emphasis is placed on ABI quality and information fusion metrics, novel methods for incorporating both structured and unstructured data, and the relative importance and criticality of successful motion imaging pre-processing algorithms.

Coffee Break 3:00 to 3:30 pm

SESSION 2

Room: Conv. Ctr. 329 Thurs. 3:30 to 5:10 pm

Geospatial Search, Visualization, and Dissemination Methods

Session Chair: Xuan Liu, IBM Thomas J. Watson Research Ctr. (USA)

- 3:30 pm: **Using GIS databases for simulated nightlight imagery**, Joshua D. Zollweg, Michael Gartley, Rochester Institute of Technology (USA) [8396-12]
- 3:50 pm: **NATO STANAG 4586 Complaint Steerable Video Chips from JPEG 2000 Large Volume Data Sets**, Bernard V. Brower, Roddy Shuler, Timothy Looney, Brian Raymond, Matthew F. Pellechia, ITT Exelis Inc. (USA) . . . [8396-13]
- 4:10 pm: **Geospatial Processing of Registered H.264 Data**, Ray Maleh, Frank A. Boyle, Paul B. Deignan, L-3 Communications Integrated Systems (USA) [8396-14]
- 4:30 pm: **The hybrid approach for large-scale network access and querying**, Songhua Xing, Xuan Liu, Arun Hampapur, IBM Thomas J. Watson Research Ctr. (USA) [8396-16]
- 4:50 pm: **Standards support for activity based intelligence**, Jim Antonisse, Harris Corp. (USA) [8396-17]

Friday 27 April

SESSION 3

Room: Conv. Ctr. 329 Fri. 8:00 to 11:30 am

Geospatial Data Processing Algorithms and Techniques

Session Chair: Kannappan Palaniappan, Univ. of Missouri-Columbia (USA)

- 8:00 am: **Uncertainty handling in geospatial data**, Peter Doucette, Dennis Motsko, Matthew Sorensen, Devin A. White, National Geospatial-Intelligence Agency (USA) [8396-18]
- 8:20 am: **Addressing terrain masking in orbital reconnaissance**, Sharad Mehta, Mercury Computer Systems, Inc. (USA) [8396-19]
- 8:40 am: **Feature selection using SFFS for appearance-based vehicles tracking in wide-area imagery**, Mahdiah Poostchi, Filiz Bunyak, Kannappan Palaniappan, Univ. of Missouri-Columbia (USA) [8396-20]
- 9:00 am: **Validate and update of 3D urban features using multisource fusion**, Marcus Arrington, ITT Exelis Inc. (USA) and National Geospatial-Intelligence Agency (USA); Daniel Edwards, National Geospatial-Intelligence Agency (USA) [8396-21]
- 9:20 am: **Vehicle orientation estimation for Radon transform-based voting in aerial imagery**, Rengarajan V. Pelapur, Filiz Bunyak, Kannappan Palaniappan, Univ. of Missouri-Columbia (USA) [8396-22]
- 9:40 am: **Particle filter-based vehicle tracking using a nonlinear motion model**, Raphael Viguier, Kannappan Palaniappan, Univ. of Missouri-Columbia (USA); Emmanuel Duflos, Philippe M. Vanheeghe, École Centrale de Lille (France) [8396-23]
- Coffee Break 10:00 to 10:30 am
- 10:30 am: **Modeling spatial uncertainties in geospatial data fusion and mining**, Boris Kovalerchuk, Central Washington Univ. (USA); Leonid I. Perlovsky, Air Force Research Lab. (USA) and Harvard Univ. (USA) [8396-24]
- 10:50 am: **Image and video-based remote target localization and tracking on smartphones**, Qia Wang, Alex Lobzhanidze, Hyun Ik Jang, Wenjun Zeng, Yi Shang, Univ. of Missouri-Columbia (USA) [8396-25]
- 11:10 am: **A spatial intensity phase evaluator (SIPHER) for perceptual object detection in images**, Herb Hirsch, Andrew Drake, CACI International Inc. (USA) [8396-26]

Courses of Related Interest

SC994 **Multisensor Data Fusion for Object Detection, Classification and Identification** (Klein) Tuesday, 8:30 am to 5:30 pm
 See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Enabling Photonics Technologies for Defense, Security, and Aerospace Applications VIII

Conference Chairs: **Michael J. Hayduk**, Air Force Research Lab. (USA); **Peter J. Delfyett, Jr.**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA)

Conference Co-Chairs: **Andrew R. Pirich**, ACP Consulting (USA); **Eric Donkor**, Univ. of Connecticut (USA)

Program Committee: **H. John Caulfield**, Diversified Research Corp. (USA); **Reinhard K. Erdmann**, Air Force Research Lab. (USA); **Michael L. Fanto**, Air Force Research Lab. (USA); **Sangyoun Gee**, Gwangju Institute of Science and Technology (Korea, Republic of); **Bahram Javidi**, Univ. of Connecticut (USA); **Robert L. Kaminski**, Air Force Research Lab. (USA); **Guifang Li**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Joseph M. Osman**, Air Force Research Lab. (USA); **Edward W. Taylor**, International Photonics Consultants, Inc. (USA); **Henry Zmuda**, Univ. of Florida (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 320 Mon. 10:30 am to 12:00 pm

Photonic Communication Systems and Technology

Session Chair: **Michael J. Hayduk**, Air Force Research Lab. (USA)

10:30 am: **Mathematical model and experimental analysis of multiple channel orbital angular momentum in spatial domain multiplexing**, Syed H. Murshid, HariPriya Muralikrishnan, Samuel Kozaitis, Florida Institute of Technology (USA) [8397-01]

10:50 am: **Orbital angular momentum in four channel spatial domain multiplexing system for multi-terabit per second communication architectures**, Syed H. Murshid, HariPriya Muralikrishnan, Samuel Kozaitis, Florida Institute of Technology (USA) [8397-02]

11:10 am: **Auto-compensating multi-user quantum key distribution network using a wavelength-addressed bus line architecture (Invited Paper)**, Eric Donkor, Univ. of Connecticut (USA) [8397-03]

11:40 am: **Co-site interference mitigation using optical signal processing**, Madeline Lu, Paul R. Prucnal, Princeton Univ. (USA) [8397-04]

Lunch Break 12:00 to 1:30 pm

SESSION 2

Room: Conv. Ctr. 320 Mon. 1:30 to 3:20 pm

Photonic Devices and Subsystems

Session Chair: **Michael L. Fanto**, Air Force Research Lab. (USA)

1:30 pm: **A variable mechanical optical attenuator**, Omar Shehab, Univ. of Maryland, Baltimore County (USA) [8397-05]

1:50 pm: **A passively modelocked laser with tunable pulse-repetition frequency in a semiconductor optical amplifier**, Eric Donkor, Univ. of Connecticut (USA) [8397-06]

2:10 pm: **Modeling InGaAsP/InP/Au distributed feedback lasers for optical communications**, Meng-Mu Shih, Univ. of Florida (USA) [8397-07]

2:30 pm: **Toward widely tunable narrow linewidth RF source through heterogenous silicon photonic integration (Invited Paper)**, Garrett A. Ejzak, David W. Grund, Jr., Janusz Murakowski, Garrett J. Schneider, Dennis W. Prather, Univ. of Delaware (USA) [8397-08]

3:00 pm: **Experimental demonstration of an all optical flip flop memory**, Kimberly Kaltenecker, Eric Donkor, Univ. of Connecticut (USA) [8397-09]

Coffee Break 3:20 to 3:50 pm

SESSION 3

Room: Conv. Ctr. 320 Mon. 3:50 to 4:50 pm

Photonic System Technology

Session Chair: **Eric Donkor**, Univ. of Connecticut (USA)

3:50 pm: **Military laser transmitter incorporating an optical sub-assembly module**, Hong-Shik Lee, Haeng-In Kim, Sang-Shin Lee, Kwangwoon Univ. (Korea, Republic of); Gun-Duk Kim, Seung-Chan Lim, KOREAELECOM Inc. (Korea, Republic of) [8397-10]

4:10 pm: **Highly angle tolerant MILES receiver incorporating an infrared etalon filter**, Tae-Hui Noh, Yeo-Taek Yoon, Hong-Shik Lee, Sang-Shin Lee, Kwangwoon Univ. (Korea, Republic of); Duk-Yong Choi, The Australian National Univ. (Australia); Gun-Duk Kim, Seung-Chan Lim, KOREAELECOM Inc. (Korea, Republic of) [8397-11]

4:30 pm: **2D real-time arithmetic operations using optical coherence properties: image processing applications**, Badr-Eddine Benkelfat, Sonia Elwardi, TELECOM & Management SudParis (France); Mourad Zghal, SUP'COM (Tunisia); Ayman Alfalou, Institut Supérieur de l'Electronique et du Numerique (France) [8397-12]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

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Photonic beamsteering of multiple RF beams via a wavelength routing true-time delay matrix, Michael Plascak, Tyler McKean, Sergio Granieri, Azad Siahmakoun, Rose-Hulman Institute of Technology (USA) [8397-13]

Transmitter for free-space optics with an integrated driver, Janusz Mikołajczyk, Zbigniew Bielecki, Jacek Wojtas, Dariusz Szabra, Mirosław Nowakowski, Magdalena Gutowska, Beata Rutecka, Robert Medrzycki, Military Univ. of Technology (Poland) [8397-14]

An integrated driver for quantum cascade lasers, Janusz Mikołajczyk, Military Univ. of Technology (Poland); Ryszard Niedbala, Marcin Wesolowski, Warsaw Univ. of Technology (Poland); Zbigniew Bielecki, Jacek Wojtas, Dariusz Szabra, Military Univ. of Technology (Poland) [8397-15]

Photonic analog-to-digital converter with asynchronous oversampling technique, Spencer Carver, Sergio Granieri, Azad Siahmakoun, Rose-Hulman Institute of Technology (USA) [8397-16]

Optical Pattern Recognition XXIII

Conference Chairs: **David P. Casasent**, Carnegie Mellon Univ. (USA); **Tien-Hsin Chao**, Jet Propulsion Lab. (USA)

Program Committee: **Mohammad Showkat Alam**, Univ. of South Alabama (USA); **Don A. Gregory**, The Univ. of Alabama in Huntsville (USA); **Bahram Javidi**, Univ. of Connecticut (USA); **B. V. K. Vijaya Kumar**, Carnegie Mellon Univ. (USA); **Yunlong Sheng**, Univ. Laval (Canada); **Robert C. Stirling**, Jet Propulsion Lab. (USA); **Ashit Talukder**, Jet Propulsion Lab. (USA); **Shizhuo Yin**, The Pennsylvania State Univ. (USA); **Rupert C. Young**, Univ. of Sussex (United Kingdom)

Thursday 26 April

SESSION 1

Room: Conv. Ctr. 331 Thurs. 8:30 to 10:30 am

Invited Session on Optical Pattern Recognition

Session Chair: **David Casasent**, Carnegie Mellon Univ. (USA)

8:30 am: **Detection and identification of oil and oil-derived substances at the surface and subsurface levels via hyperspectral imaging** (*Invited Paper*), Mohammad Showkat Alam, Ravi P. Gollapalli, Sidike Paheding, Univ. of South Alabama (USA) [8398-01]

9:00 am: **A self-organized learning strategy for object recognition by an embedded line of attraction** (*Invited Paper*), Ming-Jung Seow, BRS Labs. (USA); Ann T. Alex, Vijayan K. Asari, Univ. of Dayton (USA) [8398-02]

9:30 am: **A compressive sensor concept for automatic target detection** (*Invited Paper*), Abhijit Mahalanobis, Lockheed Martin Missiles and Fire Control (USA) [8398-03]

10:00 am: **Overview of pattern recognition research at NIST IAD** (*Invited Paper, Presentation Only*), Ashit Talukder, National Institute of Standards and Technology (USA) [8398-04]

Coffee Break 10:30 to 11:00 am

SESSION 2

Room: Conv. Ctr. 331 Thurs. 11:00 am to 12:00 pm

Object Classification and Detection

Session Chair: **Tien-Hsin Chao**, Jet Propulsion Lab. (USA)

11:00 am: **Optimization of support vector machine (SVM) for object classification**, Matthew Scholten, Neli Dhingra, Thomas T. Lu, Tien-Hsin Chao, Jet Propulsion Lab. (USA) [8398-05]

11:20 am: **Active imaging technique for sensor data reconstruction and identification**, Andre U. Sokolnikov, Visual Solutions and Applications (USA) [8398-07]

11:40 am: **A computationally efficient appearance-based algorithm for geospatial object detection**, Duygu Arslan, A. Aydin Alatan, Middle East Technical Univ. (Turkey) [8398-08]

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

SESSION 3

Room: Conv. Ctr. 331 Thurs. 1:40 to 3:00 pm

Correlators for Optical Pattern Recognition

Session Chairs: **Rupert C. Young**, Univ. of Sussex (United Kingdom); **David Casasent**, Carnegie Mellon Univ. (USA)

1:40 pm: **Towards an all-numerical implementation of correlation**, Ayman Alfalou, Institut Supérieur de l'Electronique et du Numerique (France); Christian Brosseau, Univ. de Bretagne Occidentale (France); Badr-Eddine Benkelfat, TELECOM & Management SudParis (France); Sofia Qasmi, Institut Supérieur de l'Electronique et du Numerique (France) [8398-09]

2:00 pm: **An adapted optical correlation method sensitive to color changes in the target image**, Marwa Elbouz, Ayman Alfalou, Institut Supérieur de l'Electronique et du Numerique (France); Mohammad Showkat Alam, Univ. of South Alabama (USA); Sofia Qasmi, Institut Supérieur de l'Electronique et du Numerique (France) [8398-10]

2:20 pm: **Target tracking using nonlinear reference phase-encoded joint transform correlation**, Mohammed N. Islam, Farmingdale State College (USA); Vijayan K. Asari, Univ. of Dayton (USA); Mohammad A. Karim, Old Dominion Univ. (USA); Mohammad Showkat Alam, Univ. of South Alabama (USA) [8398-11]

2:40 pm: **Optical multichannel correlators for high-speed targets detection, recognition, and localisation**, Veacheslav L. Perju, National Council for Accreditation and Attestation (Moldova); David Casasent, Carnegie Mellon Univ. (USA) [8398-12]

Coffee Break 3:00 to 3:40 pm

SESSION 4

Room: Conv. Ctr. 331 Thurs. 3:40 to 5:00 pm

Correlation Filters for Optical Pattern Recognition

Session Chairs: **Ashit Talukder**, National Institute of Standards and Technology (USA); **Rupert C. Young**, Univ. of Sussex (United Kingdom)

3:40 pm: **Improving OT-MACH filter performance for target recognition applications with the use of a Rayleigh distribution filter**, Ahmad T. Alkandri, Nagachetan Bangalore, Akber Gardezi, Philip Birch, Rupert C. Young, Chris Chatwin, Univ. of Sussex (United Kingdom) [8398-13]

4:00 pm: **Composite wavelet filters for enhanced automated target recognition**, Jeffrey Chiang, Yuhuan Zhang, Thomas T. Lu, Tien-Hsin Chao, Jet Propulsion Lab. (USA) [8398-14]

4:20 pm: **Adaptive filtering with organic photorefractive materials via four-wave mixing**, Jed Khoury, Air Force Research Lab. (USA); John J. Donoghue, Solid State Scientific Corp. (USA); Bahareh Haji-saeed, Charles L. Woods, Air Force Research Lab. (USA); John Kierstead, Solid State Scientific Corp. (USA); Nasser N. Peyghambarian, College of Optical Sciences, The Univ. of Arizona (USA); Michiharu Yamamoto, Nitto Denko Technical Corp. (USA) [8398-15]

4:40 pm: **Variants of minimum correlation energy filters: comparative study**, Nikolay N. Evtikhiev, Dmitriy V. Shaulskiy, Evgeny Y. Zlokazov, Rostislav S. Starikov, National Research Nuclear Univ. MEPhI (Russian Federation) . [8398-16]

POSTERS—THURSDAY

Room: Conv. Ctr. Hall A Thurs. 6:00 to 7:30 pm

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Design and simulation of a multiport neural network heteroassociative memory for optical pattern recognitions, Vladimir G. Krasilenko, Vinnitsa Social Economy Institute (Ukraine); Alexander A. Lazarev, Vinnytsia National Technical Univ. (Ukraine); Sveta Grabovlyak, Vinnitsa Social Economy Institute (Ukraine) [8398-23]

The investigation of the Fourier spectrum-based image complexity metrics for recognition applications, Veacheslav L. Perju, National Council for Accreditation and Attestation (Moldova); David Casasent, Carnegie Mellon Univ. (USA); Liuba Ababei, Free International Univ. of Moldova (Moldova) [8398-24]

Hybrid optical-digital encryption system based on wavefront coding paradigm, Mikhail V. Konnik, The Univ. of Newcastle (Australia) [8398-25]

Development of a novel image processing method, the LPED method, Chialun J. Hu, Southern Illinois Univ. Carbondale (USA) [8398-26]

Using wavefront coding technique as an optical encryption system: reliability analysis and vulnerabilities assessment, Mikhail V. Konnik, The Univ. of Newcastle (Australia) [8398-27]

Friday 27 April

SESSION 5

Room: Conv. Ctr. 331 Fri. 8:30 to 10:30 am

Techniques and Applications

Session Chairs: **Mohammad Showkat Alam**, Univ. of South Alabama (USA); **Tien-Hsin Chao**, Jet Propulsion Lab. (USA)

8:30 am: **Compact liquid crystal waveguide Fourier transform spectrometer for real-time gas sensing in NIR spectral band**, Tien-Hsin Chao, Thomas T. Lu, Jet Propulsion Lab. (USA); Scott Davis, George Farca, Scott D. Rommel, Vescent Photonics Inc. (USA) [8398-17]

8:50 am: **A secure approach for encrypting and compressing biometric information employing orthogonal code and steganography**, Muhammad F. Islam, George Washington Univ. (USA); Mohammed N. Islam, Farmingdale State College (USA) [8398-18]

9:10 am: **Spatial domain sharpening of color image employing bidimensional empirical mode decomposition**, Sharif M. A. Bhuiyan, Jesmin F. Khan, Tuskegee Univ. (USA); Mohammad Showkat Alam, Univ. of South Alabama (USA) [8398-19]

9:30 am: **Automated detection of semagram-laden images using adaptive neural networks**, Paul Cerkez, DCS Corp. (USA); James Cannady, Nova Southeastern Univ. (USA) [8398-20]

9:50 am: **Characterization of optical correlation via dynamic range compression using organic photorefractive materials**, Jed Khoury, Air Force Research Lab. (USA); John J. Donoghue, Solid State Scientific Corp. (USA); Bahareh Haji-saeed, Charles L. Woods, Air Force Research Lab. (USA); John Kierstead, Solid State Scientific Corp. (USA); Nasser N. Peyghambarian, College of Optical Sciences, The Univ. of Arizona (USA); Michiharu Yamamoto, Nitto Denko Technical Corp. (USA) [8398-21]

10:10 am: **A new time-adaptive, discrete, bionic-wavelet transform for enhancing speech from adverse noise environment**, Sumithra Palanisamy, Bannari Amman Institute of Technology (India); Prakash Duraisamy, Univ. of North Texas (USA); Mohammad Showkat Alam, Univ. of South Alabama (USA); Xiaohui Yuan, Univ. of North Texas (USA) [8398-22]

Visual Information Processing XXI

Conference Chairs: **Mark Allen Neifeld**, The Univ. of Arizona (USA); **Amit Ashok**, The Univ. of Arizona (USA)

Program Committee: **Gary W. Euliss**, The MITRE Corp. (USA); **Richard D. Juday**, NASA Johnson Space Ctr. (USA); **Ram M. Narayanan**, The Pennsylvania State Univ. (USA); **John Pellegrino**, U.S. Army Research Lab. (USA); **Robert A. Schowengerdt**, The Univ. of Arizona (USA); **Joseph van der Gracht**, HoloSpex, Inc. (USA)

Tuesday 24 April

SESSION 1

Room: Conv. Ctr. 331 Tues. 8:20 to 10:00 am

Superresolution Algorithms and System Design

Session Chair: **Amit Ashok**, The Univ. of Arizona (USA)

- 8:20 am: **Toward automatic subpixel registration of unmanned airborne vehicle images**, Amr H. Yousef, Jiang Li, Mohammad A. Karim, Old Dominion Univ. (USA) [8399-01]
- 8:40 am: **Confidence measures of optical flow estimation suitable for multiframe superresolution**, Andrey V. Kanaev, U.S. Naval Research Lab. (USA) [8399-02]
- 9:00 am: **Precise local blur estimation based on the first-order derivative**, Henri Bouma, Judith Dijk, Adam W. M. van Eekeren, TNO Defence, Security and Safety (Netherlands) [8399-03]
- 9:20 am: **Compressive imaging measurement design from an image patch manifold prior**, Robert R. Muise, Lockheed Martin Missiles and Fire Control (USA) [8399-04]
- 9:40 am: **Fast stochastic Wiener filter for superresolution image restoration with information theoretic visual quality assessment**, Amr H. Yousef, Jiang Li, Mohammad A. Karim, Old Dominion Univ. (USA) [8399-05]
- Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 331 Tues. 10:30 to 11:10 am

Image Analysis I

Session Chair: **Ram M. Narayanan**, The Pennsylvania State Univ. (USA)

- 10:30 am: **An adaptive segmentation technique for automatic object region and boundary extraction for human activity recognition**, Fatema A. Albalooshi, Vijayan K. Asari, Univ. of Dayton (USA) [8399-06]
- 10:50 am: **A novel approach to detect active regions in the solar dynamics observatory images of the sun**, Santosh Suresh, Roger R. Dube, Chance M. Glenn, Sr., Rochester Institute of Technology (USA) [8399-07]
- Lunch/Exhibition Break 11:10 am to 1:20 pm

SESSION 3

Room: Conv. Ctr. 331 Tues. 1:20 to 3:00 pm

Pattern Recognition

Session Chair: **Amit Ashok**, The Univ. of Arizona (USA)

- 1:20 pm: **Tracking individuals in surveillance video of a high-density crowd**, Ninghang Hu, TNO Defence, Security and Safety (Netherlands) and Univ. van Amsterdam (Netherlands); Henri Bouma, TNO Defence, Security and Safety (Netherlands); Marcel Worring, Univ. van Amsterdam (Netherlands) [8399-09]
- 1:40 pm: **Sparse coding for hyperspectral images using random dictionary and soft thresholding**, Ender Oguslu, Jiang Li, Old Dominion Univ. (USA) [8399-10]
- 2:00 pm: **Low-power, autonomous, remote-sensor units using the latest advances in silicon-based neural network computing**, Michel Paindavoiné, Xavier Bruneau, GlobalSensing Technologies France (France); Tom Flaherty, GlobalSensing, Inc. (USA); Anne Menendez, Guy Paillet, CogniMem Technologies, Inc. (USA) [8399-11]
- 2:20 pm: **Similarity measures versus change detection algorithms in hyperspectral imagery**, Simon Adar, Yoel Shkolnisky, Eyal Ben-Dor, Tel Aviv Univ. (Israel) [8399-12]
- 2:40 pm: **Human action recognition using body signature and hidden Markov model**, Kaung-Pen Chou, Chen-Chiung Hsieh, Tatung Univ. (Taiwan) . . [8399-13]
- Coffee/Exhibition Break 3:00 to 4:00 pm

SESSION 4

Room: Conv. Ctr. 331 Tues. 4:00 to 5:20 pm

Image Analysis II

Session Chair: **Michael E. Gehm**, The Univ. of Arizona (USA)

- 4:00 pm: **Multipatform GPGPU implementation of the active contours without edges algorithm**, Olmo Zavala-Romero, Anke D. Meyer Baese, The Florida State Univ. (USA) [8399-14]
- 4:20 pm: **Edge detection with edge pattern analysis and inflection characterization**, Bo Jiang, National Institute of Aerospace (USA) [8399-15]
- 4:40 pm: **Partial spectral unmixing of hyperspectral data for oil spill detection**, Jesmin F. Khan, Sharif M. A. Bhuiyan, Tuskegee Univ. (USA); Mohammad Showkat Alam, Univ. of South Alabama (USA) [8399-16]
- 5:00 pm: **Automatic road extraction from remote sensing images based on a Hessian matrix**, Yoonsung Bae, Jae Ho Jang, Jong Beom Ra, KAIST (Korea, Republic of) [8399-17]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A Tues. 6:00 to 7:30 pm

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- End-to-end image quality assessment**, Joaquin Raventos, Nightline, Inc. (USA) [8399-29]
- Novel multiplexed coaxial holographic storage technique**, Po Sheun Chung, City Univ. of Hong Kong (Hong Kong, China); Wei Jia, Shanghai Institute of Optics and Fine Mechanics (China); Zhongyu Chen, Tsing Chung, Jacky Wen, Yuk Tak Chow, City Univ. of Hong Kong (Hong Kong, China) [8399-30]
- Spatially adaptive defogging for enhancement of color and visibility of UAV image**, Inhye Yoon, Hyuncheol Kim, Jaehyun Im, Chung-Ang Univ. (Korea, Republic of); Jongsue Bae, Sanghoon Lee, Hanwha Corp. (Korea, Republic of); Joonki Paik, Chung-Ang Univ. (Korea, Republic of) [8399-32]
- Robust 3D model tracking system for intelligent video surveillance**, Kyung Hoon Bae, Yong-Sung Kim, Seung-Ji Yang, Dong-Hahk Lee, SK Telecom (Korea, Republic of) [8399-33]

Wednesday 25 April

SESSION 5

Room: Conv. Ctr. 331Wed. 8:40 to 10:00 am

Image Enhancement

Session Chair: Amit Ashok, The Univ. of Arizona (USA)

8:40 am: Ghost-free high dynamic range imaging using layered exposed images based on local histogram equalization, Jaehyun Im, Hyuncheol Kim, Taekyung Kim, Chung-Ang Univ. (Korea, Republic of); Sanghoon Lee, Jongsue Bae, Hanwha Corp. (Korea, Republic of); Joonki Paik, Chung-Ang Univ. (Korea, Republic of) [8399-18]

9:00 am: Scene-based, nonuniformity correction in infrared videos, Yoonsung Bae, Jongho Lee, KAIST (Korea, Republic of); Jong-Ho Lee, Agency for Defense Development (Korea, Republic of); Jong Beom Ra, KAIST (Korea, Republic of) [8399-19]

9:20 am: Infrared image denoising by nonlocal means filtering, Barak Deenoor, Adrian Stern, Yitzhak Yitzhaky, Natan S. Kopeika, Ben-Gurion Univ. of the Negev (Israel) [8399-20]

9:40 am: Adaptive smoothing in real-time image stabilization, Shunguang Wu, David C. Zhang, Joe Zhang, Michael T. Melle, SRI International Sarnoff (USA) [8399-21]

Coffee Break 10:00 to 10:30 am

SESSION 6

Room: Conv. Ctr. 331Wed. 10:30 to 11:50 am

Three-Dimensional Imaging

Session Chair: Jiang Li, Old Dominion Univ. (USA)

10:30 am: Surface reconstruction for 3D remote sensing, Matthew S. Baran, Richard L. Tutwiler, Donald J. Natale, The Pennsylvania State Univ. (USA) [8399-22]

10:50 am: Dense point-cloud creation using superresolution for a monocular 3D reconstruction system, Yakov Diskin, Vijayan K. Asari, Univ. of Dayton (USA) [8399-23]

11:10 am: A study of the sensitivity of long-range passive ranging techniques to atmospheric scintillation, Jason P. de Villiers, Council for Scientific and Industrial Research (South Africa); Fred C. Nicolls, Univ. of Cape Town (South Africa) [8399-24]

11:30 am: A method for 3D scene reconstruction using shadow information and a single fixed viewpoint, David C. Bamber, Jeremy D. Rogers, Waterfall Solutions Ltd. (United Kingdom) [8399-25]

Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 7

Room: Conv. Ctr. 331 Wed. 1:20 to 2:20 pm

Image Reconstruction

Session Chair: Mark Allen Neifeld, The Univ. of Arizona (USA)

1:20 pm: Mean squared error performance of MFBD nonlinear scene reconstruction using speckle imaging in horizontal imaging applications, Glen E. Archer, Jeremy P. Bos, Michael C. Roggemann, Michigan Technological Univ. (USA) [8399-26]

1:40 pm: A new MTF compensation algorithm based on Wiener filter and Richardson-Lucy algorithm, Jihye Lee, Joohwan Chun, KAIST (Korea, Republic of); Donghan Lee, Korea Aerospace Research Institute (Korea, Republic of) [8399-27]

2:00 pm: A comparison of some predictors of stereoscopic match correctness, Val Petran, Artificial Perception Technologies Inc. (USA) and Case Western Reserve Univ. (USA); Frank L. Merat, Case Western Reserve Univ. (USA) [8399-28]

Thursday 26 April

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A 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.

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Quantifying focus criterion function comparison for two-stage autofocusing system, Qian Liang, Yufu Qu, BeiHang Univ. (China) [8399-31]

Quantum Information and Computation X

Conference Chairs: **Eric Donkor**, Univ. of Connecticut (USA); **Andrew R. Pirich**, ACP Consulting (USA); **Howard E. Brandt**, U.S. Army Research Lab. (USA)

Program Committee: **Paul M. Alsing**, Air Force Research Lab. (USA); **Reinhard K. Erdmann**, Air Force Research Lab. (USA); **Michael R. Frey**, Bucknell Univ. (USA); **Michael J. Hayduk**, Air Force Research Lab. (USA); **Louis H. Kauffman**, Univ. of Illinois at Chicago (USA); **Vladimir E. Korepin**, Stony Brook Univ. (USA); **Samuel J. Lomonaco, Jr.**, Univ. of Maryland, Baltimore County (USA); **John M. Myers**, Harvard Univ. (USA); **Alexander V. Sergienko**, Boston Univ. (USA); **Tai Tsun Wu**, Harvard Univ. (USA)

Thursday 26 April

SESSION 1

Room: Conv. Ctr. 334 Thurs. 8:00 to 10:00 am

Quantum Imaging, Sensing, and Measurement

Session Chairs: **Andrew R. Pirich**, ACP Consulting (USA); **Howard E. Brandt**, U.S. Army Research Lab. (USA)

8:00 am: **Probing correlation in quantum arrays**, Michael R. Frey, Bucknell Univ. (USA); Theodore J. Yoder, Franklin & Marshall College (USA) [8400-01]

8:20 am: **The first experimental demonstration of ghost imaging with sunlight**, Sanjit Karmakar, Yanhua Shih, Univ. of Maryland, Baltimore County (USA) [8400-02]

8:40 am: **Manipulations of cold atoms on a chip: double well and 1D Bose gas**, Jason S. Alexander, Violeta Prieto, Chris Rowlett, Patricia J. Lee, William M. Golding, U.S. Army Research Lab. (USA) [8400-03]

9:00 am: **Optical frequency combs for quantum control on atom chips**, Qudsia Quraishi, Vladimir Malinovsky, Jason S. Alexander, Violeta Prieto, Chris Rowlett, Patricia J. Lee, U.S. Army Research Lab. (USA) [8400-04]

9:20 am: **Spectroscopy of a deterministic single-donor device in silicon**, Martin Fuechsle, Jill A. Miwa, Suddhasatta Mahapatra, The Univ. of New South Wales (Australia); Hoon Ryu, Korea Institute of Science and Technology Information (Korea, Republic of); Sunhee Lee, Purdue Univ. (USA); Lloyd C. L. Hollenberg, The Univ. of Melbourne (Australia); Gerhard Klimeck, Purdue Univ. (USA); Michelle Y. Simmons, The Univ. of New South Wales (Australia) . [8400-05]

9:40 am: **Phonons in a double-well: transverse vibrations in a pair of trapped ions**, Patricia J. Lee, U.S. Army Research Lab. (USA) [8400-06]

Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 334 Thurs. 10:30 to 11:50 am

Quantum Key Distribution and Cryptography

Session Chairs: **Eric Donkor**, Univ. of Connecticut (USA); **John M. Myers**, Harvard Univ. (USA)

10:30 am: **Effects of loss and amplification on entangled photon holes**, James D. Franson, Univ. of Maryland, Baltimore County (USA) [8400-07]

10:50 am: **LDPC error correction in the context of quantum key distribution**, Anastasia Nakassis, Alan Mink, National Institute of Standards and Technology (USA) [8400-08]

11:10 am: **Nonorthogonal multistate discrimination strategies outperforming ideal classical receivers**, Francisco E. Becerra, Jingyun Fan, National Institute of Standards and Technology (USA); Julius Goldhar, Univ. of Maryland, College Park (USA); Jon T. Kosloski, The Johns Hopkins Univ. (USA); Alan L. Migdall, National Institute of Standards and Technology (USA) [8400-09]

11:30 am: **Thwarting the photon number splitting attack with entanglement enhanced BB84 quantum key distribution**, Chris D. Richardson, Carl Sabottke, Louisiana State Univ. (USA); Petr Anisimov, Stony Brook Univ. (USA); Ulvi Yurtsever, MathSense Analytics (USA); Antia Lamas, National Univ. of Singapore (Singapore); Jonathan Dowling, Louisiana State Univ. (USA) [8400-10]

Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 3

Room: Conv. Ctr. 334 Thurs. 1:20 to 3:00 pm

Quantum Bits and Logic Gates

Session Chairs: **Michael R. Frey**, Bucknell Univ. (USA); **Louis H. Kauffman**, Univ. of Illinois at Chicago (USA)

1:20 pm: **Szilar engine reversibility as quantum gate function**, Fabian M. Mihelic, The Univ. of Tennessee (USA) [8400-11]

1:40 pm: **Quantum information processing with tapered optical fibers**, Meimei Lai, Univ. of Maryland, Baltimore County (USA); Scott M. Hendrickson, The Johns Hopkins Univ. Applied Physics Lab. (USA); Todd B. Pittman, James D. Franson, Univ. of Maryland, Baltimore County (USA) [8400-12]

2:00 pm: **Unitary qubit representation of quantum turbulence**, George Vahala, The College of William & Mary (USA); Bo Zhang, The Univ. of Texas at Austin (USA); Linda Vahala, Old Dominion Univ. (USA); Min Soe, Rogers State Univ. (USA) [8400-13]

2:20 pm: **New type of qubits using incoherent thermal fields**, Hui Chen, Tao Peng, Yanhua Shih, Univ. of Maryland, Baltimore County (USA) [8400-14]

2:40 pm: **Quantum modes of a spin 1/2 particle in a magnetic waveguide**, William M. Golding, U.S. Army Research Lab. (USA) [8400-15]

Coffee Break 3:00 to 3:30 pm

SESSION 4

Room: Conv. Ctr. 334 Thurs. 3:30 to 5:50 pm

Quantum Computing

Session Chairs: **Samuel J. Lomonaco, Jr.**, Univ. of Maryland, Baltimore County (USA); **Reinhard K. Erdmann**, Air Force Research Lab. (USA)

3:30 pm: **Progress in fault tolerance quantum computing**, Gerald N. Gilbert, Yaakov S. Weinstein, The MITRE Corp. (USA) [8400-16]

3:50 pm: **Finsler metrics in quantum circuit optimization**, Howard E. Brandt, U.S. Army Research Lab. (USA) [8400-17]

4:10 pm: **Quantum computing and nonconvex optimization**, Vitaliy A. Yatsenko III, Institute of Space Research (Ukraine) [8400-18]

4:30 pm: **Study of improved semantics on elements in quantum computation**, Nan Wu, FangMin Song, Nanjing Univ. (China); Xiangdong Li, New York City College of Technology (USA) [8400-19]

4:50 pm: **A multipixel three-dimensional superconducting nanowire photon detector**, A. Matthew Smith, Air Force Research Lab. (USA) [8400-40]

5:10 pm: **Generalized Donkor model with induced dipole-dipole-forbidden transitions using maple**, Camilo Jaramillo, Univ. EAFIT (Colombia) . . . [8400-21]

5:30 pm: **All optical XOR, CNOT gates with initial insight for quantum computation using linear optics**, Omar Shehab, Univ. of Maryland, Baltimore County (USA) [8400-22]

POSTERS—THURSDAY

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Determination of Fermi energy under size quantization with film thickness in non-parabolic n-GaAs compound semiconductor, Subhamoy Singha Roy, JIS College of Engineering (India) [8400-39]

Proposed experiment in two qubit linear optical photonic gates for maximal success rates, A. Matthew Smith, Air Force Research Lab. (USA); Dmitry B. Uskov, Brescia Univ. (USA); Michael L. Fanto, Air Force Research Lab. (USA); Linghang Ying, Lev Kaplan, Tulane Univ. (USA) [8400-20]

Friday 27 April

SESSION 5

Room: Conv. Ctr. 334 Fri. 8:00 to 10:00 am

Quantum Information Theory I

Session Chairs: **Paul M. Alsing**, Air Force Research Lab. (USA); **Michael J. Hayduk**, Air Force Research Lab. (USA)

8:00 am: **Quantum system decomposition for the semi-classical quantum Fourier transform**, Ben Greco, Clemson Univ. (USA); Jack Lenahan, Imagine One Technology & Management, Ltd. (USA); Dave Neumann, Suzanne H. Huerth, Space and Naval Warfare Systems Ctr. Atlantic (USA); Christopher Paribello, Jan Medlock, Clemson Univ. (USA); Lucas A. Overbey, Space and Naval Warfare Systems Ctr. Atlantic (USA) [8400-24]

8:20 am: **Outcome-influenced sequences of choices of wave functions**, John M. Myers, Frederick H. Madjid, Harvard Univ. (USA) [8400-25]

8:40 am: **Battle of the sexes: an analysis using Yang-Baxter operators as quantum gates**, Juan M. Lopez, Univ. EAFIT (Colombia) [8400-26]

9:00 am: **Strictly discordant quantum probes of the qubit depolarizing channel**, Michael R. Frey, Bucknell Univ. (USA); Theodore J. Yoder, Franklin & Marshall College (USA) [8400-27]

9:20 am: **A geometric view of quantum cellular automata**, Jonathan R. McDonald, Air Force Research Lab. (USA); Howard A. Blair, Syracuse Univ. (USA); Paul M. Alsing, Air Force Research Lab. (USA) [8400-28]

9:40 am: **Local availability of mathematics and space-time dependent scale factors for number systems: effects on quantum physics**, Paul Benioff, Argonne National Lab. (USA) [8400-23]

Coffee Break 10:00 to 10:30 am

SESSION 6

Room: Conv. Ctr. 334 Fri. 10:30 to 11:50 am

Quantum Information Theory II

Session Chairs: **Eric Donkor**, Univ. of Connecticut (USA); **Andrew R. Pirich**, ACP Consulting (USA)

10:30 am: **Quantum knots and their applications**, Samuel J. Lomonaco, Jr., Univ. of Maryland, Baltimore County (USA); Louis H. Kauffman, Univ. of Illinois at Chicago (USA) [8400-29]

10:50 am: **Quantum algorithms for the Jones polynomial and Khovanov homology**, Louis H. Kauffman, Univ. of Illinois at Chicago (USA); Samuel J. Lomonaco, Jr., Univ. of Maryland, Baltimore County (USA) [8400-30]

11:10 am: **Possible quantum algorithms for the Rasmussen's invariant**, Juan F. Ospina, Univ. EAFIT (Colombia) [8400-31]

11:30 am: **Applications of the Yang-Baxter-Rowell equation to topological quantum computation**, Aida K. Arnedo, Univ. EAFIT (Colombia) [8400-32]

Lunch Break 11:50 am to 1:20 pm

SESSION 7

Room: Conv. Ctr. 334 Fri. 1:20 to 3:20 pm

Quantum Entanglement

Session Chairs: **Howard E. Brandt**, U.S. Army Research Lab. (USA); **John M. Myers**, Harvard Univ. (USA)

1:20 pm: **Nonlocality, entanglement witnesses, and supra-correlations**, Paul M. Alsing, Air Force Research Lab. (USA); Howard A. Blair, Syracuse Univ. (USA) [8400-33]

1:40 pm: **A multipli-entangled photon source for cluster state generation**, Michael L. Fanto, Reinhard K. Erdmann, Paul M. Alsing, Corey J. Peters, Air Force Research Lab. (USA) [8400-34]

2:00 pm: **Simulation of Bell states with incoherent thermal light**, Tao Peng, Univ. of Maryland, Baltimore County (USA) [8400-35]

2:20 pm: **Generation, detection, and applications of quantum hyper-entangled and entangled states**, James F. Smith III, U.S. Naval Research Lab. (USA) [8400-36]

2:40 pm: **Nonlocal realism considered for entangled photon phenomena**, Reinhard K. Erdmann, Paul M. Alsing, Richard J. Michalak, Michael L. Fanto, Corey J. Peters, Air Force Research Lab. (USA) [8400-37]

3:00 pm: **Generating and storing nonclassical correlations in a warm Rb vapor cell with buffer gas**, Mark Bashkansky, Fredrik K. Fatemi, Igor Vurgaftman, U.S. Naval Research Lab. (USA) [8400-38]

Independent Component Analyses, Compressive Sampling, Wavelets, Neural Net, Biosystems, and Nanoengineering X

Conference Chair: **Harold Szu**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

Conference Co-Chair: **Liyi Dai**, U.S. Army Research Office (USA)

Program Committee: **Shun-ichi Amari**, RIKEN (Japan); **Richard G. Baraniuk**, Rice Univ. (USA); **John J. Benedetto**, Univ. of Maryland, College Park (USA); **Chee-Hung Henry Chu**, Univ. of Louisiana at Lafayette (USA); **Kai-Dee Chu**, U.S. Dept. of Homeland Security (USA); **Ronald R. Coifman**, Yale Univ. (USA); **John Daugman**, Univ. of Cambridge (United Kingdom); **Ronald G. Driggers**, U.S. Naval Research Lab. (USA); **Jide Familoni**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Fredric M. Ham**, Florida Institute of Technology (USA); **Yutaka Hata**, Univ. of Hyogo (Japan); **Charles C. Hsu**, Trident Systems Inc. (USA); **Tzyy-Ping Jung**, Univ. of California, San Diego (USA); **Keith A. Krapels**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Horacio R. Lamela Rivera**, Univ. Carlos III de Madrid (Spain); **Douglas A. Lauffenburger**, Massachusetts Institute of Technology (USA); **Soo-Young Lee**, KAIST (Korea, Republic of); **Anke D. Meyer Baese**, The Florida State Univ. (USA); **Uwe Meyer Baese**, The Florida State Univ. (USA); **Francesco Carlo Morabito**, Univ. Mediterranea di Reggio Calabria (Italy); **Hiroshi Nakajima**, OMRON Corp. (Japan); **Charles C. Nguyen**, The Catholic Univ. of America (USA); **Hyung-Min Park**, Sogang Univ. (Korea, Republic of); **Kitt C. Reinhardt**, Air Force Office of Scientific Research (USA); **Metin Sitti**, Carnegie Mellon Univ. (USA); **Jan-Olov Stromberg**, Royal Institute of Technology (Sweden); **Nadarajen A. Vydellingum**, National Institutes of Health (USA) and National Cancer Institute (USA); **Olaf Wolkenhauer**, Univ. Rostock (Germany); **Donald C. Wunsch II**, Missouri Univ. of Science and Technology (USA); **Ning Xi**, Michigan State Univ. (USA); **Takeshi Yamakawa**, Kyushu Institute of Technology (Japan); **Yufeng Zheng**, Alcorn State Univ. (USA)

Wednesday 25 April

SESSION 1

Room: Conv. Ctr. 332 Wed. 8:00 to 8:40 am

Wavelet Pioneer Award

Session Chairs: **John J. Benedetto**, Univ. of Maryland, College Park (USA); **Harold H. Szu**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

Wavelet Pioneer Award for MRA Wavelet Frame Applications

Presented to **Prof. Zuowei Shen**, National Univ. of Singapore (Singapore)

MRA-based wavelet frame and applications (*Invited Paper*), Zuowei Shen, National Univ. of Singapore (Singapore) [8401-01]

PANEL DISCUSSION

Room: Conv. Ctr. 332 Wed. 8:40 to 9:00 am

Wavelet Features for Smart Processing

Panel Moderators: **Zuowei Shen**, National Univ. of Singapore (Singapore); **John J. Benedetto**, Univ. Maryland, College Park (USA)

Panelists: **Harold Szu**, U.S. Army Night Vision & Electronic Sensors Directorate; **Richard G. Baranuik**, Rice Univ. (USA); **Liyi Dai**, U. S. Army Research Office (USA)

SESSION 2

Room: Conv. Ctr. 332 Wed. 9:00 to 10:00 am

Wavelets Image Applications I

Session Chairs: **Yufeng Zheng**, Alcorn State Univ. (USA); **John J. Benedetto**, Univ. of Maryland, College Park (USA)

9:00 am: **Interdisciplinary educational approach to the human sciences**, Yufeng Zheng, Alcorn State Univ. (USA); Nian Zhang, Univ. of the District of Columbia (USA); Harold Szu, Catholic Univ. of America (USA) [8401-02]

9:20 am: **Semi-supervised learning of heterogeneous data in remote sensing imagery**, John J. Benedetto, Wojciech Czaja, Julia Dobrosotskaya, Timothy Doster, Kevin Duke, Univ. of Maryland, College Park (USA); David B. Gillis, U.S. Naval Research Lab. (USA) [8401-03]

9:40 am: **A wavelet-based method for multispectral face recognition**, Yufeng Zheng, Alcorn State Univ. (USA) [8401-04]

Coffee Break 10:00 to 10:30 am

SESSION 3

Room: Conv. Ctr. 332 Wed. 10:30 to 11:30 am

Multiple Resolution Analyses

Session Chairs: **Zuowei Shen**, National Univ. of Singapore (Singapore); **John J. Benedetto**, Univ. of Maryland, College Park (USA)

10:30 am: **Face recognition from a moving platform via sparse representation using compressive sampling**, Ming-Kai Hsu, The George Washington Univ. (USA); Charles C. Hsu, Sam Mandelson, Trident Systems Inc. (USA); H. H. Szu, The Catholic Univ. of America (USA) [8401-05]

10:50 am: **Sub-pixel registration of moving objects in visible and thermal imagery with the factored 3-way restricted Boltzmann machine**, Stephen M. Won, S. Susan Young, U.S. Army Research Lab. (USA) [8401-06]

11:10 am: **PCA/LDA approach for text-independent speaker recognition**, Zhenhao Ge, Sudhendu R. Sharma, M.J.T. Smith, Purdue Univ. (USA) . . [8401-07]

Lunch/Exhibition Break 11:30 am to 1:30 pm

SESSION 4

Room: Conv. Ctr. 332 Wed. 1:30 to 2:10 pm

ICA Unsupervised Learning Pioneer Award

Session Chairs: **Soo-Young Lee**, KAIST (Korea, Republic of); **Tzyy-Ping Jung**, Univ. of California, San Diego (USA)

ICA Unsupervised Learning Pioneer Award For the Contribution of Signal Separation

Presented to **Dr. Emmanuel Vincent**, IRISA/INRIA Rennes (France)

1:30 pm: **Advances in audio source separation and multisource audio content retrieval** (*Invited Paper*), Emmanuel Vincent, IRISA / INRIA Rennes (France) [8401-09]

PANEL DISCUSSION

Room: Conv. Ctr. 332 Wed. 2:10 to 2:30 pm

Why Different Vector Length in Ln-Norm are Used in Compressive Sensing, Wavelets, and ICA?

Panel Moderators: **Soo-Young Lee**, Korea Advanced Institute of Science and Technology (Korea, Republic of); **Tzyy-Ping Jung**, Univ. of California, San Diego (USA)

Panelists: **Emmanuel Vincent**, IRISA / INRIA Rennes (France); **Harold Szu**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Liyi Dai**, U. S. Army Research Office (USA); **Richard G. Baranuick**, Rice Univ. (USA)

SESSION 5

Room: Conv. Ctr. 332 Wed. 2:30 to 3:10 pm

Computational Intelligence I

Session Chairs: **Emmanuel Vincent**, IRISA / INRIA Rennes (France);
Soo-Young Lee, KAIST (Korea, Republic of)

- 2:30 pm: **Blind signal separation and extraction based on permutation-free frequency-domain ICA**, Choong-Hwan Choi, Won-il Chang, Soo-Young Lee, KAIST (Korea, Republic of) [8401-10]
2:50 pm: **Discriminant feature extraction by combining unsupervised and supervised learning**, Chang-Hyun Kim, Byeong-Yeol Kim, Chung-An Lee, Hyun-Ah Song, Soo-Young Lee, KAIST (Korea, Republic of). [8401-11]
Coffee/Exhibition Break. 3:10 to 4:10 pm

SESSION 6

Room: Conv. Ctr. 332 Wed. 4:10 to 5:10 pm

Computational Intelligence II

Session Chairs: **Soo-Young Lee**, KAIST (Korea, Republic of);
Kenneth A. Byrd, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

- 4:10 pm: **The effects of speckle noise removal on LDV vital-sign measurement accuracy**, Kenneth A. Byrd, Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8401-12]
4:30 pm: **Augmented reality for recognition of human intention**, Jeffrey C. Jenkins, Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8401-13]
4:50 pm: **Robust binocular disparity system based on Nios II processor**, Diego Gonzalez, Guillermo Botella Juan, Univ. Complutense de Madrid (Spain); Uwe Meyer Baese, Anke D. Meyer Baese, The Florida State Univ. (USA) [8401-15]

Thursday 26 April

SESSION 7

Room: Conv. Ctr. 332 Thurs. 8:00 to 8:40 am

Compressive Sampling Pioneer Award

Presented to **Prof. Richard G. Baraniuk**, Rice Univ. (USA)

- 8:00 am: **Compressive signal processing (Invited Paper)**, Richard G. Baraniuk, Rice Univ. (USA) [8401-16]

PANEL DISCUSSION

Room: Conv. Ctr. 332 Thurs. 8:40 to 9:00 am

Where the Compressive Sensing and Sampling have not been applied to?

Panel Moderators: **Prof. Rich G. Baraniuk**, Rice Univ. (USA);
Dr. Liyi Dai, U.S. Army Research Office (USA)

Panelists: **Prof. John Benedetto**, Univ. of Maryland, College Park (USA);
Dr. Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

SESSION 8

Room: Conv. Ctr. 332 Thurs. 9:00 to 10:20 am

Compressive Sampling Applications

Session Chairs: **Richard G. Baraniuk**, Rice Univ. (USA);
Liyi Dai, U.S. Army Research Office (USA)

- 9:00 am: **Adaptive compressive sampling learned by ANN**, Soo-Young Lee, KAIST (Korea, Republic of); Harold Szu, Catholic Univ. of America (USA) [8401-17]
9:20 am: **Video image cliff notes**, H. H. Szu, The Catholic Univ. of America (USA); Charles C. Hsu, Trident Systems Inc. (USA) [8401-18]
9:40 am: **Elucidating compressive sensing from Nyquist critical sampling viewpoint**, Charles C. Nguyen, H. H. Szu, The Catholic Univ. of America (USA); Kitt C. Reinhardt, Air Force Office of Scientific Research (USA) [8401-19]
10:00 am: **EOIR compressive sensing camera design**, Ana Ramirez, Gonzalo R. Arce, Univ. of Delaware (USA) [8401-20]
Coffee Break 10:20 to 10:40 am

SESSION 9

Room: Conv. Ctr. 332 Thurs. 10:40 am to 12:00 pm

Compressive Sensing and Sampling Applications

Session Chairs: **Soo-Young Lee**, KAIST (Korea, Republic of);
Liyi Dai, U.S. Army Research Office (USA)

- 10:40 am: **Design of baseball hats with compressive sensing electrodes for wireless EEG brainwaves**, Harold Szu, Catholic Univ. of America (USA); Tzyy-Ping Jung, Univ. of California, San Diego (USA); Takeshi Yamakawa, Kyushu Institute of Technology (Japan) [8401-21]
11:00 am: **Biomedical wellness applications by Smartphones**, H. H. Szu, The Catholic Univ. of America (USA); Charles C. Hsu, Trident Systems Inc. (USA); Joseph S. Landa, BriarTek, Inc. (USA) [8401-22]
11:20 am: **Compressive sampling approach to visual attention in image scene analysis**, Chee-Hung Henry Chu, Michael A. Pratt, Anurag Singh, Univ. of Louisiana at Lafayette (USA) [8401-23]
11:40 am: **Avoiding the inverse fractal problem for compressive sampling of 1/f data sets**, Holger M. Jaenisch, Licht Strahl Engineering, Inc. (USA) . [8401-25]
Lunch/Exhibition Break 12:00 to 1:40 pm

SESSION 10

Room: Conv. Ctr. 332 Thurs. 1:40 to 2:20 pm

Nanoengineering Pioneer Award

Session Chairs: **Francisco Santiago**, Naval Surface Warfare Ctr. Dahlgren Div. (USA); **Metin Sitti**, Carnegie Mellon Univ. (USA);

F. Jack Agee, Rice Univ. (USA);
Harold H. Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

Nanoengineering Pioneer Award for his contribution to NanoSensing

Presented to **Prof. Yiping Zhao**, The Univ. of Georgia (USA)

- 1:40 pm: **Toward practical SERS sensing (Invited Paper)**, Yiping Zhao, The Univ. of Georgia (USA) [8401-26]

PANEL DISCUSSION

Room: Conv. Ctr. 332 Thurs. 2:20 to 2:40 pm

How Did Nanotechnology Impact on Sensors?

Panel Moderator: **Xiaowei Zhuang**, Harvard (USA);
Francisco Santiago, Naval Surface Warfare Ctr. Dahlgren Div. (USA)

Panelists: **Yiping Zhao**, The Univ. of Georgia (USA);
Harold Szu, U. S. Army Night Vision & Electronic Sensors Directorate (USA);
Uwe Meyer Baese, The Florida State Univ. (USA);

John Gray, Naval Surface Warfare Ctr. Dahlgren Div. (USA);
Metin Sitti, Carnegie Mellon Univ. (USA);
F. Jack Agee, Rice Univ (USA); **Xi Ning**, Michigan State Univ. (USA)

SESSION 11

Room: Conv. Ctr. 332 Thurs. 2:40 to 5:10 pm

Semiconductor Applications

Session Chairs: **Yiping Zhao**, The Univ. of Georgia (USA);
Horacio R. Lamela Rivera, Univ. Carlos III de Madrid (Spain)

2:40 pm: **A NANO enhance to Moore's Law**, Jerry Wu, Yin-Lin Shen, The George Washington Univ. (USA); Kitt C. Reinhardt, Air Force Office of Scientific Research (USA); Harold Szu, The Catholic Univ. of America (USA) [8401-27]

3:00 pm: **Carbon nanostructures properties by terahertz time-domain spectroscopy analysis for nanoengineering applications**, Horacio R. Lamela Rivera, Ehsan Dadransia, Univ. Carlos III de Madrid (Spain) [8401-28]

Coffee Break 3:20 to 3:50 pm

3:50 pm: **Optimization of high-speed pipelining in FPGA-based FIR filters using genetic algorithm**, Uwe Meyer Baese, Guillermo Botella Juan, The Florida State Univ. (USA); Encarnacion Castillo, Antonio Garcia, Univ. de Granada (Spain) [8401-29]

4:10 pm: **Multiple-model particle filter: tracking target on three-dimensional space**, Eduardo P. Serrano, Univ. de San Martin (Argentina); Ricardo O. Sirne, Univ. de Buenos Aires (Argentina); Carlos E. D'Attellis, Univ. de San Martin (Argentina); Guillermo La Mura, Univ. de Buenos Aires (Argentina) [8401-30]

4:30 pm: **A computational approach for statistical learning**, Xinjia Chen, Southern Univ. and A&M College (USA) [8401-31]

4:50 pm: **An objective evaluation metric for color image fusion**, Wenjie Dong, The Univ. of Texas-Pan American (USA); Yufeng Zheng, Alcorn State Univ. (USA) [8401-32]

Friday 27 April

SESSION 12

Room: Conv. Ctr. 332 Fri. 8:00 to 8:40 am

Systems Biology Pioneer Award

Session Chairs: **Nadarajen A. Vydelingum**, National Institutes of Health (USA); **Anke D. Meyer Baese**, The Florida State Univ. (USA);
Douglas A. Lauffenburger,
Massachusetts Institute of Technology (USA)

System Biology Pioneer Award for the Excellence in the Field of Cellular Imaging Science

Presented to **Prof. Xiaowei Zhuang**, Harvard Univ. (USA)

8:00 am: **Bioimaging on the nanoscale: single-molecule and superresolution fluorescence microscopy** (*Invited Paper*), Xiaowei Zhuang, Harvard Univ. (USA) [8401-33]

PANEL DISCUSSION

Room: Conv. Ctr. 332 Fri. 8:40 to 9:20 am

Optical RGB Resolution Beyond Rayleigh Criterion

Panel Moderators: **John Caulfield**, Alabama A&M Univ. (USA);
Xiaowei Zhuang, Harvard Univ.(USA)

Panelists: **Hiroshi Nakajima**, OMRON Corp. (Japan);

Nadarajen A. Vydelingum, National Institute of Health (USA);

Jide Familoni, U.S. Army Night Vision &

Electronic Sensors Directorate (USA);

Soo-Young Lee, Korea Advanced Institute of Science and Technology (Korea, Republic of);

Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA);

Yutaka Hata, Univ. of Hyogo (Japan)

SESSION 13

Room: Conv. Ctr. 332 Fri. 9:20 to 10:00 am

System Biology Imaging Processing

Session Chairs: **Chee-Hung Henry Chu**, Univ. of Louisiana at Lafayette (USA); **Xiaowei Zhuang**, Harvard Univ. (USA)

9:20 am: **Biomedical wellness monitoring systems with molecular markers**, Whitney M. Ingram, The Univ. of Georgia (USA); Lein Ma, Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8401-34]

9:40 am: **Opto-acoustic processing algorithms for intravascular imaging using polymer optical interferometric ultrasonic sensors**, Horacio R. Lamela Rivera, Aranzalu Fernandez, Pablo Gonzalez, Daniel C. Gallego, Univ. Carlos III de Madrid (Spain) [8401-35]

Coffee Break 10:00 to 10:20 am

SESSION 14

Room: Conv. Ctr. 332 Fri. 10:20 am to 12:00 pm

Engineering Systems and Applications

Session Chairs: **Xiaowei Zhuang**, Harvard Univ. (USA);

Babajide O. Familoni, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

10:20 am: **Further development of artificial neural networks (ANNs) for spectral interference correction in optical emission spectrometry**, Zhimin Li, Vassili Karanassios, Univ. of Waterloo (Canada) [8401-36]

10:40 am: **Quantitative analysis of breast DCE-MR images based on novel empirical models**, Sebastian Goebel, Ludwig-Maximilians-Univ. München (Germany); Anke D. Meyer Baese, The Florida State Univ. (USA) [8401-37]

11:00 am: **Automatic evaluation of single and joint kinetic and morphologic features for non-masses**, Anke D. Meyer Baese, The Florida State Univ. (USA) [8401-38]

11:20 am: **How effective is kinetic, morphologic, and mixed analysis for both mass and non-mass lesions?**, Anke D. Meyer Baese, The Florida State Univ. (USA) [8401-39]

11:40 am: **Neurosciences meet augmented reality on the battlefield**, Jeffrey C. Jenkins, Jide Familoni, William Horner, Harold H. Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8401-40]

Lunch Break 12:00 to 1:00 pm

SESSION 15

Room: Conv. Ctr. 332 Fri. 1:00 to 1:40 pm

Biomedical Wellness Pioneer Award

Session Chairs: **Soo-Young Lee**, KAIST (Korea, Republic of);
Hiroshi Nakajima, OMRON Corp. (Japan)

Biomedical Wellness Pioneer Award for Contribution to Biomedical Bioinformatics

Presented to **Prof. Lipo Wang**,
Nanyang Technological Univ. (Singapore)

1:00 pm: **Feature selection in bio-informatics** (*Invited Paper*), Lipo Wang, Nanyang Technological Univ. (Singapore) [8401-41]

SESSION 16

Room: Conv. Ctr. 332 Fri. 1:40 to 2:20 pm

Biomedical Wellness Leadership Award

Presented to **Dr. John Tangney**,
U.S. Office of Naval Research Human &
Bioengineering Systems Div. Directorate

Leadership Recipients and Panels

Moderators: **Harold Szu**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Soo-Young Lee**, Korea Advanced Institute of Science and Technology (Korea, Republic of); **Hiroshi Nakajima**, OMRON Corp. (Japan); **Yutaka Hata**, Univ. of Hyogo (Japan);

Takeshi Yamakawa, Kyushu Institute of Technology (Japan);
Lipo Wang, Nanyang Technological Univ. (Singapore)

- 2010 Wavelet Leadership Award to **Sir John Daugman**, Univ. Cambridge, for Iris' Gabor Code
- 2002 Unsupervised Learning ICA Leadership to **Prof. Sunichi Amari**, Japan RIKEN Director
- 1999: Wavelet Leadership Award to **Mr Tom Hopper** of U. S. FBI fingerprint compression, JPEG 2000

1:40 pm: **Biomedical wellness challenges and opportunities**
(Invited Paper), John Tangney, Office of Naval Research (USA) . . . [8401-42]

SESSION 17

Room: Conv. Ctr. 332 Fri. 2:20 to 5:00 pm

Human Measurement Sciences

Session Chairs: **Chee-Hung Henry Chu**, Univ. of Louisiana at Lafayette (USA); **Yutaka Hata**, Univ. of Hyogo (Japan)

2:20 pm: **SAFE for PTSD: noncontact psychophysiological measure based on high-resolution thermal imaging to aid in PTSD diagnosis and assessment of treatment**, Babajide O. Familoni, J. Andrew Hutchinson, U.S. Army Night Vision & Electronic Sensors Directorate (USA); C. Andrew Morgan III, Yale School of Medicine (USA); Ann M. Rasmussen, Boston Univ. (USA); Barbara L. O'Kane, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8401-43]

2:40 pm: **Under-dermal emulator of vascular identification**, Joseph S. Landa, Robert P. Blake, Alex Rich, BriarTek, Inc. (USA); Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8401-44]

Coffee Break 3:00 to 3:20 pm

3:20 pm: **Adaptive region of interest (ROI) detection and tracking for respiration measurement in thermal video**, Balvinder Kaur, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Jill K. Nelson, George Mason Univ. (USA); J. Andrew Hutchinson, Timothy J. Williams, Barbara L. O'Kane, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8401-45]

3:40 pm: **Trans-skull ultrasonic Doppler system aided by fuzzy logic**, Yutaka Hata, Masato Nakamura, Univ. of Hyogo (Japan); Naomi Yagi, Tomomoto Ishikawa, Ishikawa Hospital (Japan) [8401-46]

4:00 pm: **Human care system for heart-rate and human-movement trajectory in home and its application to detect mental disease and cognitive disorder**, Yutaka Hata, Seigo Kanazawa, Univ. of Hyogo (Japan); Maki Endo, Naoki Tsuchiya, Hiroshi Nakajima, OMRON Corp. (Japan) [8401-47]

4:20 pm: **Systems health care: daily measurement and lifestyle change**, Hiroshi Nakajima, Naoki Tsuchiya, OMRON Corp. (Japan); Toshikazu Shiga, Omron Healthcare Co., Ltd. (Japan); Yutaka Hata, Univ. of Hyogo (Japan) [8401-48]

4:40 pm: **Fundamental matrix and planar homographies in stereo vision**, Chee-Hung Henry Chu, Univ. of Louisiana at Lafayette (USA); Qiang He, Mississippi Valley State Univ. (USA) [8401-49]

Don't Miss the Free Exhibition

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500 Companies

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- Tuesday · 10:00 am to 5:00 pm
- Wednesday · 10:00 am to 5:00 pm
- Thursday · 10:00 am to 2:00 pm

Evolutionary and Bio-inspired Computation: Theory and Applications VI

Conference Chairs: **Olga Mendoza-Schrock**, Air Force Research Lab. (USA); **Mateen M. Rizki**, Wright State Univ. (USA)

Program Committee: **Misty Blowers**, Air Force Research Lab. (USA); **Dale E. Courte**, Univ. of Dayton (USA); **Peter M. LaMonica**, Air Force Research Lab. (USA); **Teresa H. O'Donnell**, Air Force Research Lab. (USA); **Leonid I. Perlovsky**, Air Force Research Lab. (USA); **Michael R. Peterson**, Univ. of Hawai'i (USA); **Todd V. Rovito**, Air Force Research Lab. (USA); **Alex F. Sisti**, Air Force Research Lab. (USA); **Hugh L. Southall**, Air Force Research Lab. (USA); **John Spina**, Air Force Research Lab. (USA)

Wednesday 25 April

SESSION 1

Room: Conv. Ctr. 318 Wed. 1:40 to 2:20 pm

Keynote Session

Session Chair: **Mateen M. Rizki**, Wright State Univ. (USA)

1:40 pm: **Hierarchical decomposition considered inconvenient: self-adaptation across abstraction layers** (Keynote Presentation), John C. Gallagher, Wright State Univ. (USA) [8402-01]

SESSION 2

Room: Conv. Ctr. 318 Wed. 2:20 to 5:40 pm

Layered Sensing Exploitation

Session Chair: **Todd V. Rovito**, Air Force Research Lab. (USA)

2:20 pm: **Uncertainty preserving patch-based online modeling for 3D model acquisition and integration from passive motion imagery**, Hao Tang, The City College of New York (USA); Peng Chang, Princeton Vision LLC (USA); Edgardo Molina, Zhigang Zhu, The City College of New York (USA) [8402-02]

2:40 pm: **Feature-based background registration in wide-area motion imagery**, Yi Wu, Temple Univ. (USA); Genshe Chen, Independent Consultant (USA); Khanh D. Pham, Erik P. Blasch, Air Force Research Lab. (USA); Li Bai, Haibin Ling, Temple Univ. (USA) [8402-03]

Coffee/Exhibition Break. 3:00 to 4:00 pm

4:00 pm: **Wide area motion imagery tracking**, Juan R. Vasquez, Karl T. Salva, Air Force Research Lab. (USA) [8402-04]

4:20 pm: **Persistent electro-optical/infrared (EO/IR) wide-area sensor exploitation**, Andrew P. Brown, Toyon Research Corp. (USA) [8402-05]

4:40 pm: **Anomaly detection driven active learning for identifying suspicious tracks and events in WAMI video**, David J. Miller, Aditya Natraj, The Pennsylvania State Univ. (USA); Kevin J. Sullivan, Katherine Dunn, Michael Sheffler, Toyon Research Corp. (USA) [8402-06]

5:00 pm: **Comparison of 3D reconstruction techniques**, Todd V. Rovito, Bernard O. Abayowa, Rebecca L. Price, Air Force Research Lab. (USA). [8402-08]

5:20 pm: **Insect vision-based, collision-avoidance system for remotely piloted aircraft**, Holger M. Jaenisch, Licht Strahl Engineering, Inc. (USA); Andrew Bevilacqua, Bevilacqua Research Corp. (USA); James W. Handley, Licht Strahl Engineering, Inc. (USA) [8402-09]

Thursday 26 April

SESSION 3

Room: Conv. Ctr. 318 Thurs. 9:00 to 10:00 am

Network Extraction, Discovery, and Analysis I

Session Chair: **Peter M. LaMonica**, Air Force Research Lab. (USA)

9:00 am: **Multi-attributed network discovery: learning suspicious patterns in social network data**, Jennifer M. Roberts, Georgiy M. Levchuk, Jared Freeman, Aptima, Inc. (USA) [8402-11]

9:20 am: **Language translation of web-based content**, Bart Kahler, Katherine C. Jones, SAIC (USA). [8402-12]

9:40 am: **Pattern activity clustering and evaluation (PACE) for security operations**, Erik P. Blasch, Air Force Research Lab. (USA); Christopher Banas, Michael Paul, BAE Systems (USA); Rebecca J. Bussjager, Air Force Research Lab. (USA) [8402-13]

Coffee Break 10:00 to 10:30 am

SESSION 4

Room: Conv. Ctr. 318 Thurs. 10:30 to 11:50 am

Network Extraction, Discovery, and Analysis II

Session Chair: **John Spina**, Air Force Research Lab. (USA)

10:30 am: **Web-based geospatial information extraction**, Bart Kahler, Katherine C. Jones, SAIC (USA) [8402-14]

10:50 am: **Layered network analysis: an approach for fusion of multi-int, textual data sources**, Peter M. LaMonica, Craig S. Anken, Air Force Research Lab. (USA) [8402-15]

11:10 am: **Quality-of-service sensitivity to bio-inspired/evolutionary computational methods for intrusion detection in wireless ad hoc multimedia sensor networks**, William S. Hortos, Jr., Associates in Communication Engineering Research and Technology (USA) [8402-16]

11:30 am: **A spider-web approach to the recovery of wireless ad hoc sensor networks damaged in destructive environments**, William S. Hortos, Jr., Associates in Communication Engineering Research and Technology (USA) [8402-17]

Lunch/Exhibition Break 11:50 am to 1:20 pm

Conference 8402 · Room: Conv. Ctr. 318

SESSION 5

Room: Conv. Ctr. 318 Thurs. 1:20 to 3:50 pm

Small Target Applications

Session Chair: Misty Blowers, Air Force Research Lab. (USA)

1:20 pm: **Dismount tracking and identification from electro-optical imagery**, Erik P. Blasch, Air Force Research Lab. (USA); Haibin Ling, Yi Wu, Temple Univ. (USA); Guna Seetharaman, Michael Talbert, Air Force Research Lab. (USA); Li Bai, Temple Univ. (USA); Genshe Chen, DCM Research Resources, LLC (USA) [8402-18]

1:40 pm: **Learning and detecting coordinated multi-entity activities from persistent surveillance**, Georgiy M. Levchuk, Charlotte Chabarekh, Caitlin Furjanic, Aptima, Inc. (USA); Aaron F. Bobick, Georgia Institute of Technology (USA) [8402-19]

2:00 pm: **CMA-HT: a crowd-motion-analysis framework based on heat-transfer-analog model**, Yu Liang, Central State Univ. (USA); William L. Melvin, Georgia Institute of Technology (USA); Subramania I. Sritharan, Shane Fernandes, Central State Univ. (USA); Olga Mendoza-Schrock, Darrell Barker, Air Force Research Lab. (USA) [8402-20]

2:20 pm: **Differential profiling of volatile organic compound biomarker signatures utilizing a logical statistical filter-set and novel hybrid evolutionary classifiers**, Claude C. Grigsby, Air Force Research Lab. (USA); Michael A. Zmuda, Miami Univ. (USA); Derek W. Boone, Tyler C. Highlander, Wright State Univ. (USA); Ryan M. Kramer, Air Force Research Lab. (USA); Mateen M. Rizki, Wright State Univ. (USA) [8402-21]

2:40 pm: **Exploring point-cloud features from partial body views for gender classification**, Aaron M. Fouts, Ryan McCoppin, Mateen M. Rizki, Louis A. Tamburino, Wright State Univ. (USA); Olga Mendoza-Schrock, Air Force Research Lab. (USA) [8402-22]

Coffee Break 3:00 to 3:30 pm

3:30 pm: **Exploring manifold learning techniques using CAESAR database**, Olga Mendoza-Schrock, Air Force Research Lab. (USA); Michael L. Raymer, Wright State Univ. (USA) [8402-23]

SESSION 6

Room: Conv. Ctr. 318 Thurs. 3:50 to 5:30 pm

Tools, Techniques, and Applications

Session Chair: Mateen M. Rizki, Wright State Univ. (USA)

3:50 pm: **Robust fuzzy-rule-base framework for entity resolution**, Roger S. Gaborski, Rochester Institute of Technology (USA); Virginia Allen, Paul Yacci, IntelliGenesis, LLC (USA) [8402-24]

4:10 pm: **Robust multiplatform rf emitter localization**, Huthaifa A. Al Issa, Raul Ordonez, Univ. of Dayton (USA) [8402-25]

4:30 pm: **Creation of an API for sensors and servos**, Richard Van Hook, Air Force Research Lab. (USA) and Wright State Univ. (USA); Neal Eikenberry, Kevin Kirke, Samuel Lurie, John C. Gallagher, Wright State Univ. (USA) [8402-26]

4:50 pm: **Micro-UAV tracking for EO exploitation**, Richard Van Hook, Air Force Research Lab. (USA); David Browning, Josh Matthews-Martinez, Joe Wilhelm, John C. Gallagher, Wright State Univ. (USA) [8402-27]

5:10 pm: **Efficient, massively parallel exploration of networks by biological agents**, Dan V. Nicolau, Jr., Molecular Sense Ltd. (United Kingdom); Dan V. Nicolau, Univ. of Liverpool (United Kingdom) [8402-28]

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Performance analysis of a track-before-detect dynamic programming algorithm based on likelihood, Zaiping Lin, Yiyu Zhou, An Wei, National Univ. of Defense Technology (China) [8402-10]

Recovering projective structure and motion from straight lines, Panu Srestasathiem, Alper Yilmaz, The Ohio State Univ. (USA) [8402-07]

Modeling and Simulation for Defense Systems and Applications VII

Conference Chair: **Eric J. Kelmelis**, EM Photonics, Inc. (USA)

Program Committee: **James N. Elele**, Naval Air Systems Command (USA); **Susan Harkrider**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **David J. Thornley**, Imperial College London (United Kingdom)

Tuesday 24 April

SESSION 1

Room: Conv. Ctr. 333 Tues. 8:00 to 9:00 am

Optical and Electronic Systems

8:00 am: **Chip-scale photonic routing fabrics for avionic and satellite applications**, Ahmed Sharkawy, Mathew Zablocki, Michael Roman, Lumilant Inc. (USA) [8403-01]

8:20 am: **Optical processors using semiconductor optical amplifiers**, Shaozhen Ma, Wenbo Li, Niloy K. Dutta, Univ. of Connecticut (USA) ... [8403-02]

8:40 am: **High-fidelity modeling and simulation for radar electronic warfare system concepts**, Chen Wu, Anne Young, Defence Research and Development Canada, Ottawa (Canada) [8403-03]

SESSION 2

Room: Conv. Ctr. 333 Tues. 9:00 to 10:00 am

Imaging and Sensors

9:00 am: **Infrared imagery acquisition process supporting simulation and real-image training**, John D. O'Connor, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8403-04]

9:20 am: **Development of radiometrically accurate synthetic thermal infrared video for tracking algorithm evaluation**, David B. Rhodes, Zoran Ninkov, Rochester Institute of Technology (USA); J. Daniel Newman, Paul P. K. Lee, ITT Exelis Inc. (USA); Gregory J. Gosian, ITT Corp. (USA) [8403-05]

9:40 am: **Software for multimodal battlefield signal modeling and optimal sensor placement**, Kenneth K. Yamamoto, Sergey Vecherin, D. Keith Wilson, U.S. Army Engineer Research and Development Ctr. (USA); Chris Pettit, U.S. Naval Academy (USA) [8403-06]

Coffee Break 10:00 to 10:30 am

SESSION 3

Room: Conv. Ctr. 333 Tues. 10:30 to 11:50 am

Heterogeneous Computing

10:30 am: **Dealing with performance/portability and performance/accuracy trade-offs in heterogeneous computing systems: a case study**, Matthew Wezowicz, Michela Taufer, David Saunders, Univ. of Delaware (USA) [8403-07]

10:50 am: **Sparse matrix solutions for graphics processing units**, Kyle Spagnoli, John R. Humphrey, Jr., Daniel Price, Eric J. Kelmelis, EM Photonics, Inc. (USA) [8403-08]

11:10 am: **ArrayFire: a GPU acceleration platform**, Gallagher Pryor, AccelerEyes LLC (USA) [8403-09]

11:30 am: **A novel approach for effectively programming hybrid HPC platforms**, John R. Humphrey, Jr., Kyle Spagnoli, Daniel Price, Eric J. Kelmelis, EM Photonics, Inc. (USA) [8403-10]

Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 4

Room: Conv. Ctr. 333 Tues. 1:20 to 3:00 pm

Complex Systems

1:20 pm: **Constraints on first order Markov Chain models of spectrally decomposed road profiles**, Philip A. Chin, John B. Ferris, Virginia Polytechnic Institute and State Univ. (USA) [8403-11]

1:40 pm: **Analysis of special nuclear material (SNM) detection and interdiction using a collaborative constructive simulation environment**, Lee A. Hendrix, Robert Mayo, Roger West, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8403-12]

2:00 pm: **Massively scalable computational fluid dynamics solvers for hybrid supercomputing platforms**, Daniel Hertenstein, John R. Humphrey, Jr., Aaron L. Paolini, Eric J. Kelmelis, EM Photonics, Inc. (USA) [8403-13]

2:20 pm: **Data models as a general, fast framework for converting simulations at all scales into fast, real-time approximations**, Holger M. Jaenisch, James W. Handley, Licht Strahl Engineering, Inc. (USA) [8403-14]

2:40 pm: **A methodology for designing modeling and simulation (M&S) that integrates verification, validation, and accreditation (VV&A) processes and documentation**, James N. Elele, Nancy M. Gould, Naval Air Systems Command (USA) [8403-15]

Coffee/Exhibition Break 3:00 to 4:00 pm

SESSION 5

Room: Conv. Ctr. 333 Tues. 4:00 to 5:00 pm

Battlespace and Operations

4:00 pm: **An analytical approach to air defense: cost, effectiveness, and SWOT analysis of employing fighter aircraft and modern SAM systems**, Orcun Kus, Turkish Air Force (Turkey); Ibrahim Kocaman, Yucel Topcu, Turkish Air Force (USA) [8403-16]

4:20 pm: **Software as a service approach to sensor simulation software deployment**, Steven Webster, KINEX Inc. (USA); Gordon J. Miller, Oakwood Controls Corp. (USA); Gregory Mayott, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [8403-17]

4:40 pm: **Enhancing army analysis capability for war fighter protection: TRADOC-RDECOM M&S decision support environment collaboration**, Keith Athmer, Chris Gaughan, U.S. Army Research Lab. (USA) [8403-18]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A Tues. 6:00 to 7:30 pm

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COMBAT: mobile-Cloud-based cOmpute/oMmunications infrastructure for BAttlefield applications, Tolga Soyata, Rajani Muraleedharan, Scott Ames, Jonathan H. Langdon, Colin F. Funai, Univ. of Rochester (USA); Minseok Kwon, Rochester Institute of Technology (USA); Wendi B. Heinzelman, Univ. of Rochester (USA) [8403-20]

Wireless Sensing, Localization, and Processing VII

Conference Chairs: **Sohail A. Dianat**, Rochester Institute of Technology (USA); **Michael David Zoltowski**, Purdue Univ. (USA)

Program Committee: **Moeness G. Amin**, Villanova Univ. (USA); **John W. Nieto**, Harris Corp. (USA); **Raghuveer M. Rao**, U.S. Army Research Lab. (USA); **Yimin D. Zhang**, Villanova Univ. (USA)

Wednesday 25 April

SESSION 1

Room: Conv. Ctr. 334 Wed. 8:00 to 10:00 am

Sensor Networks

Session Chair: **John W. Nieto**, Harris Corp. (USA)

- 8:00 am: **STER: a look at sensor-triggered communication for wireless networks**, Aaron L. Robinson, Kristopher Langston, The Univ. of Memphis (USA) [8404-01]
- 8:20 am: **Prototype rf sensing platform for wireless sensor networks**, Christopher R. Barber, Rastko R. Selmic, Louisiana Tech Univ. (USA) .. [8404-02]
- 8:40 am: **Distributed parameter estimation in wireless sensor networks using fused local observations**, Mohammad Fanaei, Matthew C. Valenti, Natalia A. Schmid, West Virginia Univ. (USA) [8404-03]
- 9:00 am: **Routing in wireless ad hoc and sensor network underground with sensor data in real time**, Emmanuel Odeh-Lartey, Ing K. Hartmann, Hamidreza Ahmadian, Univ. Siegen (Germany). [8404-04]
- 9:20 am: **Distributed geolocation algorithm in mobile ad hoc networks using received signal strength differences**, Shanzeng Guo, Helen Y. Tang, Defence Research and Development Canada, Ottawa (Canada) [8404-05]
- 9:40 am: **Effects of energy harvesting on quality-of-service in real-time, wireless sensor networks**, William S. Hortos, Jr., Associates in Communication Engineering Research & Technology (USA) [8404-06]
- Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 334 Wed. 10:30 am to 12:10 pm

Diversity and Multicarrier Techniques

Session Chair: **Michael David Zoltowski**, Purdue Univ. (USA)

- 10:30 am: **New space-time codes for coherent transmission scheme using multiple antennas**, Xinjia Chen, Ernest L. Walker, Southern Univ. and A&M College (USA) [8404-07]
- 10:50 am: **Detection of code spreading OFDM based on 0-1 integer quadratic programming**, Ali A. Elghariani, Michael D. Zoltowski, Purdue Univ. (USA) [8404-08]
- 11:10 am: **Adaptive compressed channel estimation: tracking from a Bayesian perspective**, Chulong Chen, Michael D. Zoltowski, Purdue Univ. (USA) [8404-09]
- 11:30 am: **Partial spread OFDM**, Ali A. Elghariani, Michael D. Zoltowski, Purdue Univ. (USA) [8404-10]
- 11:50 am: **Comparing the performance of continuous phase modulation and constant envelope orthogonal frequency division multiplexing**, John W. Nieto, Harris Corp. (USA) [8404-11]
- Lunch/Exhibition Break 12:10 to 2:00 pm

SESSION 3

Room: Conv. Ctr. 334 Wed. 2:00 to 3:00 pm

Implementation and Applications

Session Chair: **Raghuveer M. Rao**, U.S. Army Research Lab. (USA)

- 2:00 pm: **New method for numerical approximations of vector derivatives based on digital signal processing techniques**, Henry Brice, Mohammed Z. Ahmed, Univ. of Plymouth (United Kingdom) [8404-12]
- 2:20 pm: **A novel approach for using polyphase filter bank in directly digital rf conversion from rf to baseband**, Deying Zhang, Qin Jiang, Mohiuddin Ahmed, HRL Labs., LLC (USA) [8404-14]
- 2:40 pm: **Serial concatenation schemes for PSK waveforms vs. turbo codes**, Fred C. Kellerman, Harris Corp. (USA) [8404-15]
- Coffee/Exhibition Break 3:00 to 4:00 pm

SESSION 4

Room: Conv. Ctr. 334 Wed. 4:00 to 5:00 pm

Detection and Localization

Session Chair: **Fred C. Kellerman**, Harris Corp. (USA)

- 4:00 pm: **Quadrature DS-SS wireless communication systems employing the generalized detector with pulse shaping**, Vyacheslav P. Tuzlukov, Kyungpook National Univ. (Korea, Republic of) [8404-16]
- 4:20 pm: **Joint optimization of source beamformer and relay coefficients using MSE criterion**, Batu K. Chalise, Yimin D. Zhang, Moeness G. Amin, Villanova Univ. (USA) [8404-17]
- 4:40 pm: **Performance of partially coherent CPM on multipath fading channel**, James A. Norris, Harris Corp. (USA) [8404-18]

Courses of Related Interest

- SC1075 **Methods of Energy Harvesting for Low-Power Sensors** (Erturk) Wednesday, 1:30 to 5:30 pm
 - SC901 **Sensor Array Signal Processing** (Rao) Thursday, 8:30 am to 5:30 pm
- See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Defense Transformation and Net-Centric Systems 2012

Conference Chair: **Raja Suresh**, General Dynamics Advanced Information Systems (USA)

Program Committee: **Vasu D. Chakravarthy**, Air Force Research Lab. (USA); **John S. Eicke**, U.S. Army Research Lab. (USA); **Bassam S. Farroha**, U.S. Dept. of Defense (USA); **Deborah L. Farroha**, U.S. Dept. of Defense (USA); **Paul Gaertner**, Embassy of Australia (USA); **Gayle D. Grant**, U.S. Army Communications-Electronics Command (USA); **Michael A. Kolodny**, U.S. Army Research Lab. (USA); **Leo J. Rose**, U.S. Air Force (USA); **Larry B. Stotts**, Defense Advanced Research Projects Agency (USA); **Venkataraman Sundareswaran**, Teledyne Scientific Co. (USA); **Guy Vézina**, Defence Research and Development Canada, Valcartier (Canada)

Tuesday 24 April

SESSION 1

Room: Conv. Ctr. 335 Tues. 8:30 am to 12:10 pm

Net-Centric Architectures and Systems

Session Chairs: **Raja Suresh**, General Dynamics Advanced Information Systems (USA); **Bassam S. Farroha**, U.S. Dept. of Defense (USA)

8:30 am: **Defining and utilizing open architecture levels** (*Invited Paper*), Megan Cramer, U.S. Navy (USA); Jason R. Stack, Office of Naval Research (USA); Brett Cordes, Naval Surface Warfare Ctr. Panama City Div. (USA) [8405-01]

9:00 am: **Models and algorithms for determining inter-unit network demand**, Jeffrey Ridder, Samuel Brett, Evidence Based Research, Inc. (USA); Craig Burris, Jimmie McEver, Jack O'Donnel, The Johns Hopkins Univ. Applied Physics Lab. (USA); David Signori, Evidence Based Research, Inc. (USA); Heather Schoenborn, U.S. Dept. of Defense (USA) [8405-02]

9:20 am: **A flexible tool for scenario analysis of network demand**, Jack O'Donnel, The Johns Hopkins Univ. Applied Physics Lab. (USA); Ayanah George, Danielle Wynn, Samuel Brett, Jeffrey Ridder, David Signori, Evidence Based Research, Inc. (USA); Heather Schoenborn, U.S. Dept. of Defense (USA) [8405-03]

9:40 am: **The ozone widget framework: towards modularity of C2 human interfaces**, David B. Hellar, Laurian Vega, Next Century Corp. (USA) ... [8405-04]

Coffee Break 10:00 to 10:30 am

10:30 am: **Military clouds: utilization of cloud computing systems at the battlefield**, Suleyman Sarikurk, Volkan Karaca, Ibrahim Kocaman, Ahmet Sirzai, Turkish Air War College (Turkey) [8405-05]

10:50 am: **Overcoming the challenges of secure mobile applications for network-centric, data-sensitive applications**, Bassam S. Farroha, Deborah L. Farroha, U.S. Dept. of Defense (USA) [8405-06]

11:10 am: **Securing services in the cloud: an investigation of the threats and the mitigations**, Bassam S. Farroha, Deborah L. Farroha, U.S. Dept. of Defense (USA) [8405-07]

11:30 am: **A framework for developing reliable corporate services in an agile environment**, Bassam S. Farroha, Deborah L. Farroha, U.S. Dept. of Defense (USA) [8405-08]

11:50 am: **Modeling socio-cultural processes in network centric environments**, Eunice E. Santos, The Univ. of Texas at El Paso (USA); Eugene Santos, Jr., Dartmouth College (USA); John Korah, Riya M. George, The Univ. of Texas at El Paso (USA); Qi Gu, Keumjoo Kim, Deqing Li, Jacob A. Russell, Thayer School of Engineering at Dartmouth (USA); Suresh Subramanian, The Univ. of Texas at El Paso (USA) [8405-09]

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

SESSION 2

Room: Conv. Ctr. 335 Tues. 1:40 to 3:40 pm

Communications and Networks

Session Chairs: **Gayle D. Grant**, U.S. Army Communications-Electronics Command (USA); **Deborah L. Farroha**, U.S. Dept. of Defense (USA)

1:40 pm: **Protection without detection: embracing a resilient coexistence in a malicious network environment**, Paul Ratazzi, Air Force Research Lab. (USA); Joshua S. White, Everis, Inc. (USA) and Clarkson Univ. (USA); Joe R. McCoy, Everis, Inc. (USA) [8405-10]

2:00 pm: **Dynamic routing control in heterogeneous tactical networks with multiple traffic priorities**, Mariusz A. Fecko, Larry Wong, Jaewong Kang, Ta Chen, Vikram Kaul, Sunil Samtani, Telcordia Technologies, Inc. (USA) .. [8405-11]

2:20 pm: **Proactive and adaptive reconfiguration for reliable communication in tactical networks**, Hui Zeng, Kyung Joon Kwak, Julia Deng, Intelligent Automation, Inc. (USA); Bo Fu, Yang Xiao, The Univ. of Alabama (USA); John J. Jeski, U.S. Army CERDEC Intelligence and Information Warfare Directorate (USA) [8405-12]

2:40 pm: **Addressing security, collaboration, and usability with tactical edge mobile devices and strategic cloud-based systems**, Christopher J. Graham, Raytheon Co. (USA) [8405-13]

3:00 pm: **A decision and utility theory construct for dynamic spectrum access systems**, Todd Martin, Kuo-Chu Chang, George Mason Univ. (USA) [8405-14]

3:20 pm: **Information dissemination in disadvantaged wireless communications using a data dissemination service and content data network**, Matthew Gillen, Joseph P. Loyall, Karen Zita Haigh, Robert Walsh, Craig Partridge, BBN Technologies (USA) [8405-15]

Wednesday 25 April

SESSION 3

Room: Conv. Ctr. 333 Wed. 8:00 to 10:00 am

Multi-Robot Control

Note room change.

Joint Session with Conference 8387

Session Chairs: **Raja Suresh**, General Dynamics Advanced Information Systems (USA); **Grant R. Gerhart**, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (Retired) (USA)

8:00 am: **A layered control architecture for single-operator control of heterogeneous unmanned system teams**, Stephen Buerger, Jason Neely, Charles Q. Little, Wendy Amai, Rommy Joyce, Sandia National Labs. (USA) [8387-01]

8:20 am: **Coordinating with humans by adjustable-autonomy for multirobot pursuit (CHAMP)**, Danielle Dumond, Jeanine Ayers, Nathan Schurr, Alan Carlin, Dustin Burke, Jeff Rousseau, Aptima, Inc. (USA) [8387-02]

8:40 am: **The reconnaissance and autonomy for small robots (RASR): MAGIC 2010 challenge**, Alberto Lacaze, Karl N. Murphy, Robotic Research LLC (USA); Mark Del Giorno, Del Services, LLC (USA); Katrina Corley, Embry-Riddle Aeronautical Univ. (USA) [8387-03]

Conference 8405 · Room: Conv. Ctr. 335

9:00 am: **Teleoperation control of collaborative multifunctional robotic swarms for multitask, multitarget scenarios**, Yushing Cheung, Stevens Institute of Technology (USA); Jae Chung, Ketula Patel, U.S. Army Armament Research, Development and Engineering Ctr. (USA) [8387-04]

9:20 am: **A feedback-trained, autonomous control system for heterogeneous search-and-rescue applications**, Jeremy Straub, The Univ. of North Dakota (USA) [8387-05]

9:40 am: **Spatial grasp technology and its application to distributed robotized systems**, Peter S. Sapaty, National Academy of Sciences of Ukraine (Ukraine) [8387-06]

SESSION 4

Room: Conv. Ctr. 313 Wed. 1:40 to 3:20 pm

Wide Area Persistent ISR and Networked Sensors I

Note room change.

Joint Session with Conference 8389

Session Chairs: **Raja Suresh**, General Dynamics Advanced Information Systems (USA); **Tien Pham**, U.S. Army Research Lab. (USA)

1:40 pm: **DARPA's HARDI program for a wide field of view, VIS-NIR-SWIR detector based on a curved focal plane array** (*Invited Paper*), Devanand K. Shenoy, Defense Advanced Research Projects Agency (USA) [8405-16]

2:10 pm: **Advanced thermal management technologies for defense electronics** (*Invited Paper*), Avram Bar-Cohen, Univ. of Maryland, College Park (USA); Kristen Bloschok, System Planning Corp. (USA) [8405-17]

2:40 pm: **An architecture for distributed video applications based on declarative networking**, Xiping Wang, Cesar Gonzales, Jorge Lobo, Seraphin Calo, Dinesh Verma, IBM Thomas J. Watson Research Ctr. (USA) [8389-36]

3:00 pm: **From information needs to information gathering: a system optimization perspective to ISR synchronization**, Moises Sudit, Hector Ortiz-Pena, Michael Moskal, CUBRC (USA); James Fink, Daniel Tuttle, Timothy Hanratty, Eric Heilman, Michael Dawson, U.S. Army Intelligence Ctr. (USA) [8389-37]

Coffee Break 3:20 to 4:00 pm

SESSION 5

Room: Conv. Ctr. 313 Wed. 4:00 to 5:40 pm

Wide Area Persistent ISR and Networked Sensors II

Note room change.

Joint Session with Conference 8389

Session Chairs: **Raja Suresh**, General Dynamics Advanced Information Systems (USA); **Tien Pham**, U.S. Army Research Lab. (USA)

4:00 pm: **Wide area, persistent surveillance video with no gimbal**, Geoffrey Egnal, Argusight, Inc. (USA) [8405-18]

4:20 pm: **Low-latency situational awareness for UxV platforms**, David Berends, SRI International Sarnoff (USA) [8389-38]

4:40 pm: **LEAPS and WFPAC status**, Augustus S. Moore, Geoff Hazel, Bryan Schulz, Logos Technologies, Inc. (USA) [8405-19]

5:00 pm: **Acoustic data analysis and scenario overwatch from an aerostat at the NATO SET-153 field experiment**, Christian G. Reiff, U.S. Army Research Lab. (USA) [8389-39]

5:20 pm: **Kestrel aerostat-based wide area persistent surveillance**, David R. Luber, Logos Technologies, Inc. (USA) [8405-20]



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Mobile Multimedia/Image Processing, Security, and Applications 2012

Conference Chairs: **Sos S. Aгаian**, The Univ. of Texas at San Antonio (USA); **Sabah A. Jassim**, The Univ. of Buckingham (United Kingdom); **Eliza Yingzi Du**, Indiana Univ.-Purdue Univ. Indianapolis (USA)

Program Committee: **Farid Ahmed**, The Johns Hopkins Univ. Applied Physics Lab. (USA); **David Akopian**, The Univ. of Texas at San Antonio (USA); **Salim Alsharif**, Univ. of South Alabama (USA); **Cesar Bandera**, BanDeMar Networks (USA); **Chang Wen Chen**, Univ. at Buffalo (USA); **Ravindranath Chowdary**, KL Univ. (India); **Reiner Creutzburg**, Fachhochschule Brandenburg (Germany); **Stephen P. DeMarco**, BAE Systems (USA); **Martin Dietze**, Consultant (Germany); **Frederic Dufaux**, Telecom ParisTech (France); **Touradj Ebrahimi**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Erlan H. Feria**, College of Staten Island (USA); **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. (USA); **Cheryl L. Resch**, The Johns Hopkins Univ. Applied Physics Lab. (USA); **Sonia Garcia-Salicetti**, Telecom ParisTech (France); **Harin Sellahewa**, The Univ. of Buckingham (United Kingdom); **Xiyu Shi**, Univ. of Surrey (United Kingdom); **Yuri Shukuryan**, National Academy of Sciences of Armenia (Armenia); **Jinshan Tang**, Michigan Technological Univ. (USA)

Monday 23 April

SESSION 1

Room: Conv. Ctr. 334 Mon. 8:40 to 9:40 am

Biometrics I

Session Chairs: **Sabah A. Jassim**, The Univ. of Buckingham (United Kingdom); **Norman Poh**, Univ. of Surrey (United Kingdom)

8:40 am: **Neuro-fuzzy prediction method for corrupted fingerprint restoration**, Somayeh Bakhtiari, Elmira Mohyeddinbonab, Sos S. Aгаian, Mo Jamshidi, The Univ. of Texas at San Antonio (USA) [8406-02]

9:00 am: **Parallel computing-based sclera recognition for human identification**, Yong Lin, Xidian Univ. (China); Eliza Y. Du, Zhi Zhou, Indiana Univ.-Purdue Univ. Indianapolis (USA) [8406-03]

9:20 am: **SURF characterized limited physiological information for face recognition**, Dakshina R. Kisku, Asansol Engineering College (India); Ajita Rattani, Univ. degli Studi di Cagliari (Italy); Phalguni Gupta, Indian Institute of Technology Kanpur (India); Jamuna K. Sing, Jadavpur Univ. (India) [8406-04]

SESSION 2

Room: Conv. Ctr. 334 Mon. 9:40 to 11:40 am

Mobile Applications

Session Chairs: **Sos S. Aгаian**, The Univ. of Texas at San Antonio (USA); **Reiner Creutzburg**, Fachhochschule Brandenburg (Germany)

9:40 am: **dLocAuth: a dynamic multifactor authentication scheme for mCommerce applications using independent location-based obfuscation**, Ihsan A. Lami, Torben Kuseler, The Univ. of Buckingham (United Kingdom) [8406-05]

Coffee Break 10:00 to 10:40 am

10:40 am: **Comprehensive feature and texture fusion-based image registration approach**, Francis R. Bowen, Eliza Y. Du, Indiana Univ.-Purdue Univ. Indianapolis (USA); Jianghai Hu, Purdue Univ. (USA) [8406-06]

11:00 am: **Human visual system-based smoking event detection**, Amjad Odetallah, Sos S. Aгаian, The Univ. of Texas at San Antonio (USA) [8406-07]

11:20 am: **Information encryption and retrieval in mid-RF range using acousto-optic chaos**, Monish R. Chatterjee, Abhinay Kundur, Univ. of Dayton (USA) [8406-08]

Lunch Break 11:40 am to 1:20 pm

SESSION 3

Room: Conv. Ctr. 334 Mon. 1:20 to 2:40 pm

Biometrics II

Session Chairs: **Eliza Yingzi Du**, Indiana Univ.-Purdue Univ. Indianapolis (USA); **Seokwon Yeom**, Daegu Univ. (Korea, Republic of)

1:20 pm: **Biometric templates selection and update using quality measures**, Ali J. Abboud, Sabah A. Jassim, The Univ. of Buckingham (United Kingdom) [8406-09]

1:40 pm: **Multibiometrics fusion for identity verification**, Dakshina R. Kisku, Asansol Engineering College (India); Ajita Rattani, Univ. degli Studi di Cagliari (Italy); Phalguni Gupta, Indian Institute of Technology Kanpur (India); Jamuna K. Sing, Jadavpur Univ. (India) [8406-10]

2:00 pm: **Adaptive error correction codes for face identification**, Wafaa R. Hussein, Harin Sellahewa, Sabah A. Jassim, The Univ. of Buckingham (United Kingdom) [8406-11]

2:20 pm: **Real-time face identification method in mobile environments**, Dong-Su Lee, Seokwon Yeom, Yong-Hyun Woo, Shin-Hwan Kim, Daegu Univ. (Korea, Republic of) [8406-12]

SESSION 4

Room: Conv. Ctr. 334 Mon. 2:40 to 4:50 pm

Multimedia Signal Processing Algorithms and Systems

Session Chairs: **Jinshan Tang**, Michigan Technological Univ. (USA); **Stephen P. DeMarco**, BAE Systems (USA)

2:40 pm: **Arabic handwritten: pre-processing and segmentation**, Makki Maliki, Sabah A. Jassim, Naseer Al-Jawad, Harin Sellahewa, The Univ. of Buckingham (United Kingdom) [8406-13]

Coffee Break 3:00 to 3:30 pm

3:30 pm: **Saccadic eyes recognition using 3D shape data from a 3D near infrared sensor**, Shengwen Guo, Alcorn State Univ. (USA); Jinshan Tang, Michigan Technological Univ. (USA); Julia B. Parakkat, Kathleen M. Robinette, Air Force Research Lab. (USA) [8406-14]

3:50 pm: **Mathematical properties of a sensitivity measure for quantifying feature variation**, Stephen P. DeMarco, BAE Systems (USA) [8406-15]

4:10 pm: **Salient region detection for object tracking**, Chan Fan, Min Jiang, Wuhan Univ. of Science and Technology (China); J. Tang, Michigan Technological Univ. (USA) [8406-16]

4:30 pm: **New methods for high-capacity embedding in multimedia covers using redundant number systems with adjunctive numerical representations**, James C. Collins, The Univ. of Texas at San Antonio (USA) [8406-17]

Symposium-Wide Plenary Session

Monday • 5:00 to 6:00 pm • Conv. Ctr. (Level 400), Ballroom I-II

Bruce Carlson, Director, National Reconnaissance Office

See p. 11 for details • Open to All Attendees

Tuesday 24 April

SESSION 5

Room: Conv. Ctr. 334 Tues. 10:00 am to 12:20 pm

Image/Information Security

Session Chairs: **Sabah A. Jassim**, The Univ. of Buckingham (United Kingdom); **James C. Collins**, The Univ. of Texas at San Antonio (USA)

10:00 am: **Privacy-aware access control for video data in intelligent surveillance systems**, Hauke Vagts, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [8406-18]

10:20 am: **A fractal-based nonlocal means image denoising algorithm**, Shahan C. Nercessian, Karen A. Panetta, Tufts Univ. (USA); Sos S. Agaian, The Univ. of Texas at San Antonio (USA) [8406-19]

10:40 am: **Incremental fusion of partial biometric information**, Ali J. Abboud, Sabah A. Jassim, The Univ. of Buckingham (United Kingdom) [8406-20]

11:00 am: **Retinal image analysis for quantification of progression of ocular disease**, Sumit Chakravarty, SGT, Inc. (USA); Mausumi Acharyya, Advenio TecnoSys Pvt. Ltd. (India) [8406-21]

11:20 am: **Different analysis methods for forensic investigation of mobile devices using commercial tools: an overview**, Knut Kröger, Reiner Creutzburg, Fachhochschule Brandenburg (Germany) [8406-22]

11:40 am: **Improving energy efficiency in handheld biometric applications**, David C. Hoyle, John W. Gale, Reagan K. Sanders, Robert W. Ives, Ryan N. Rakvic, Robert C. Schultz, U.S. Naval Academy (USA) [8406-23]

12:00 pm: **Local enhancement and denoising algorithms on arbitrary mesh surfaces**, Sos S. Agaian, The Univ. of Texas at San Antonio (USA); Richard Sartor, Jr., Interdisciplinary Solutions (USA) [8406-24]

POSTERS-TUESDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Penetration tests in next generation networks, Filip Rezac, Miroslav Voznak, Technical Univ. of Ostrava (Czech Republic) [8406-25]

Multispectral palmprint recognition by kernel associative memory-based computational model and finite ridgelet transform, Dakshina R. Kisku, Asansol Engineering College (India); Ajita Rattani, Univ. degli Studi di Cagliari (Italy); Phalguni Gupta, Indian Institute of Technology Kanpur (India); Jamuna K. Sing, Jadavpur Univ. (India) [8406-26]

iPhone examination with modern forensic software tools, Thomas Hoene, Silas Luttenberger, Reiner Creutzburg, Fachhochschule Brandenburg (Germany) [8406-27]

A manifold learning-based identification of latent variations in root cross sections of plants, Sumit Chakravarty, SGT, Inc. (USA); Madhushri Banerjee, Georgia Gwinnett College (USA) [8406-28]

Forensic determination of burner serial number placed on DVD-R(W) optical disks, Frank Irmeler, Knut Kröger, Reiner Creutzburg, Fachhochschule Brandenburg (Germany) [8406-29]

Computer-assisted machine-to-human protocols for authentication of a RAM-based embedded system, Abdourhamane Idrissa, Alain Aubert, Thierry Fournel, Lab. Hubert Curien (France) [8406-30]

Analysis methods of Mac OS X with commercial forensic software: an overview, Knut Kröger, Reiner Creutzburg, Fachhochschule Brandenburg (Germany) [8406-31]

Forensics of geodata collected by various mobile devices, Knut Kröger, Stefan Sack, Reiner Creutzburg, Fachhochschule Brandenburg (Germany) [8406-32]

Joint context prediction for covert data merging, Richard E. Metzler, The Univ. of Texas at San Antonio (USA) [8406-33]

Arabic writer identification based on diacritic's features, Makki Maliki, Naseer Al-Jawad, Sabah A. Jassim, The Univ. of Buckingham (United Kingdom) [8406-34]

Enhancement and analysis of fused thermal and RGBD data, Michael O. Blanton, Sos S. Agaian, The Univ. of Texas at San Antonio (USA) [8406-35]

Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications 2012

Conference Chair: **Jerome J. Braun**, MIT Lincoln Lab. (USA)

Program Committee: **Sheela V. Belur**, The Van Dyke Technology Group, Inc. (USA); **D. Paul Benjamin**, Pace Univ. (USA); **Belur V. Dasarathy**, Information Fusion Technologies (USA); **Michael Heizmann**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Charles F. Hester**, U.S. Army Research, Development and Engineering Command (USA); **Mieczyslaw M. Kokar**, Northeastern Univ. (USA); **Damian M. Lyons**, Fordham Univ. (USA); **Mirela Popa**, General Dynamics Armament and Technical Products (USA); **Firooz A. Sadjadi**, Lockheed Martin Maritime Systems & Sensors (USA); **Pierre Valin**, Defence Research and Development Canada, Valcartier (Canada); **Pramod Kumar Varshney**, Syracuse Univ. (USA); **Shanchieh Jay Yang**, Rochester Institute of Technology (USA)

Wednesday 25 April

SESSION 1

Room: Conv. Ctr. 335 Wed. 8:40 to 10:20 am

Information Fusion Approaches and Algorithms I

Session Chairs: **Jerome J. Braun**, MIT Lincoln Lab. (USA); **Damian M. Lyons**, Fordham Univ. (USA)

8:40 am: **Spectral and spatial algorithm architecture for classification of HSI and lidar**, Robert S. Rand, Timothy S. Khuon, National Geospatial-Intelligence Agency (USA) [8407-01]

9:00 am: **Effects of aberrations on image reconstruction of data from hybrid intensity interferometers**, Jeremy Murray-Krezan, Peter N. Crabtree, Air Force Research Lab. (USA) [8407-02]

9:20 am: **Multisource taxonomy-based classification using the transferable belief model**, William J. Farrell III, Andrew M. Knapp, Lakota Technical Solutions, Inc. (USA) [8407-03]

9:40 am: **Computationally efficient Bayesian fusion**, Brian R. La Cour, Jason M. Aughenbaugh, The Univ. of Texas at Austin (USA) [8407-04]

10:00 am: **Automated tracking of 2D optical and 3D flash lidar objects**, Ryan J. Poore, Richard L. Tutwiler, David L. Hall, The Pennsylvania State Univ. (USA) [8407-05]

Coffee Break 10:20 to 11:00 am

SESSION 2

Room: Conv. Ctr. 335 Wed. 11:00 am to 12:20 pm

Information Fusion Approaches and Algorithms II

Session Chairs: **Mirela Popa**, Chemring Detection Systems, Inc. (USA); **Charles F. Hester**, U.S. Army Research, Development and Engineering Command (USA)

11:00 am: **Cross layers decision making and fusion model in layered sensing systems**, Abdulqadir I. Khoshnaw, Saleh Zein-Sabatto, Mohan Malkani, Tennessee State Univ. (USA) [8407-06]

11:20 am: **Multilayer network centric fusion architecture and optimality**, Omar Aboutalib, System Analysis and Sensor Fusion Co. (USA) and California State Univ., Fullerton (USA) [8407-08]

11:40 am: **Leveraging provenance to improve data fusion in sensor networks**, Gulustan Dogan, Ted Brown, The City Univ. of New York (USA); Eunsoo Seo, Tarek F. Abdelzaher, Univ. of Illinois at Urbana Champaign (USA) [8407-09]

12:00 pm: **Analysis of decision fusion algorithms in handling uncertainties for integrated health monitoring systems**, Saleh Zein-Sabatto, Mohammad Bodruzzaman, Tennessee State Univ. (USA) [8407-10]

Lunch/Exhibition Break 12:20 to 2:00 pm

SESSION 3

Room: Conv. Ctr. 335 Wed. 2:00 to 5:00 pm

Information Fusion in Robotics

Session Chairs: **Damian M. Lyons**, Fordham Univ. (USA); **D. Paul Benjamin**, Pace Univ. (USA)

2:00 pm: **Multirobot autonomous landmine detection using distributed multisensor information aggregation**, Janyl Jumadinova, Raj Dasgupta, Univ. of Nebraska at Omaha (USA) [8407-11]

2:20 pm: **Architectural design and support for knowledge sharing across heterogeneous MAST systems**, Ronald C. Arkin, Sergio Garcia-Vergara, Sung G. Lee, Georgia Institute of Technology (USA) [8407-12]

2:40 pm: **Navigation of uncertain terrain by fusion of information from real and synthetic imagery**, Damian M. Lyons, Paramesh Nirmal, Fordham Univ. (USA) [8407-13]

Coffee/Exhibition Break 3:00 to 4:00 pm

4:00 pm: **Allothetic and idiothetic sensor fusion in rat-inspired robot localization**, Alfredo Weitzenfeld, Univ. of South Florida Polytechnic (USA); Jean-Marc Fellous, The Univ. of Arizona (USA); Alejandra Barrera, Instituto Tecnológico Autónomo De México (Mexico); Gonzalo Tejera, Univ. de la República (Uruguay) [8407-14]

4:20 pm: **Using a virtual world for robot planning**, D. P. Benjamin, Pace Univ. (USA); Damian M. Lyons, Fordham Univ. (USA); John V. Monaco, Lin Yixia, Pace Univ. (USA) [8407-15]

4:40 pm: **Using arm and hand gestures to command robots during stealth operations**, Adrian Stoica, Jet Propulsion Lab. (USA) [8407-16]

PANEL DISCUSSION

Room: Conv. Ctr. 335 Wed. 5:00 to 6:00 pm

Panel Moderator: **Jerome J. Braun**, MIT Lincoln Lab. (USA)

Thursday 26 April

SESSION 4

Room: Conv. Ctr. 335 Thurs. 8:40 to 10:20 am

**Information Fusion Approaches and Algorithms III
(Biometrics-related)**

*Session Chairs: D. Paul Benjamin, Pace Univ. (USA);
Jerome J. Braun, MIT Lincoln Lab. (USA)*

- 8:40 am: **Multimodal biometric approach for cancelable face template generation**, Padma Polash P. Paul, Shermin Bazazian, Marina Gavrilo, Univ. of Calgary (Canada). [8407-17]
- 9:00 am: **Fusion of pose and appearance manifolds for tracking in cluttered environments**, Jonathan Fry, Jeffrey Borck, The Pennsylvania State Univ. (USA); Richard L. Tutwiler, The Pennsylvania State Univ. (USA) and Applied Research Lab. (USA); David L. Hall, The Pennsylvania State Univ. (USA) [8407-18]
- 9:20 am: **Context-based gait recognition**, Shermin Bazazian, Padma Polash P. Paul, Marina Gavrilo, Univ. of Calgary (Canada) [8407-19]
- 9:40 am: **Human face identification using multisource fusion**, Mrinal K. Bhowmik, Debotosh Bhattacharjee, Dipak K. Basu, Mita Nasipuri, Jadavpur Univ. (India). [8407-20]
- 10:00 am: **Real-time threat assessment for critical infrastructure protection using evidential reasoning: techniques for handling data incest**, Russell Brandon, James Varndell, Scott Page, Waterfall Solutions Ltd. (United Kingdom). [8407-21]
- Coffee Break 10:20 to 10:50 am

SESSION 5

Room: Conv. Ctr. 335 Thurs. 10:50 am to 12:10 pm

Image Fusion

Session Chairs: Charles F. Hester, U.S. Army Research, Development and Engineering Command (USA); Pierre Valin, Defence Research and Development Canada, Valcartier (Canada)

- 10:50 am: **Automatic and generic mosaicing of multisensor images: an application to Pleiades HR**, François Bignalet-Cazalet, Daniel Greslou, Ctr. National d'Études Spatiales (France) [8407-22]
- 11:10 am: **Adaptive optimal spectral range for dynamically changing scene**, Ephi Pinsky, Avihay Siman-Tov, David Peles, Rafael Advanced Defense Systems Ltd. (Israel). [8407-23]
- 11:30 am: **Colour the INSight: combining a direct view rifle sight with fused thermal and image intensifier imagery**, Maarten A. Hogervorst, Chris Jansen, Alexander Toet, Piet Bijl, TNO Defence, Security and Safety (Netherlands); Paul Bakker, Thales Nederland B.V. (Netherlands); Arend C. Hiddema, PHOTONIS Netherlands B.V. (Netherlands); Stef van Vliet, Ministerie van Defensie (Netherlands) [8407-24]
- 11:50 am: **Synergistic use of very high-resolution SAR and optical data for mapping and target detection**, Vassilis Tsagaris, Nikos Fragoulis, Christos Theoharatos, IRIDA Labs. (Greece). [8407-25]
- Lunch/Exhibition Break 12:10 to 1:40 pm

SESSION 6

Room: Conv. Ctr. 335 Thurs. 1:40 to 3:20 pm

Information Fusion Approaches and Algorithms IV (Human-in-the-loop)

Session Chairs: Pierre Valin, Defence Research and Development Canada, Valcartier (Canada); Mirela Popa, Chemring Detection Systems, Inc. (USA)

- 1:40 pm: **Advances in data representation for hard/soft information fusion**, Jeffrey C. Rimland, Daniel M. Coughlin, David L. Hall, Jacob L. Graham, The Pennsylvania State Univ. (USA). [8407-26]
- 2:00 pm: **Human cognitive and perceptual factors in JDL level 4 hard/soft data fusion**, Jeffrey C. Rimland, David L. Hall, Jacob L. Graham, The Pennsylvania State Univ. (USA). [8407-27]
- 2:20 pm: **Use of sonification in the detection of anomalous events**, Mark Ballora, Ganesh Monahan, David L. Hall, The Pennsylvania State Univ. (USA); Robert Cole, Heidi Kruesi, Herbert G. Greene, Raytheon Intelligence & Information Systems (USA). [8407-28]

- 2:40 pm: **Homeland situation awareness through mining and fusing heterogeneous information from intelligence databases and field sensors**, Giusj Digioia, Univ. degli Studi di Roma Tre (Italy) and Engineering Ingegneria Informatica SpA (Italy); Stefano Panzieri, Univ. degli Studi di Roma Tre (Italy) [8407-29]
- 3:00 pm: **Multisource causal data mining**, Robert Woodley, Michael Gosnell, 21st Century Systems, Inc. (USA) [8407-30]
- Coffee Break 3:20 to 3:50 pm

SESSION 7

Room: Conv. Ctr. 335 Thurs. 3:50 to 4:50 pm

Information Fusion Systems and Evaluation Measures

Session Chairs: Damian M. Lyons, Fordham Univ. (USA); Charles F. Hester, U.S. Army Research, Development and Engineering Command (USA)

- 3:50 pm: **Evaluation of information relevance criteria within PEIRCE**, Pierre Valin, Defence Research and Development Canada, Valcartier (Canada); Guy Michaud, Sebastien Paquet, Fujitsu Consulting Inc. (Canada) [8407-31]
- 4:10 pm: **Agent-based analysis of trustworthiness in wireless sensor networks**, Ronald Fernandes, Biyan Li, Kalyan Vadakkeveedu, Ajay Verma, Paul Gustafson, Knowledge Based Systems, Inc. (USA); Jong S. Hwang, Air Force Research Lab. (USA) [8407-32]
- 4:30 pm: **Practical considerations in Bayesian fusion of point sensors**, Christian P. Minor, Contractor (USA); Kevin R. Johnson, Naval Air Warfare Ctr. Weapons Div. (USA) [8407-33]

POSTERS-THURSDAY

Room: Conv. Ctr. Hall A 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.

Authors may set-up their posters between 10:00 am and 5:00 pm the day of their poster. Posters that are not set-up by the 5:00 pm cut-off time will be considered no-shows and their manuscripts may not be published. Poster authors should be at their papers from 6:00 pm to 7:30 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:00 pm. Any papers left on the boards at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Adaptive IR and VIS image fusion, Jaroslav Rehacek, Bohumil Stoklasa, Zdenek Hradil, Palacký Univ. Olomouc (Czech Republic) [8407-35]

Courses of Related Interest

SC994 **Multisensor Data Fusion for Object Detection, Classification and Identification** (Klein) Tuesday, 8:30 am to 5:30 pm
See Course Materials Desk, located near the SPIE Registration Area, Pratt St. Lobby, Open during Registration Hours

Cyber Sensing 2012

Conference Chairs: **Igor V. Ternovskiy**, Air Force Research Lab. (USA); **Peter Chin**, The Johns Hopkins Univ. Applied Physics Lab. (USA)

Program Committee: **Mohiuddin Ahmed**, HRL Labs., LLC (USA); **Thomas G. Allen**, Air Force Research Lab. (USA); **H. John Caulfield**, Alabama A&M Univ. (USA); **Tuan A. Duong**, Adaptive Computation LLC (USA); **Tony C. Kim**, Air Force Research Lab. (USA); **Eugene Levin**, Michigan Technological Univ. (USA); **Leonid I. Perlovsky**, Air Force Research Lab. (USA); **Aleksandr V. Sergeev**, Michigan Technological Univ. (USA)

Tuesday 24 April

SESSION 1

Room: Conv. Ctr. 321 Tues. 8:20 to 10:00 am

Session Chair: **Peter Chin**,
The Johns Hopkins Univ. Applied Physics Lab. (USA)

8:20 am: **Insider threat detection enabled by converting user applications into fractal fingerprints and autonomously detecting anomalies**, Holger M. Jaenisch, Licht Strahl Engineering, Inc. (USA) and The Johns Hopkins Univ. (USA); James W. Handley, Licht Strahl Engineering, Inc. (USA) [8408-01]

8:40 am: **Cyber situational awareness and selective hardening**, Anurag Dwivedi, Daniel J. Tebben, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8408-02]

9:00 am: **Using inferred causal relationships for anomaly detection in multicast publish/subscribe networks**, Lanier A. Watkins, The Johns Hopkins Univ. Applied Physics Lab (USA) [8408-03]

9:20 am: **From measurements to metrics: PCA-based indicators of cyber anomaly**, Farid Ahmed, Tommy Johnson, Sonia Tsui, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8408-04]

9:40 am: **Anomaly detection for internet surveillance**, Henri Bouma, Stephan Raaijmakers, Arvid Halma, Harry Wedemeijer, TNO Defence, Security and Safety (Netherlands) [8408-05]

Coffee Break 10:00 to 10:30 am

SESSION 2

Room: Conv. Ctr. 321 Tues. 10:30 am to 12:10 pm

Session Chair: **Mohiuddin Ahmed**, HRL Labs., LLC (USA)

10:30 am: **PeerShield: collaborative intrusion and vulnerability detection for wireless mobile networks**, Hasan Cam, U.S. Army Research Lab. (USA) [8408-06]

10:50 am: **RISE: relational-integrity-sensitive-encoding for program intrusion detection**, Hasan Cam, U.S. Army Research Lab. (USA) [8408-07]

11:10 am: **Coalmine: a method of analyzing social networks for botnet command and control channels**, Joshua S. White, John L. Stacy, Jeanna N. Matthews, Clarkson Univ. (USA) [8408-08]

11:30 am: **A method for the automated detection phishing websites through both site characteristics and image analysis**, Joshua S. White, Jeanna N. Matthews, John L. Stacy, Clarkson Univ. (USA) [8408-09]

11:50 am: **Integrating cost effective security options into cloud computing**, Daniel Kent, Cisco Systems, Inc. (USA) [8408-10]

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

SESSION 3

Room: Conv. Ctr. 321 Tues. 1:30 to 3:00 pm

Session Chairs: **Tuan A. Duong**, Jet Propulsion Lab. (USA);
Eugene Levin, Michigan Technological Univ. (USA)

1:30 pm: **A solution for parallel network architectures applied to network defense appliances and sensors** (*Invited Paper*), Eric Naber, Paul Velez, Aman Johal, The Johns Hopkins Univ. Applied Physics Lab. (USA) [8408-11]

2:00 pm: **Data fusion in cyber security: first order entity extraction from common cyber data**, Nicklaus A. Giacobe, The Pennsylvania State Univ. (USA) [8408-12]

2:20 pm: **The distributed nature of cyber situation awareness**, Michael J. Tyworth, Nicklaus A. Giacobe, Vincent Mancuso, The Pennsylvania State Univ. (USA) [8408-13]

2:40 pm: **Operational advantages of using cyber electronic warfare in the battlefield**, Nurgul Yasar, Fatih M. Yasar, Turkish Air War College (Turkey) [8408-14]

Coffee/Exhibition Break 3:00 to 4:00 pm

SESSION 4

Room: Conv. Ctr. 321 Tues. 4:00 to 5:00 pm

Session Chairs: **Igor V. Ternovskiy**, Air Force Research Lab. (USA);
Thomas G. Allen, Air Force Research Lab. (USA)

4:00 pm: **Analysis of web-related threats in ten years of logs from a scientific portal**, Rafael D. Coelho dos Santos, The Johns Hopkins Univ. (USA) and Instituto Nacional de Pesquisas Espaciais (Brazil); André R. A. Grégio, Ctr. de Tecnologia da Informação Renato Archer (Brazil); Jordan Raddick, Vamsi Vattki, Alex Szalay, The Johns Hopkins Univ. (USA) [8408-16]

4:20 pm: **Improved stepping stone detection through active watermarking**, Joseph I. Gilbert, David J. Robinson, Air Force Institute of Technology (USA) [8408-17]

4:40 pm: **Distributed pattern detection in cyber networks**, Randy C. Paffenroth, Philip C. Du Toit, Numerica Corp. (USA); Louis L. Scharf, Anura P. Jayasumana, Vidarshana Banadara, Colorado State Univ. (USA) [8408-18]

Wednesday 25 April

SESSION 5

Room: Conv. Ctr. 321 Wed. 8:10 to 10:00 am

Session Chair: **Igor V. Ternovskiy**, Air Force Research Lab. (USA)

8:10 am: **Novel sensing paradigm based on dynamic logic theory in collaborative tracking systems** (*Invited Paper*), Leonid I. Perlovsky, Air Force Research Lab. (USA) [8408-19]

8:40 am: **Improved near-Earth objects detection using dynamic logic**, Igor V. Ternovskiy, Thomas G. Allen, Air Force Research Lab. (USA) [8408-20]

9:00 am: **Automatic decision support in large-scale heterogeneous sensor networks**, Robert Kozma, The Univ. of Memphis (USA) [8408-21]

9:20 am: **Multi-agent system for target-adaptive radar tracking**, Alan C. O'Connor, Air Force Research Lab. (USA) [8408-22]

9:40 am: **Application of dynamic logic algorithm to analyze AFRL gotcha data**, Freeman Lin, Air Force Research Lab. (USA) [8408-23]

Coffee Break 10:00 to 10:30 am

Conference 8408 · Room: Conv. Ctr. 321

SESSION 6

Room: Conv. Ctr. 321Wed. 10:30 to 11:50 am

Session Chairs: **Eugene Levin**, Michigan Technological Univ. (USA);
Aleksandr V. Sergeev, Michigan Technological Univ. (USA)

10:30 am: **Toward automatic scene understanding using hierarchical associative approach**, Igor V. Ternovskiy, Air Force Research Lab. (USA) [8408-24]

10:50 am: **Human-computer symbiosis in cyberspace environments**, Eugene Levin, Justin F. Carter, Aleksandr V. Sergeev, Michigan Technological Univ. (USA) [8408-25]

11:10 am: **WFS alignment and calibration techniques for the laser communication system**, Aleksandr V. Sergeev, Eugene Levin, Michael C. Roggemann, Michigan Technological Univ. (USA) [8408-26]

11:30 am: **Bio-inspired visual and olfactory receptor system for elusive target detection**, Tuan A. Duong, Adaptive Computation LLC (USA) [8408-27]

Lunch/Exhibition Break 11:50 am to 1:20 pm

SESSION 7

Room: Conv. Ctr. 321 Wed. 1:20 to 3:00 pm

Session Chairs: **Thomas G. Allen**, Air Force Research Lab. (USA);
Tony C. Kim, Air Force Research Lab. (USA)

1:20 pm: **Trust and microblogging: a proposed framework for assessing trust in Twitter**, Kathleen A. Moore, The Pennsylvania State University (USA) [8408-29]

1:40 pm: **Tracking fine-grained topics in microblogs**, Nils F. Sandell, Mark R. Luetttgen, Systems and Technology Research, Inc. (USA); George Cybenko, Dartmouth College (USA) [8408-30]

2:00 pm: **Towards a trustworthy distributed architecture for complex sensing networks**, Heidi C. Schubert, Real-Time Innovations (USA); Jahn Luke, Air Force Research Lab. (USA) [8408-31]

2:20 pm: **Blind extraction and security analysis of multimedia spread spectrum hidden watermarks**, John A. Marsh, SUNY Institute of Technology (USA) and Assured Information Security, Inc. (USA); Gerard F. Wohlrab, Air Force Research Lab. (USA) [8408-32]

2:40 pm: **Fractals, malware, and data models**, Holger M. Jaenisch, Licht Strahl Engineering, Inc. (USA); Andrew N. Potter, Deborah Williams, Sentar, Inc. (USA); James W. Handley, Licht Strahl Engineering, Inc. (USA) [8408-33]



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Car Rental



Hertz Car Rental is the official car rental agency for this Symposium. To reserve a car, identify yourself as a SPIE Defense, Security, and Sensing Conference attendee using the Hertz Meeting Code **CV# 029B0017**.

- In the United States call 1-800-654-2240.

Parking during SPIE Defense, Security, and Sensing

For parking information please check the SPIE website <http://spie.org/x25169.xml> or the Information Desk located in Pratt St. Lobby near Exhibitor Registration.

Business Services

SPIE Copy Center

Pratt St. Lobby (Level 300)
Monday through Friday during registration hours San Diego Copy will provide a copy service during the week for conference attendees and exhibitors. The rates are 5 cents per copy.

Baltimore Convention Center Business Center

Pratt St. Lobby (Level 300)

The Business Center provides full service business needs for your convenience. They provide photocopying, faxing, computer workstations and printing services. Shipping is provided through FedEx. Office supplies are also available. Phone 410-649-7194. Monday through Friday.

Messages

SPIE has an urgent message line available during registration hours Sunday through Friday by calling: 410-649-6102.

Luggage/Package Storage and Coat Check

Room 336 (Level 300)

Monday through Friday

Complimentary luggage/package and coat storage will be available to attendees.

Please note hours of operation posted onsite. If you intend to stay later than closing time, you will need to claim your checked items before this station closes.

Child Care Services

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Information Desk

Pratt St. Lobby (Level 300)

The Information Desk will be open 10:00 am to 4:00 pm Monday through Thursday for sightseeing, shopping, and restaurant information.

Housing Desk

Pratt St. Lobby (Level 300) near the SPIE Bookstore

Sunday 4:00 to 7:00 pm

Monday 7:30 am to 4:30 pm

Tuesday 8:00 am to Noon

Housing desk will be open to assist with all housing inquiries.

General Information

Food and Beverage Services

Coffee Breaks

Complimentary coffee will be served at approximately 10:00 am and 3:00 pm in the following locations:

- Monday Mezzanine Level 200
- Tuesday through Thursday am All Exhibition Halls
- Thursday pm and Friday Mezzanine Level 200

Desserts

Tuesday and Wednesday
Served in the Exhibition Halls

Dessert snacks will be served from 3:00 to 3:30 pm. Complimentary tickets for the dessert will be included in course and conference attendee registration packets.

Meals and Refreshments for Purchase

Main Terrace (Level 300)
Monday through Friday

Food outlets will serve hot and cold snacks, espresso, beverages, sandwiches, salads, hot entrees, and pastries.

Food Outlets Open in the Exhibition Halls

Tuesday through Thursday 10:00 am to 2:00 pm

Policies

Refunds

There is a \$40 service charge for processing refunds. Requests for registration refunds must be received no later 12 April 2012. All registration fees will be forfeited after this date. Membership dues are not refundable. SPIE Digital Library subscriptions are not refundable.

Audio/Video/Digital Recording Policy

In the Meeting Rooms and Poster Sessions: For copyright reasons, recordings of any kind are strictly prohibited without prior written consent of the presenter in any conference session, course or of posters presented. Each presenter being taped must file a signed written consent form. Individuals not complying with this policy will be asked to leave a given session and asked to surrender their film or recording media. Consent forms are available at the Speakers Check-In Desk.

In the Exhibition Hall: For security and courtesy reasons, photographing or videotaping individual booths and displays in the exhibit hall is allowed ONLY with explicit permission from onsite company representatives. Individuals not complying with this policy will be asked to surrender their film or delete the image and to leave the exhibition hall.

Laser Pointer Safety Information

SPIE supplies tested and safety approved laser pointers for all conference meeting rooms, and for course rooms if instructors request one. For safety reasons, SPIE requests that presenters use our provided laser pointers available in each meeting room.

If using your own laser pointer, have it tested at your facility to make sure it has <5 mW power output. Laser pointers in Class II and IIIa (<5 mW) are eye safe if power output is correct - but don't automatically trust the labeling. Commercially available laser pointers, red or green (or any color), could be incorrectly labeled as to their wavelength and power output.

Presenters intending to use their own laser pointer for presentations are required to come to the Speakers Check-In Desk onsite and test their pointer on our power meter. If the pointer fails the safe power level you may not use the pointer at the conference. You will be required to sign a waiver releasing SPIE of any liability for use of potentially nonsafe laser pointers.

Use of a personal laser pointer at an SPIE event represents user's acceptance of liability for use of a non-SPIE supplied laser pointer device. Misuse of any laser pointer could lead to eye damage.

Underage Persons on Show Floor

For safety and insurance reasons, no persons under the age of 16 will be allowed in the exhibition area during move-in and move-out. During open exhibition hours, only children over the age of 12 accompanied by an adult will be allowed in the exhibition area.

Unauthorized Solicitation

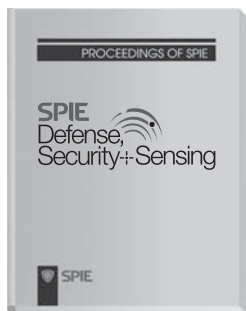
Unauthorized solicitation in the Exhibition Hall is prohibited. Any non-exhibiting manufacturer or supplier observed to be soliciting business in the aisles, or in another company's booth, will be asked to leave immediately.

Unsecured Items

Personal belongings such as briefcases, backpacks, coats, book bags, etc., should not be left unattended in meeting rooms or public areas. These items will be subject to removal by security upon discovery.

New Books from SPIE

	<p>Field Guide to Radiometry <i>Barbara Grant</i> Vol. FG23</p>		<p>Field Guide to Diffractive Optics <i>Yakov G. Soskind</i> Vol. FG21</p>
	<p>Hyperspectral Remote Sensing <i>Michael T. Eismann</i> Vol. PM210</p>		<p>Hadamard Transforms <i>Sos S. Aghaian, Hakob G. Sarukhanyan, Karen O. Egiazarian, Jaakko Astola</i> Vol. PM207</p>
	<p>Field Guide to Binoculars and Scopes <i>Paul R. Yoder Jr., Daniel Vukobratovich</i> Vol. FG19</p>		<p>Signal and Image Restoration: Information-Theoretic Approaches <i>Joseph P. Noonan, Prabhakar Basu</i> Vol. PM213</p>
	<p>Field Guide to Probability, Random Processes, and Random Data Analysis <i>Larry C. Andrews, Ronald L. Phillips</i> Vol. FG22</p>		<p>Field Guide to Special Functions <i>Larry C. Andrews</i> Vol. FG18</p>
	<p>Color Vision and Colorimetry: Theory and Applications, Second Edition <i>Daniel Malacara</i> Vol. PM204</p>		<p>Statistics for Imaging, Optics, and Photonics <i>Peter Bajorski</i> Vol. PM219</p>



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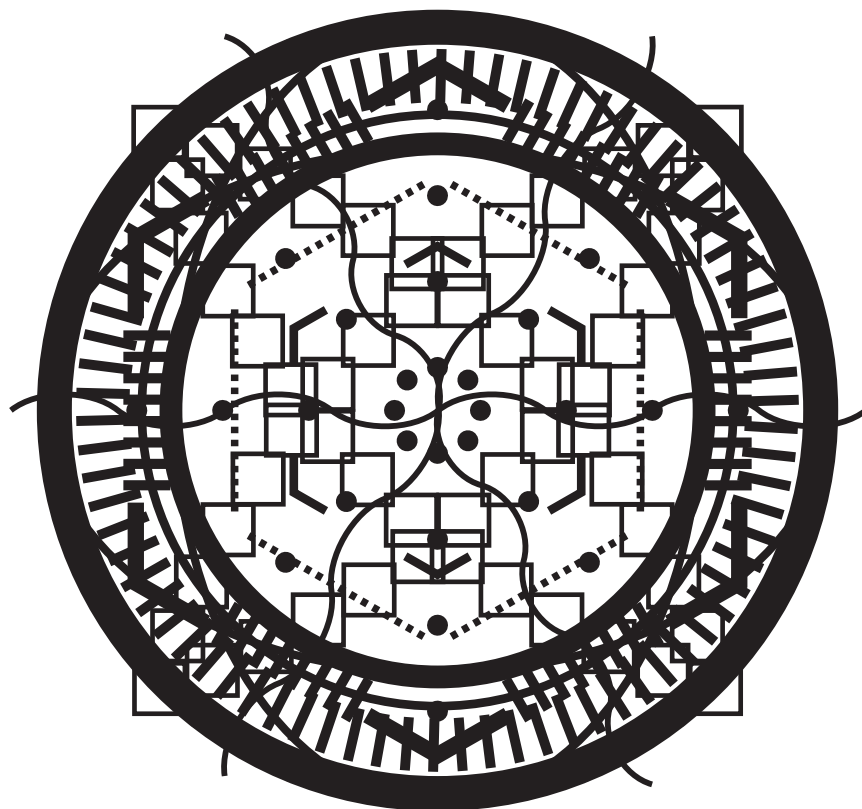
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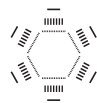
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