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2014

2014 DSS TECHNICAL PROGRAM.

DEFENSE+
SECURITY

SENSING TECHNOLOGY+
APPLICATIONS

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Baltimore Convention Center
Baltimore, Maryland, USA

DSS EXPO: 6-8 May 2014

Conferences & Courses: 5-9 May 2014

SPIE.

daily coverage of the optics and photonics industry and the markets that it serves

the business of photonics
optics.org

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

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

SPIE.

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 $3.2 million in support of education and outreach programs in 2013.

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www.spie.org/dss

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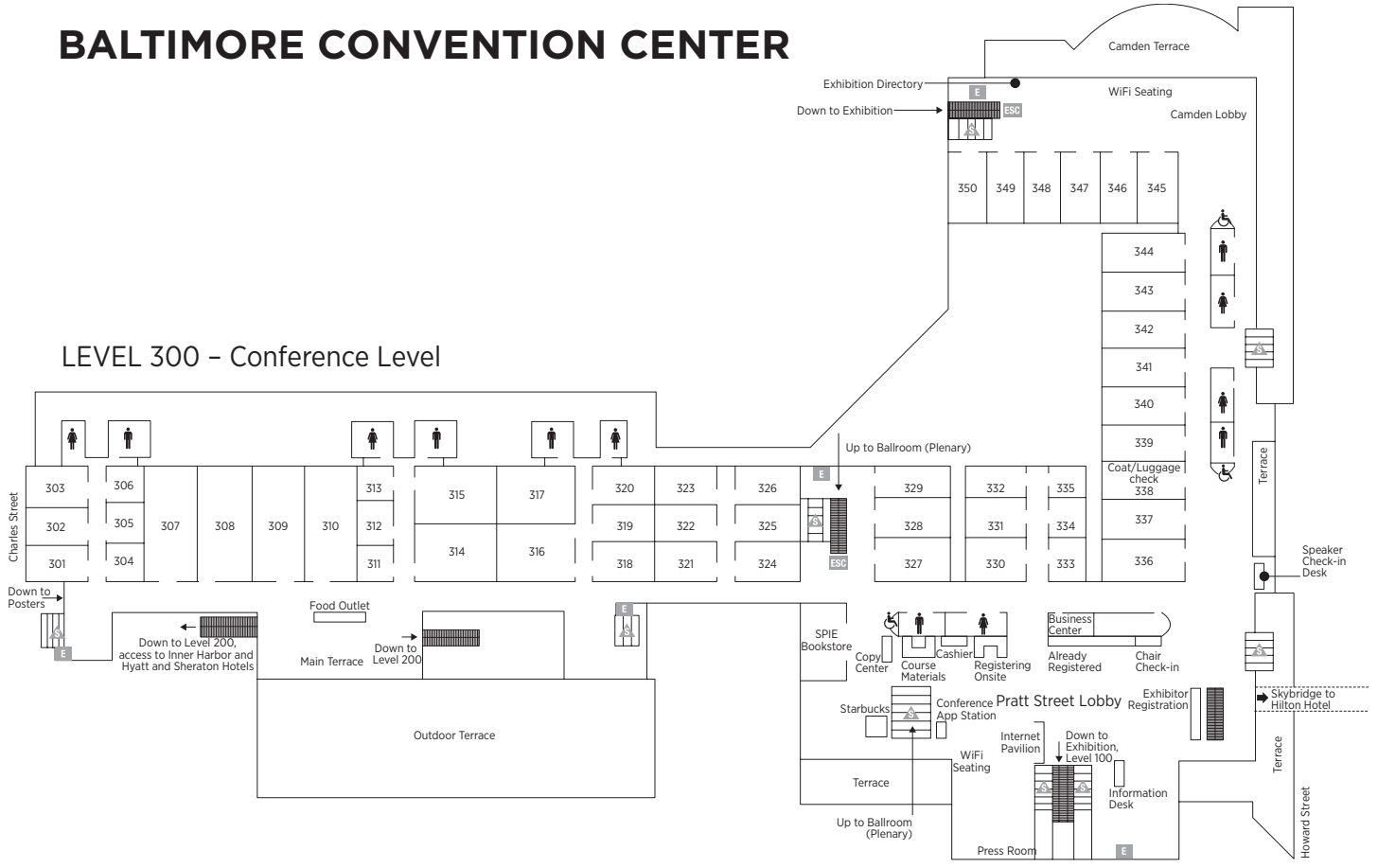

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HILTON BALTIMORE

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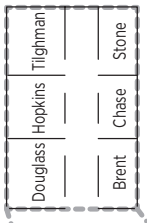

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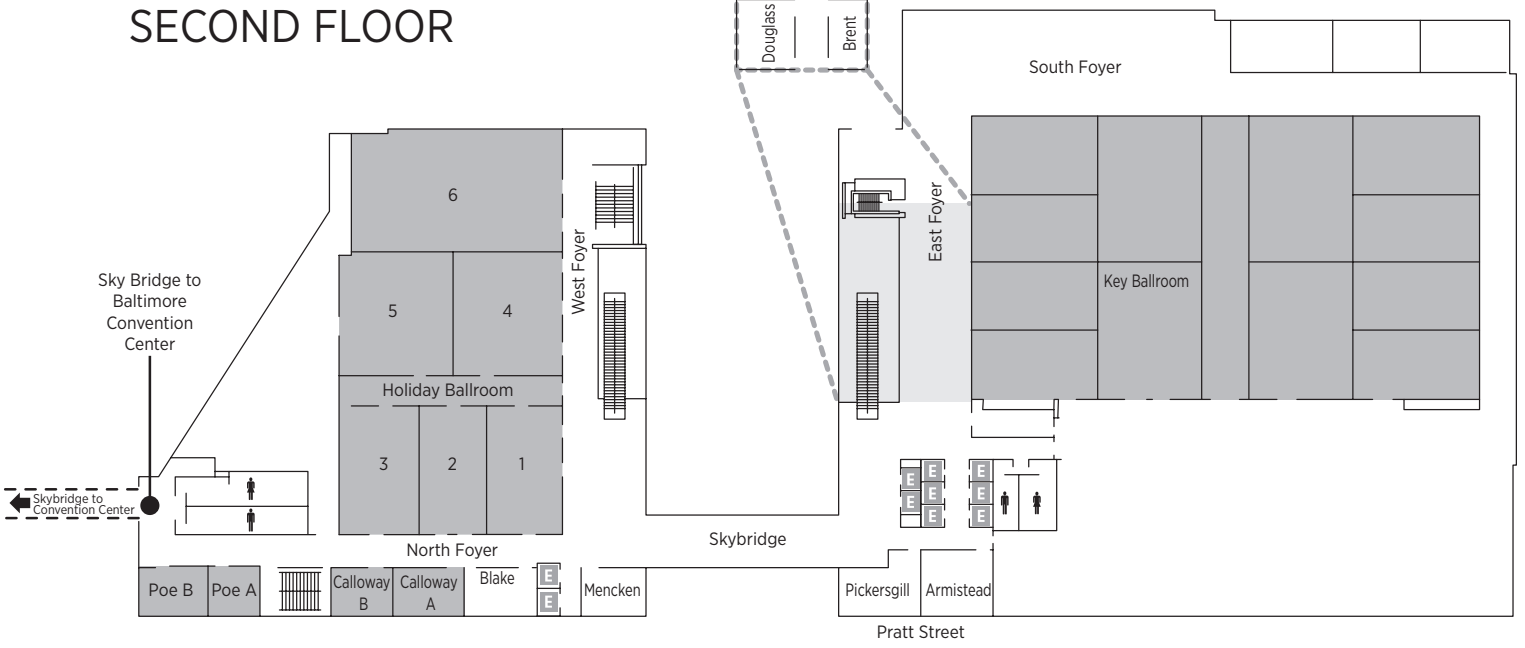

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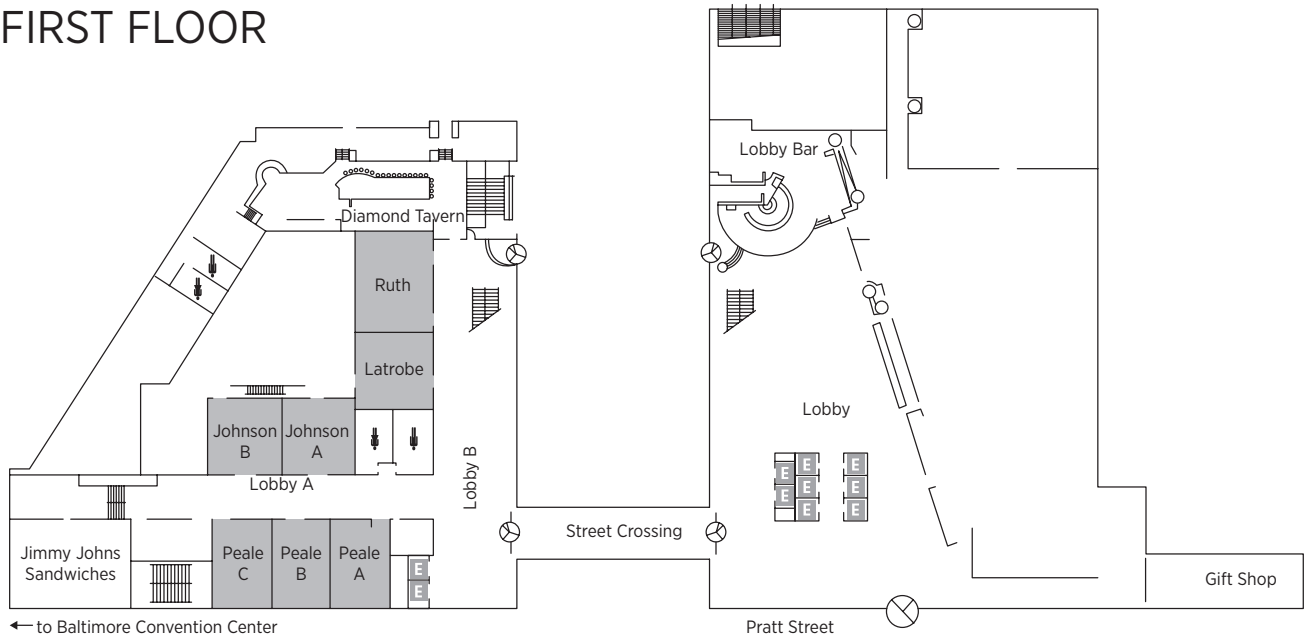

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SENSING FOR INDUSTRY, ENVIRONMENT, AND HEALTH


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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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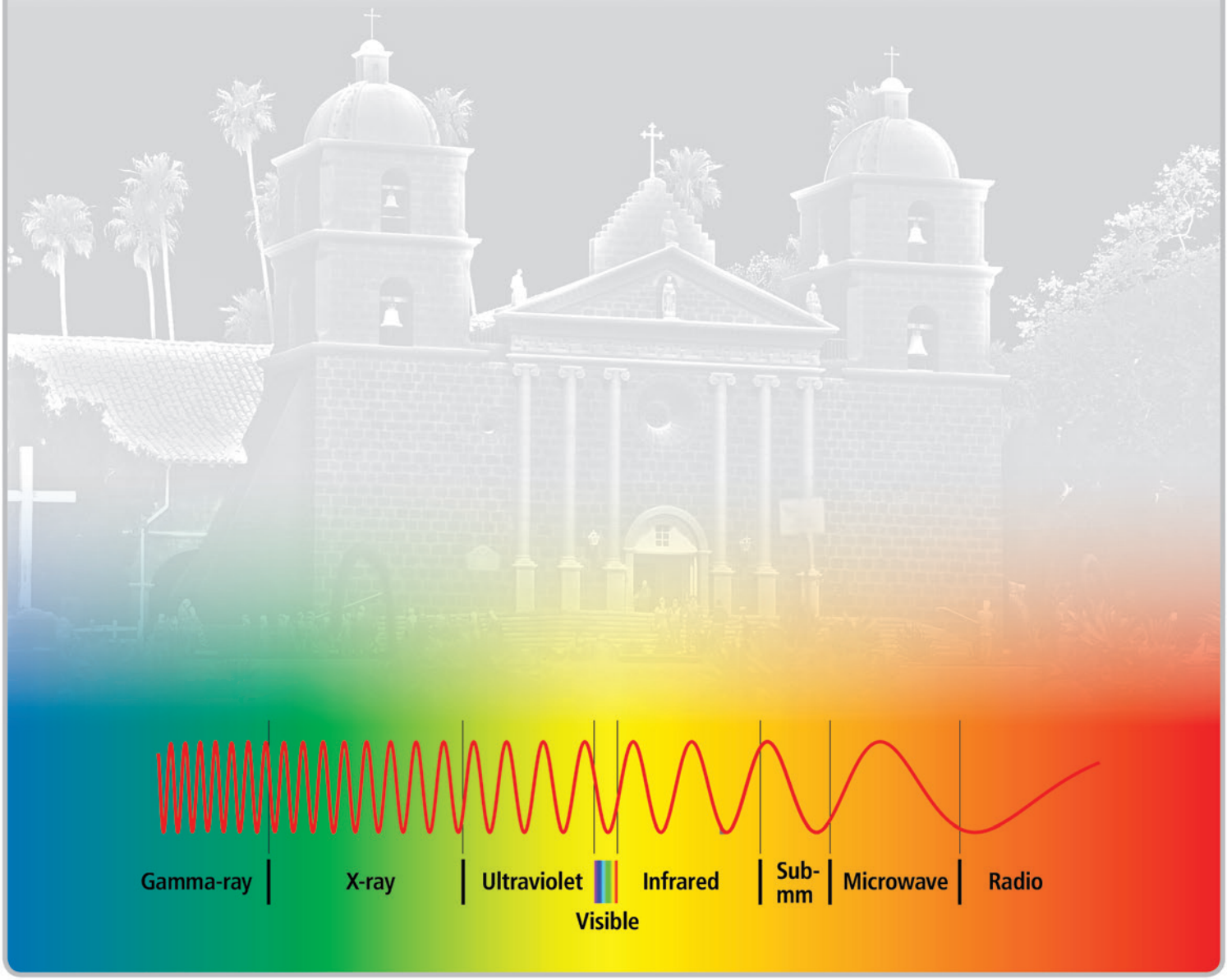
IN ALL DOMAINS



INNOVATION IN ALL DOMAINS

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DAILY EVENT SCHEDULE

MONDAY
5 May

Fellows Luncheon, Fellows Luncheon Presentation **II-VI Photovoltaic Materials** *(Sivananthan)* · 12:00 to 1:30 pm, p.10

The Infrared Applications: ThermoSense XXXVI Vendor Session (Conf. 9105) *(Rozlosnik, Kaplan)* · 12:00 to 4:40 pm, p.10

Invited Panel Discussion: Issues and Challenges of Information Fusion in Contested Environments (Conf. 9091) *(Chong, Blasch, Kadar)* · 1:15 to 4:45 pm, p.11

Defense + Security 2014 Plenary Presentation Innovation: Hard on Earth, Harder in Space

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C. · 5:00 to 6:00 pm, p.12

ASC OP/TF6 and SPIE IRMWG Joint Meeting *(Phenis)* · 2:00 to 4:30 pm, p.20

VISIT THE BOOKSTORE

Pratt St. Lobby (Level 300)
Open during Registration hours

BOOKS · SOUVENIRS · GIFTS
INFORMATION · MEMBERSHIP
PROFESSIONAL DEVELOPMENT

TUESDAY
6 May

DSS EXPO — Free Exhibition of Core Technologies, No-Cost Workshops, and Product Tutorials · 10:00 am to 5:00 pm, p.24

Job Fair · 10:00 am to 5:00 pm, p.13

Professional Resume Review *(Carter)* · 10:00 am to 2:00 pm, p.13

TEDCO Commercialization Workshop: A Pathway to Creating New Products Utilizing *Universities and Federal Labs (Auvil)* · 11:00 am to 1:30 pm, p.21

Lunch with the Experts—A Student Networking Event · 12:30 to 1:30 pm · *Open to Student Attendees*, p.14

Panel Discussion: Trusted Systems in Defense (Conf. 9097) *(Kim)* · 1:00 to 1:40 pm, p.14

Panel Discussion: Advanced Analysis of Generalized Point-Clouds and Multidimensional Structures (Conf. 9089A) *(Dockstader)* · 1:20 to 2:50 pm, p.14

Panel Discussion: Optical Metrology Trends (Conf. 9110) *(Harding)* · 1:40 to 3:00 pm, p.14

Professional Development Speaker Series · 2:00 to 3:00 pm

Charting a Course in the Photonics Industry *(Restaino, Fountain)* · 2:00 to 3:00 pm, p.21

Getting Hired Panel · 3:30 to 4:30 pm, p.21

Workshop: Night Vision Integrated Performance Model (NV-IPM) (Conf. 9071) *(Teaney, Reynolds)* · 5:00 to 6:00 pm, p.14

Speed Networking Social · 5:00 to 6:30 pm, p.14

Optomechanical/ Instrument Technical Group Event *(Hatheway)* · 6:00 to 10:00 pm, p.15

Poster Session · 6:00 to 7:30 pm, p.15

WEDNESDAY
7 May

Sensing Technology + Applications 2014 Plenary Presentations · 8:30 to 10:00 am, p.16

Planar Optronic Systems Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology, Leibniz Univ. Hannover

The Emerging Industrial Internet
Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Professional Resume Review *(Carter)* · 10:00 am to 2:00 pm, p.22

DSS EXPO — Free Exhibition of Core Technologies, No-Cost Workshops, and Product Tutorials · 10:00 am to 5:00 pm, p.24

Job Fair · 10:00 am to 5:00 pm, p.22

MIRTHE Workshop: Early Stage Technology Commercialization *(Montemarano)* · 10:30 am to 12:00 pm, p.22

Panel Discussion: Open Architecture (OA) Open Business Mode (OBM) Systems *(Suresh)* · 11:00 am to 12:00 pm, p.17

Panel Discussion: The Future of Sensing: An Industry Perspective · 2:00 to 3:00 pm, p.23

ITAR and Other International Trade Regulations workshop: Strategies for Navigating U.S. Export Controls and International Trade Issues for the Optics and Photonics Industry *(Scarlott, Moss)* · 3:30 to 4:30 pm, p.23

Banquet and Award Announcements
DSS Lifetime Achievement Award Presentation · 7:00 to 9:30 pm, p.17

Distinguished Banquet Speaker: **Dr. David A. Honey**, Director of Science and Technology Acquisition, Technology and Facilities (AT&F), Office of the Director of National Intelligence)

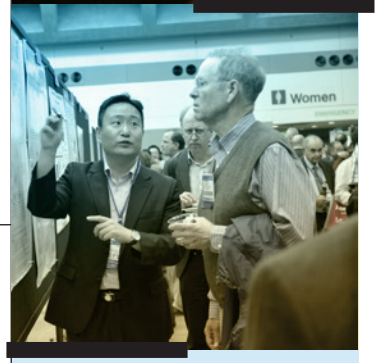
THURSDAY
8 May

DSS EXPO — Free Exhibition of Core Technologies, No-Cost Workshops, and Product Tutorials · 10:00 am to 2:00 pm, p.24

Doing Business Globally: Legal Best Practices for Ensured Success *(Scarlott, Moss)* · 10:30 am to 12:00 pm, p.23

Panel Discussion: Strategic Vision Security and Defense (Conf. 9119) *(Stambovsky)* · 1:00 to 1:30 pm, p.17

Poster Session · 6:00 to 7:30 pm, p.17



Demand the Best Lenses!

Optics for 12 µm-pitch FPAs Available Now!

New uncooled 12 µm-pitch FPAs for thermal imaging provide higher resolution on larger HD formats and contribute to reduction in size, weight, power, and cost (SWaP-C) for smaller formats. The small pitch FPAs present significant challenges to lens designers and manufacturers.

Ophir Optics now has an extensive offering of lenses that meet these challenges.

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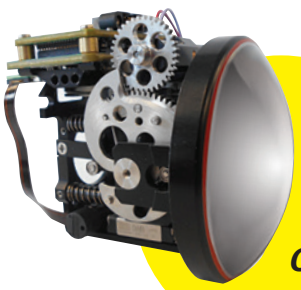

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SPECIAL EVENTS.

Monday 05 May.

Fellows Luncheon

Monday 5 May 2014 · 12:00 to 1:30 PM
Location: Hilton: Holiday Ballroom 4

All SPIE Fellows are invited to join your colleagues for this fourth 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 planning to attend are asked to RSVP to Brent Johnson.

Fellows Luncheon Presentation:

II-VI PHOTOVOLTAIC MATERIALS
Dr. Sivalingam Sivananthan
The University of Illinois at Chicago

VENDOR SESSION

The Infrared Applications: ThermoSense XXXVI Vendor Session

Monday 5 May 2014 · 12:00 to 4:40 PM · Conf. 9105
Location: Conv. Ctr. Room 316

Moderators: **Andrés E. Rozlosnik,** Si Termografia Infrarroja (Argentina), and **Herb Kaplan,** Honeyhill Technical Co. (USA)

The Infrared Applications: ThermoSense XXXVI Vendor Session will be held on Monday afternoon, 5 May 2014 as part of SPIE's DSS 2014 Conference in Baltimore. 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 Vendor Session was started ten 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.

Plan your travel to arrive early enough to get this valuable preview of evolving technology.

VENDORS IN PRESENTATION ORDER:

Telops (Booth 1112)
A New Rugged Line of High Performance Infrared Cameras
Presenter: **Vincent Farley,** Business Development Manager

New Infrared Technologies (Booth 877)
The CORE-S: an affordable solution for industrial process monitoring using uncooled MWIR FPAs, and its evolution towards larger imaging arrays (256x256)
Presenter: **Rodrigo Linares,** Business Development Manager

ULIS (Booth 809)
ULIS uncooled IR detectors and new developments
Presenter: **Ludovic Brasse,** Sales Manager

StingRay Optics, LLC (Booth 962)
StingRay Optics Standard Products 2014
Presenter: **Sam Wyman,** Standard Products Specialist

SCD.USA, LLC (Booth 716)
New Infrared Detector Technology from SCD
Presenter: **Robert McDaniel,** President and CEO SCD.USA

New Imaging Technologies (NIT) (Booth 1048)
Advantages of Native High Dynamic range in SWIR
Presenter: **Jean-Louis Laurent,** Sales Director

Xenics (Booth 1025)
A low SWaP gimbal, equipped with SWIR and LWIR camera cores for UAS operation
Presenter: **Jan Vermieren,** Technical Adviser and Business Development Manager

Magnity Electronics (Booth 1070)
Recent advances in thermal imaging technologies and products at Magnity
Presenter: **Chongfei Shen,** Magnity Electronics CEO

CI Systems, Inc. (Booth 1001)
RadIR: True Temperature Cameraby CI Systems
Presenter: **ILya Koshkin,** Technology and Business Development at CI Systems

JENOPTIK (Booth 107)
New High Definition Camera from JENOPTIK
Presenter: **David Fisher,** Sales Manager Infrared Camera Products

Heimann Sensor GmbH (Booth 1005)
New low cost thermopile focal planes to enable consumer applications
Presenter: **Bodo Forg,** Project Manager

Sensors Unlimited - UTC Aerospace Systems (Booth 817)
Highest sensitivity, highest resolution SWIR imaging cameras
Presenter: **Shannon Larbig,** Sales Manager, Component Products

Opgal Optronic Industries Ltd. (Booth 512)
Therm-App™: Merging the thermal imaging world with the Android smartphone
Presenter: **Craig Beal,** Product Manager

PHOTONIS Digital Imaging (Booth 1213)
Low Light Digital Imaging as a Platform for Fusion Technologies
Presenter: **Löig E. Bourrée,** Vice President of Night Vision Technologies

INVITED PANEL DISCUSSION

Issues and Challenges of Information Fusion in Contested Environments

Monday 5 May 2014 · 1:15 to 4:45 PM · Conf. 9091
Location: Conv. Ctr. Room 325

Panel Organizers: **Chee-Yee Chong,** Consultant; **Erik Blasch,** Air Force Research Lab.; **Ivan Kadar,** Interlink Systems Sciences, Inc.

Panel Moderators: **Chee-Yee Chong,** Consultant; **Ivan Kadar,** Interlink Systems Sciences, Inc

Panelists: **Erik Blasch,** Air Force Research Lab.; **Chee-Yee Chong,** Consultant; Laurie Fenstermacher, Air Force Research Lab.; John Gorman, DARPA,; **Hillary Holloway,** Systems & Technology Research Inc.; **Eric Jones,** Systems & Technology Research, Inc.; **Ivan Kadar,** Interlink Systems Sciences, Inc.; **Georgiy Levchuk,** Aptima, Inc.; **Nils F. Sandell,** Systems & Technology Research, Inc.

In contested environments such as those involving peer nations, fusion has to address challenges not present in uncontested environments, e.g., counter insurgencies. The objects of interest may be hard to detect due to the use of stealth technology. Sensing may be at stand-off distances and observations may be sparse. Full motion video that has been very valuable in recent missions will no longer be available. Communication will be unreliable due to possible jamming and bandwidth may be limited. Thus fusion has to deal with more difficult targets using lower quality/quantity data over less capable communication networks.

The panel will address issues and challenges highlighting the problem of acquiring, representing, handling, processing, fusing and using information sources in contested environments. A number of invited experts will discuss current challenges of the fusion process and research to address these challenges.

See Monday 05 May Industry Events p. 20

Defense + Security Plenary Presentation

Monday 5 May 2014 · 5:00 to 6:00 PM
Location: Conv. Ctr. Ballroom 1-2

INNOVATION: HARD ON EARTH, HARDER IN SPACE

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities.

Dr. Troy E. Meink

Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

Dr. Troy E. Meink, a member of the Senior Executive Service, is the Deputy Under Secretary of the Air Force for Space; and the Director, Executive Agent for Space Staff, Washington, D.C. He provides the principal support to the Under Secretary's role as the Headquarters U.S. Air Force focal point for space matters and in coordinating activities across the Air Force space enterprise.

Dr. Meink is from Lemmon, S.D., and entered the Air Force in 1988 through the ROTC program at South Dakota State University. His assignments have included operations and training, systems engineering, research and development, and program management of major defense acquisition programs. Dr. Meink began his career as a KC-135 Tanker Navigator and Instructor and then a lead test engineer for the design and evaluation of ballistic missile test vehicles for the Missile Defense Agency resulting in two successful launch campaigns. He managed multiple next generation joint research and development programs transitioning global space capabilities, optical sensors, and advanced structures into DoD operations. Dr. Meink subsequently led multiple communications organizations within the Air Force and the Office of the Assistant Secretary of Defense, Networks and Information Integration. Prior to his current assignment, he was Director, Signals Intelligence Systems Acquisition, National Reconnaissance Office.

As a rated officer, Dr. Meink completed 100 sorties including eight combat and 29 combat support missions in support of operations Desert Shield, Desert Storm, and Provide Comfort. He has authored 20 articles in professional journals and conference publications, has been awarded three patents, and designed, built, and flown two experimental aircraft.

Photo by Stephen Cearley

SPIE DSS Welcome Reception

Monday 5 May 2014 · 6:15 to 7:45 PM
Location: Power Plant Live

All registered conference attendees are invited to join your colleagues at the Welcome Reception and celebrate "Cinco de Mayo." This informal networking event will be held at the Power Plant Live, Baltimore's premier dining and entertainment destination, located just one block from the world famous Inner Harbor.

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

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JOB FAIR

SPIE DSS 2014
Defense + Security
Sensing Technology + Applications

Sponsored by **SPIE Career Center**

Meet. Discuss. Impress.

Free Admission

Part of DSS EXPO and Conference.
Exhibition registration required for entrance.

Conv. Ctr. Exhibition Hall, Level 100

Tuesday 6 May · 10:00 am to 5:00 pm
Wednesday 7 May · 10:00 am to 5:00 pm

Visit the SPIE Career Center **booth #1069** for more information.

Talk with representatives from companies currently looking to hire.

Positions available for engineers, scientists, researchers, and technical sales professionals

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

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Tuesday 06 May.

Lunch with the Experts - A Student Networking Event

Tuesday 6 May 2014 · 12:30 to 1:30 PM
Location: Hilton: Holiday Ballroom 4

Open to Student Attendees

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.

PANEL DISCUSSION

Optical Metrology Trends Panel

Tuesday 6 May 2014 · 1:40 to 3:00 PM · Conf. 9110
Location: Conv. Ctr. Room 340

Moderator: **Kevin G. Harding,** GE Global Research (USA)

Panelists: **Scott Sandwith,** New River Kinematics (USA);
Peter J. de Groot, Zygo Corp. (USA);
Erik L. Novak, 4D Technology Corp. (USA);
Thomas M. Hedges, Nikon Metrology, Inc. (Japan)

Optical Metrology continues to see wider use in all areas of industry from additive manufacturing to nano fabrication to large structures. A panel of industry experts in the area of Optical Metrology will present their views on the future and challenges the industry faces in the coming years and answer questions from the audience.

PANEL DISCUSSION

Advanced Analysis of Generalized Point-Clouds and Multidimensional Structures

Tuesday 6 May 2014 · 1:20 to 2:50 PM · Conf. 9089A
Location: Conv. Ctr. Room 324

Moderator: **Shiloh L. Dockstader,** Exelis Inc.

Panelists: **Hui Cheng,** SRI International; Karl Walli, U.S.Air Force; **Guna Seetharaman,** AFRL/RI; Suzanne Inscoe, NGA; **Paul McManamon,** Univ. of Dayton

In this panel we explore the current state-of-the-art in generalized point-cloud and 3D site model creation, visualization, exploitation, and dissemination. The panelists will present various methods for generating point-clouds to include synthesis from video, multi-frame imagery, and other non-traditional sources and discuss the advantages and disadvantages of relative point-cloud and 3D/4D data representations. Among other issues, this will include a discussion on the pros and cons of point-cloud vs. estimated digital elevation and site model representations. The panel will also address the challenges associated with derived point-cloud and multi-dimensional data set processing relative to the use of more direct collection methods involving LIDAR and time-of-flight sensor systems. Finally, the panel will present and discuss a variety of applications of 3D data that can potentially improve upon otherwise traditional exploitation tasks. This discussion will cover the advantages of fusing different 3-D data sets for the purposes of improving the performance of target detection and tracking, superresolution, mensuration, activity recognition, and other advanced processing and analytical functions.

PANEL DISCUSSION

Trusted Systems in Defense

Tuesday 6 May 2014 · 1:00 to 1:40 PM · Conf. 9097
Location: Conv. Ctr. Room 347

Panel Moderator: **Tony Kim,** Air Force Research Lab.

Panelists: **Peter Chin,** Draper Lab.; **Igor V. Ternovskiy,** Air Force Research Lab.; **Jeff Hughes,** Tenet 3, LLC

What technology and policy aspects in Trusted Systems, Devices, and Components could make large organizations capable of better protecting their assets and data?

Speed Networking Social

Tuesday 6 May 2014 · 5:00 to 6:30 PM
Location: Pratt Street Ale House
206 W. Pratt St.

Open to All Attendees

Join us for the next generation of networking. Add a new contact to your network every three minutes while enjoying appetizers at an off-site venue. Bring plenty of business cards, practice your pitch, and prepare to expand your network.

WORKSHOP

Night Vision Integrated Performance Model (NV-IPM)

Tuesday 6 May 2014 · 5:00 to 6:00 PM · Conf. 9071
Location: Conv. Ctr. Room 341

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

The Night Vision Integrated Performance Model (NV-IPM) version 1.1 was recently released by NVESD. The aim of this new model is to provide a flexible and extensible engineering tool for system design which encapsulates all of the capabilities of the existing Night Vision model suite along with many new design tools and features. This workshop will introduce some common NV-IPM modeling cases and discuss the model features and capabilities in greater detail. The workshop will also introduce users to future development goals for NV-IPM, including image generation, a fully 2-D implementation, and improved Modtran support. Attendees are encouraged to provide feedback and suggestions throughout the course of the workshop.

Poster Session

Tuesday 6 May 2014 · 6:00 to 7:30 PM
Location: Conv. Ctr. Hall C

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.

Optomechanical/Instrument Technical Group Event

Tuesday 6 May 2014 · 8:00 to 10:00 PM
Location: Hilton: Holiday Ballroom 1

Chair: **Alson E. Hatheway,** Alson E. Hatheway Inc. (USA)

This is the East Coast meeting of the premier group of optomechanical engineers that design and analyze the world's optical instruments and systems. This gathering is open to all attendees of the DSS Symposium. Anyone who wishes to put an item on the agenda should contact the Chair, Al Hatheway, at aeh@aehinc.com.

Our speaker will be Steve Rummel, Director of Product Technology for II-VI Infrared of Saxonburg, PA. II-VI is a major supplier of optics for CO_2 laser applications. Mr. Rummel will discuss new developments in highly stable, heat resistant materials for use in high power applications, especially where a high quality optical finish is required on the surfaces. He'll review the microstructure and property data II-VI's reaction bonded silicon carbide, discuss diamond-containing formulations for ultra-high heat load capability and present B4C containing versions which compete with beryllium.

Following Steve Rummel's talk the floor will be open for other agenda items and our traditional 'Problems and Solutions Workshop' session. Be prepared to present some challenges to the Group.

See Tuesday 06 May Industry Events p. 20

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Wednesday 07 May.

Sensing Technology + Applications Plenary Presentations

Wednesday 7 May 2014 · 8:30 to 10:00 AM
Location: Conv. Ctr. Ballroom 1-2

8:30 to 9:15 AM

PLANAR OPTRONIC SYSTEMS

Development of large-scale, polymer-based sensor foils with purely optical measurement principles

Prof. Dr.-Ing. Ludger Overmeyer
Head of Institute of Transport and Automation Technology
Leibniz Univ. Hannover

ABSTRACT: Optronics, a combination of optics and semiconductor technology, refers to products and processes in which signals can be converted and transmitted optically. We research on polymer foils that are equipped with sensors throughout, eliminating the need for electronic components. All sensors function optically, and indicate changes in parameters such as temperature and strain in properties of light. Our vision is to provide sensor technology on a large-scale, just 100 µm thick, flexible polymer foil manufactured on an industrial scale. Applications range from aviation and construction surveillance to the molecular analytics in life sciences.

Our chemists search for tailor-made materials for constructing optical waveguides and substrates. Physicists build process-adaptable radiation sources and sinks and improve existing sensor technology such as Arrayed-Waveguide and fiber Bragg gratings. Other scientists develop concepts and simulations in order to create, transport and process light signals in sensor networks. In addition, engineers work on the realization of a cost- and resource-efficient mass production.

Prof. Dr.-Ing. Ludger Overmeyer obtained his diploma ("Dipl.-Ing.") in electrical engineering from Hannover University in 1991, and a PhD degree ("Dr.-Ing.") in laser engineering process control from Hannover University in 1996. From 1991, he worked as research assistant at Laserzentrum Hannover (LZH) and became head of the department "Machines and Control" in 1994. In 1997, Professor Overmeyer began as project manager in the industry within the department of research and development at Mühlbauer AG, where he became head of research and development in 1998. Since 2002, he is full professor for transport and automation technology at Leibniz University Hannover and director of the Institute for Transport and Automation Technology, Leibniz University Hannover.

9:15 to 10:00 AM

THE EMERGING INDUSTRIAL INTERNET

Mr. William Ruh
Vice President and Corporate Officer
GE Global Software Headquarters

ABSTRACT: The industrial world is undergoing a seismic shift in productivity and efficiency as machines become increasingly intelligent. This shift will result in the creation of an Industrial Internet that will have the same transformative effect as the consumer internet. Intelligence is brought about through innovative sensor technology, machine to machine connectivity, new approaches to automation, and most importantly software that gives insight to people in real-time. This seismic shift to what one venture capitalist has dubbed: 'software eating the world', will require more and more companies to make strategic decisions on their willingness to invest resources and take the risks to capture this increasingly valuable part of the value-chain. The big question for companies that want to win and survive in today's economy is: do you focus on existing products and business models or do you create new integrated hardware/software solutions and services that is greater than the sum of the individual parts. This talk will explore the notion of the Industrial Internet, emerging business opportunities and GE's strategic decision to focus on software and analytic-based services.

Mr. William Ruh is vice president of GE's software and analytics center. Mr. Ruh is responsible for setting and leading the software services and solutions portfolio strategy, development and operations across all of GE. His team develops software to power the Industrial Internet, a living network of intelligent machines and systems designed to advance industry and improve lives. These systems and solutions put data to work for GE's customers, giving businesses intelligent insight to make more sustainable and safe products. Mr. Ruh has more than 25 years of industry experience in enterprise application integration and object oriented technology. Previously, he was vice president at Cisco where he held global responsibility for developing advanced services and solutions. Before that, Mr. Ruh served as executive vice president and chief technology officer of Concept Five Technologies, Inc. Prior to that, he served as the chief technology officer and senior vice president of Software AG, Inc. where he was responsible for the growth and expansion of the solutions and consulting services team to provide customers with customized and industry-specific solutions. Mr. Ruh has also held various management roles at The Advisory Board, The MITRE Corporation, IBM and AkroMetrix, LLC. Mr. Ruh earned a B.S. and M.S. in Computer Science from California State University, Fullerton.

PANEL DISCUSSION

Open Architecture (OA) Open Business Mode (OBM) Systems

Wednesday 7 May 2014 · 11:00 AM to 12:00 PM
Location: Conv. Ctr. Room 328

OPEN ARCHITECTURE (OA) OPEN BUSINESS MODE (OBM) SYSTEMS

Moderator:

Raja Suresh
General Dynamics Advanced Information Systems (USA)

Panelists:

Rear Admiral Mathias Winter
Program Executive Officer, Unmanned Aviation and Strike Weapons
U.S. Navy (USA)

Leo Rose
Air Force Research Lab. (USA)

Mike Eagan, Vice President
General Dynamics Advanced Information Systems (USA)

Robert Dean
General Dynamics Robotic Systems (USA)

See Wednesday 07 May Industry Events p. 22

Banquet and Award Announcements

Wednesday 7 May 2014 · 7:00 to 9:30 PM
Tickets required · $98 each

Location: Hilton: Holiday Ballroom 4-6

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

INTRODUCTION OF NEW SPIE FELLOWS

DSS LIFETIME ACHIEVEMENT AWARD PRESENTATION

Distinguished Banquet Speaker

National Security Challenges for Science and Technology

Dr. David A. Honey
Director of Science and Technology Acquisition, Technology and Facilities (AT&F), Office of the Director of National Intelligence

Dr. David A. Honey currently serves as the Director, Science and Technology, and as the Assistant Deputy Director of National Intelligence for Science and Technology. In this assignment he is responsible for the development of effective strategies, policies, and programs that lead to the successful integration of science and technology capabilities into operational systems.

Prior to this assignment, Dr. Honey served as the Deputy Assistant Secretary of Defense, Research, in the Office of the Assistant Secretary of Defense (Research and Engineering), from 31 August 2009-4 November 2011. He was responsible for policy and oversight of DoD Science and Technology programs from Basic Research through Advanced Technology Development. He was also responsible for oversight of DoD laboratories, ensuring the long-term strategic direction of the Department's S&T programs, and for developing those technologies needed for continued technological superiority of US forces.

Before that, Dr. Honey was the Defense Sector General Manager and a Senior Vice President in a small business pursuing innovations in the fields of advanced sensors, communications, UAVs and undersea warfare technology. Dr. Honey also served on the Air Force Scientific Advisory Board.

Dr. Honey was the Director of the Defense Advanced Research Projects Agency (DARPA) Strategic Technology Office (STO), Director of the Advanced Technology Office (ATO), and Deputy Director and Program Manager of the Microsystems Technology Office (MTO). While at DARPA he led efforts in optoelectronics, networks, communications, information assurance, network centric-warfare applications, information assurance, sensor systems, space and near-space sensors and structures, maritime technology, underground facility detection and characterization, alternative energy, and chemical-biological defense.

Dr. Honey is a retired Air Force Lieutenant Colonel who began his military career as a pilot (B-52D/H and FB-111) and later transitioned into managing a wide variety of technical programs involving intelligence, surveillance and reconnaissance.

He received a B.S. in Photographic Science from Rochester Institute of Technology; an M.S. in Optical Science from the University of Arizona; an M.S. in Engineering Physics from the Air Force Institute of Technology (AFIT); and a PhD in Solid State Science from Syracuse University.

Thursday 08 May.

PANEL DISCUSSION

Strategic Vision Security and Defense

Thursday 8 May 2014 · 1:00 to 1:30 PM · Conf. 9119
Location: Conv. Ctr. Room 340

Moderator: **Daniel Stambovsky,** Air Force Research Lab. (USA)

Panelists: **David Schaffer,** Binghamton Univ. (USA)
Bryant Wysocki, Air Force Research Lab. (USA)
David Aha, U.S. Naval Research Lab. (USA)
Misty Blowers, Air Force Research Lab. (USA)

Poster Session

Thursday 8 May 2014 · 6:00 to 7:30 PM
Location: Conv. Ctr. Hall C

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.

See Thursday 08 May Industry Events p. 23

2 CO-LOCATED EVENTS WITH SPIE DSS 2014

Advanced High Power Lasers

Includes the 27th Annual Solid State and Diode Laser Technology Review

The Advanced High Power Laser Conference consists of two Key Note Speakers, a series of technical presentations, and an included short course, "Introduction to High-Power Fiber Lasers". This two full-day event is open to SPIE attendees who can meet attendance criteria required for the unclassified, limited sessions. For complete information please go to www.deps.org and click on the AHPL Conference from the home page.

Co-located meeting with
SPIE.DSS

Sponsored by
Directed Energy Professional Society

Baltimore Convention Center Level 300
Visit our Exhibits in the DE Cluster

2014 Best Student & Young Researchers Paper Awards.

CONFERENCE 9091
SIGNAL PROCESSING, SENSOR/INFORMATION FUSION, AND TARGET RECOGNITION XXIII
Location: Conv. Ctr. Room 325

Young Researcher Best Paper Award

Commencing in 2014, a conference awards committee will be established to evaluate the submitted papers and associated presentation to select "the Young Researcher Best Paper Award."

CONFERENCE 9088
ALGORITHMS FOR SYNTHETIC APERTURE RADAR IMAGERY XXI
Location: Conv. Ctr. Room 327

SAR 2014 Best Student Paper Award

In order to be considered for this award, the student must be the presenter and the primary author. A panel of experts will evaluate the papers, both for quality and content with regard to: 1) innovation, clarity, and style, and 2) the importance of the work to the field.

CONFERENCE 9090
AUTOMATIC TARGET RECOGNITION XXIV
Location: Conv. Ctr. Room 329

Announcing the 2014 ATR Best Paper Awards

Lockheed Martin Corporation generously offered to sponsor the Best Paper Awards for the Automatic Target Recognition (ATR) conference, part of the SPIE DSS 2014 Symposium, which will be held in Baltimore, Maryland, 5-9 May 2014. Three awards are planned: one Best Student Paper Award, and two overall Best Paper Awards.

Award Sponsored by: LOCKHEED MARTIN

Electro-Optics Alliance (EOA) Annual Meeting

Co-located meeting with **SPIE.DSS**

Thursday 8 May 2014 · 8:00 am to 5:00 pm · Location: Conv. Ctr. Room 317

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/eve_index.html

Meeting data: http://eoc.psu.edu/events/201405_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 1855
The Electro-Optics Center
A Manufacturing Technology Center of Excellence

Industry Events.

These important sessions provide valuable information and networking opportunities needed to succeed in business.

Open to all attendees.

Location: Conv. Ctr. Exhibition Hall – Industry Events Area

MONDAY.

THE INFRARED APPLICATIONS: THERMOSENSE XXXVI VENDOR SESSION

Monday 5 May 2014 · 12:00 to 4:40 PM · Conf. 9105
Location: Conv. Ctr. Room 316

Moderators: **Andrés E. Rozlosnik,** Si Termografia Infrarroja (Argentina), and **Herb Kaplan,** Honeyhill Technical Co. (USA)

The Infrared Applications: ThermoSense XXXVI Vendor Session will be held on Monday afternoon, 5 May 2014 as part of SPIE's DSS2014 Conference in Baltimore. 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. See page 10 for list of vendors.

ASC OP/TF6 AND SPIE IRMWG JOINT MEETING

Monday 5 May 2014 · 2:00 to 4:30 PM
Location: Hilton: Holiday 1

Chair: **Adam Phenis,** TF6 Leader (USA)

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:

- Update the nominal values of material properties
- Determine the blank-to-blank variations in the material properties
- Develop standards for wavelength bands, reference wavelengths, and sampling and test protocols
- Foster the development of cost-effective methods for measuring material properties
- 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.

TUESDAY.

PROFESSIONAL RESUME REVIEW

Tuesday 6 May 2014 · 10:00 AM to 2:00 PM
Location: Conv. Ctr. Exhibition Hall – Industry Events, Job Fair Area

FREE - All attendees welcome

Get your CV/resume reviewed for free by technical recruitment specialists. Receive comments and suggestions on your resume and see how you can further improve it!

Lori Carter, Technical Recruiter Consultant
Vesper Wave Solutions

Vesper Wave Solutions has in-depth experience supporting the staffing needs for the US defense, intelligence, military and high-tech communities.

JOB FAIR

Tuesday 6 May 2014 · 10:00 am to 5:00 PM
Location: Conv. Ctr. Exhibition Hall – Industry Events, Job Fair Area

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

All SPIE services are free to individuals seeking employment.

Post your resume today! Visit the Career Center: www.SPIECareerCenter.org

DSS EXPO

Tuesday 6 May 2014 · 10:00 am to 5:00 PM
Location: Conv. Ctr. Exhibition Level 100

Attend the Free Exhibition of Core Technologies, No-Cost Workshops, and Product Tutorials. SPIE DSS Expo is the East Coast's largest exhibition for precision optics, lasers, sensors, optical materials, thermal imaging, optoelectronics, instrumentation, data analysis, and more. It's the best opportunity this year to meet and discuss your situation with suppliers, discover new possibilities, and increase capabilities at a lower budget.

TEDCO WORKSHOP ON COMMERCIALIZATION

Tuesday 6 May 2014 · 11:00 AM to 1:30 PM
Location: Conv. Ctr. Exhibition Hall – Industry Events Area

A Pathway to Creating New Products Utilizing Universities and Federal Labs

Moderator: **Stephen Auvil,** Sr. Vice President Technology Transfer & Commercialization, Maryland Technology Development Corp. (TEDCO)

11:00 to 11:30 AM

Step One: Transferring Technology from the Laboratory

Speaker: **Stephen Auvil**

This talk will provide companies and entrepreneurs with insight into the university/federal laboratory technology transfer process including what it is, why it is done, and what kind of opportunity it represents for commercial partners and entrepreneurs. An understanding of the motivations of universities and federal laboratories and what they are seeking from commercialization partners will be discussed. The mechanisms by which industry can work with labs will be described (research agreements, CRADAs, etc.) and a discussion of the license negotiation process will be included.

11:30 AM to 12:00 PM

Step Two: Getting a Technology to Market

Speaker: **Ron Kaese**

This talk will describe the various stages of commercializing a technology from a university or federal laboratory and what it takes to be successful. This includes the types of funding and other resources that are generally available and appropriate at each stage of the company's product development. Specific examples of funding programs and other resources in Maryland will be used as examples of typical state-based resources for early-stage companies.

12:00 to 12:45 PM

Industry Panel: Commercialization Stories

Moderator: **Stephen Auvil**

A panel of entrepreneurs who are commercializing non-defense, photonics-related technologies licensed from universities or federal laboratories will share their experiences with the commercialization process. Each entrepreneur will give a brief introduction to their story followed by a question and answer session led by the moderator. Audience participation will be encouraged.

Networking Reception to Follow

CHARTING A COURSE IN THE PHOTONICS INDUSTRY

Tuesday 6 May 2014 · 2:00 to 3:00 PM
Location: Conv. Ctr. Exhibition Hall – Industry Events Area

This speaker series will help you explore potential career pathways in the world of photonics outside of academia. Get solid advice on how you can translate your knowledge, abilities, and interests into meaningful work from experienced leaders. The series will conclude with a question-and-answer session (with all speakers) and a light refreshment reception.

From astronomy instrumentation Post-Doc to Branch Head at NRL

Dr. Sergio Restaino, Naval Research Laboratory

Dr. Restaino is the Branch Head for the Radio/IR/Optical Sensors Branch of the Remote Sensing Division at the Naval Research Laboratories. Dr. Restaino conducts research on high angular resolution imaging by use of Adaptive Optics and long baseline optical interferometry. He has more than 20 years' experience in these fields and is Fellow of SPIE.

My Journey as a Soldier - Scientist

Augustus W. Fountain III, Ph.D., SPIE Fellow
Edgewood Chemical Biological Center

Dr. Fountain is the Department of the Army's Senior Research Scientist for Chemistry at the U.S. Army Edgewood Chemical Biological Center (ECBC) and a 2014 Fellow of SPIE. He is an internationally recognized expert in chemical defense and is called on to provide advice to government agencies in the planning of analytical chemistry and nanoscience projects in emerging technologies. Additionally, he serves as an at-large representative of the United States to the NATO Sensors & Electronics Technology Panel advising them on CBRNE detection.

Networking Reception to Follow

GETTING HIRED PANEL

Tuesday 6 May 2014 · 3:30 to 4:30 PM
Location: Conv. Ctr. Exhibition Hall – Industry Events Area

Join us for a panel discussion on careers in optics and photonics outside the academic world. Learn about the process of getting hired at tech-based companies and non-academic jobs directly from professionals in the optics and photonics sector.

Panel Members:

Tony Amarel, Recruitment Specialist
OpticsProfessionals LLC

Paige Lawson, HR Generlist/Recruiter
LightWorks Optical Systems

Lori Carter, Technical Recruiter Consultant
Vesper Wave Solutions

SPIE. INDUSTRY EVENTS

Industry Events.

Explore the business side of DSS 2014

Open to all attendees.

Location: Conv. Ctr. Exhibition Hall – Industry Events Area

WEDNESDAY.

PROFESSIONAL RESUME REVIEW

Wednesday 7 May 2014 · 10:00 AM to 2:00 PM
Location: Conv. Ctr. Exhibition Hall – Industry Events, Job Fair Area

FREE - All attendees welcome

Get your CV/resume reviewed for free by technical recruitment specialists. Receive comments and suggestions on your resume and see how you can further improve it!

Lori Carter, Technical Recruiter Consultant
Vesper Wave Solutions

Vesper Wave Solutions has in-depth experience supporting the staffing needs for the US defense, intelligence, military and high-tech communities

JOB FAIR

Wednesday 7 May 2014 · 10:00 am to 5:00 PM
Location: Conv. Ctr. Exhibition Hall – Industry Events, Job Fair Area

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

All SPIE services are free to individuals seeking employment.

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DSS EXPO

Wednesday 7 May 2014 · 10:00 am to 5:00 PM
Location: Conv. Ctr. Exhibition Level 100

Attend the Free Exhibition of Core Technologies, No-Cost Workshops, and Product Tutorials. SPIE DSS Expo is the East Coast's largest exhibition for precision optics, lasers, sensors, optical materials, thermal imaging, optoelectronics, instrumentation, data analysis, and more. It's the best opportunity this year to meet and discuss your situation with suppliers, discover new possibilities, and increase capabilities at a lower budget.

MIRTHE WORKSHOP ON EARLY STAGE TECHNOLOGY COMMERCIALIZATION

Wednesday 7 May 2014 · 10:30 AM to 12:00 PM
Location: Conv. Ctr. Exhibition Hall – Industry Events Area

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 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.

Panelists

Ralph Taylor-Smith, General Partner of Battelle Ventures and Innovation Valley Partners

Petros Kotidis, CEO, Block Engineering

Tim Day, CEO, Daylight Solutions

Mark Zondlo, Princeton University

About the organizers

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).

MIRTHE is an Engineering Research Center for Mid-InfraRed Technologies for Health and the Environment sponsored by National Science Foundation. MIRTHE invents, develops and commercializes high-performance, cost-effective and market-ready mid-infrared trace gas sensor systems based on new technologies such as quantum cascade lasers in close collaboration with industry, practitioners, academic institutions and government laboratories for applications in health, environment and homeland security. To learn more go to www.mirthecenter.org

Morning refreshments will be provided.
Networking reception to follow

THE FUTURE OF SENSING: AN INDUSTRY PERSPECTIVE

Wednesday 7 May 2014 · 2:00 to 3:00 PM
Location: Conv. Ctr. Exhibition Hall – Industry Events Area

This panel session emphasizes non-DoD photonic sensing, including industrial inspection/process control, machine vision, food safety, biotech, energy exploration and other applications enabled by COTS fiber sensors, molecular spectroscopy, hyperspectral imaging, and thermal imaging.

Panel Moderator: **Peter Hallett,** Director of Marketing and Industry Relations

Panel Members

Tim Day, CEO, Daylight Solutions
MOLECULAR SPECTROSCOPY

David Bannon, CEO, Headwall Photonics
HYPERSPECTRAL SENSING

Michael Allen, Director, Marketing & Product Development, Ocean Optics
SPECTROSCOPIC SENSING

John Maida, Chief Optical Scientist, Haliburton Applied Photonics Center
FIBER SENSING

Leonard Chen, Directory of Technology, Raytheon Vision Systems
THERMAL IMAGING / IR

Networking Reception to Follow

ITAR AND OTHER INTERNATIONAL TRADE REGULATIONS WORKSHOP: Strategies for Navigating U.S. Export Controls and International Trade Issues for the Optics and Photonics Industry

Wednesday 7 May 2014 · 3:30 to 4:30 PM
Location: Conv. Ctr. Exhibition Hall – Industry Events Area

Instructors
Kerry Scarlott, Goulston & Storrs
Ian Moss, Goulston & Storrs

If your company's sales activities, products or services come into contact with foreign jurisdictions, this is a must-attend program. The stakes have never been higher. Anyone who wants to answer questions such as, "How do U.S. export controls apply to me?" or "What are the legal pitfalls of doing business internationally?" or "What are best practices for engaging in global trade?" will benefit from attending this workshop.

INTENDED AUDIENCE: Owners, executives, product managers who wish to learn how to grow business while effectively and efficiently navigating U.S. international trade laws and regulations.

Networking Reception to Follow

THURSDAY.

DSS EXPO

Thursday 8 May 2014 · 10:00 am to 2:00 PM
Location: Conv. Ctr. Exhibition Level 100

DOING BUSINESS GLOBALLY: Legal Best Practices for Ensured Success

Thursday 8 May 2014 · 10:30 AM to Noon
Location: Conv. Ctr. Exhibition Hall – Industry Events Area

Opening Remarks: **Sell Your Products Globally**

Paul Matino, International Trade Specialist
U.S. Department of Commerce

Instructors
Kerry Scarlott, Goulston & Storrs

Ian Moss, Goulston & Storrs

During this fast-paced session, you will learn techniques for safely navigating the legal pitfalls of international trade. Traps for the unwary will be revealed, together with strategies for success. Advanced issues related to export controls, intellectual property protection, supply chain management, use of agents and distributors, and ethical considerations will be explored and demystified.

INTENDED AUDIENCE: Owners, executives, product managers who wish to learn how to grow business while effectively and efficiently navigating U.S. international trade laws and regulations.

Networking Reception to Follow

E.
EXHIBITION

Tuesday 6 May 2014
10 am to 5 pm

Wednesday 7 May 2014
10 am to 5 pm

Thursday 8 May 2014
10 am to 2 pm

Attend the East Coast's largest exhibition on lasers, optics, sensors, image processing, infrared systems, optoelectronics, and more

Meet 450 technology suppliers in one place, saving time and money.

Visit with reps from the largest prime contractors, key suppliers, and dynamic startups ready to help you boost capabilities and cut costs. This free exhibition of core technologies, no-cost workshops, and product tutorials showcases the newest products, latest innovations, and cutting-edge technologies, including:

- Robotics and Unmanned Systems
- 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

"Working with this community has resulted in innovations that have saved lives. It has turned big data into big value. You, in SPIE, are our partners. You continue to develop the sensors of the future, to help us with the integration of the innovation, to develop the automated tools as close to the primary data as possible. This enables our analysts the time to analyze information and deliver better knowledge, so policy makers have more options. This is about decision advantage."

–Letitia Long,
Director, National Geospatial Intelligence Agency

Don't Miss These Free New Technology Demos and Displays

See innovations from our exhibitors in this special showcase. Get an up-close look at the latest in technologies like smartphone thermal imaging, high-dexterity manipulation systems, 6 axis motion systems, and more.

FLIR ONE the first ever smartphone-based thermal imager

Booth #881

FLIR ONE uses MSX multi-spectral image blending that adds edge detail from the visible spectrum to thermal images to enhance image detail. FLIR ONE uses FLIR's all new Lepton camera core, the world's smallest commercially available microbolometer-based thermal camera. Lepton was designed for easy integration into third party products, such as smartphones, tablets, diagnostic tools, automobiles, toys, building controls, process equipment, security systems, machine vision systems, and advanced gaming devices.

The Johns Hopkins University Applied Physics Laboratory's "Robo Sally"

Booth #1081

A high-dexterity anthropomorphic manipulation system with an articulating sensor head mounted to a mobility platform. The system enables operation in extreme environments by projecting human dexterity and decision capabilities from a safe stand-off distance. Robo Sally is based on APL's 17 DOF Prosthetic Arms, developed under DARPA 's Revolutionizing Prosthetics Program.

ALIO's Hybrid Hexapods® demonstrates multi-axis synchronization

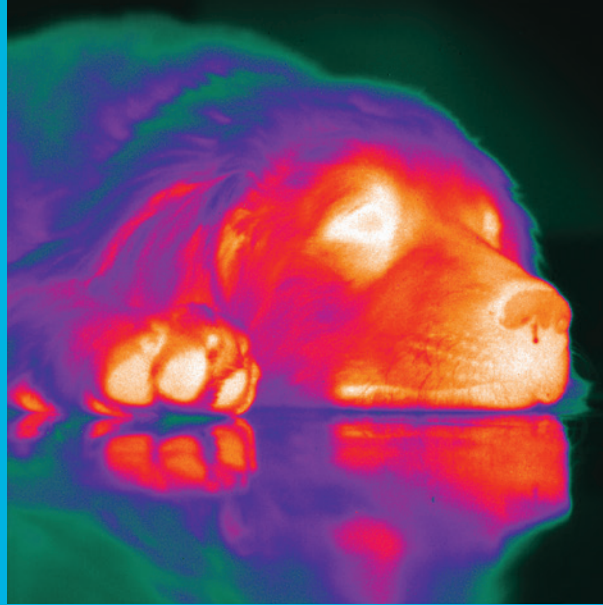
Booth #981

A Hybrid Hexapod® is a mix of parallel kinematics and serial kinematics which makes it a Hybrid with 6 axis of motion.

This new type of motion solution eliminates the weaknesses of the conventional hexapod with two orders of magnitude more accuracy while providing a much more robust solution for applications requiring high lateral loading. It will change the way you think about hexapod applications.

4th Annual Imaging Gallery Showcase

SPIE and StingRay Optics are once again teaming up at SPIE DSS EXPO 2014 to display the finest examples of today's imaging technology…with an artistic flair!



On the exhibition floor during show hours

StingRay SPIE.

For more details on the 2014 Imaging Gallery, please contact:

Mr. Sam Wyman, swyman@stingrayoptics.com, or Jennifer Myers, jmyers@stingrayoptics.com,

PRODUCT DEMONSTRATIONS

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

Location: Conv. Ctr. Exhibition Hall - Demo Area

TIME	Tuesday 6 May	Wednesday 7 May	Thursday 8 May
10:30 AM		**New Low Cost IR Focal Planes** **Bodo Forg,** Heimann Sensor LOW COST thermopile IR focal planes enable a new generation of inexpensive thermal imagers and open up new CONSUMER APPLICATIONS. Come see our demo cameras in operation!	**High performance IR detection** **Maciej Fimiarz,** VIGO System VIGO System is introducing a new line of SMART - high performance IR detection sets including high performance IR detectors integrated with preamplifier and temperature controllers.
11:30 AM	**Advances in optical filters for sensing applications** **Jason Palidwar,** Iridian Spectral Technologies Learn about new optical filter products such as multi-spectral filter arrays and large, extremely uniform optics made possible by improvements in filter coating and processing technologies.	**Engineered Colored Filter Glasses for Enhanced Sensor Performance** **Adam Willsey,** Kopp Glass, Inc. Learn how Kopp tailors glass formulations for optimal sensor performance, examples include: sharp-cut filters with reduced autofluorescence properties, custom rare-earth doped glasses, and more.	**IRG Product Demo** **Matthew Roth,** SCHOTT Defense SCHOTT Defense's high performing IRG chalcogenide materials and IR adhesive bonding provides multi-spectral imaging solutions from the visible to long-wave infrared wavelengths.
12:30 PM	**The Impact of Lightweight, Low-cost 3D Flash LIDAR Vision Systems in Autonomous Systems** **Thomas Laux,** Advanced Scientific Concepts The advent of solid state, small form factor, lightweight and lower cost 3D Flash LIDAR™ sensors that capture and stream 3D point cloud and intensity data in real-time.		**New Compact Chalcogenide Lens Solutions for LWIR** **John Franks,** Umicore Optical Materials USA Inc. Umicore's GASIR® infrared lenses have been developed for an easy fit with a wide range of camera cores. Our catalog lenses provide a cost effective solution for high-resolution thermal imaging.
1:30 PM	**Fix Mounted Thermal Imagers with Innovative Technologies** **Chongfei Shen,** Shanghai Magnity Electronics Magnity's fix mounted thermal imagers excel in image quality and rich-functioned software and SDK for various applications. Advanced algorithms are implemented, such as super-resolution and RET.	**Ultra-compact gimbal combines SWIRL/LWIR image fusion for extreme day/night UAS operations.** **Jan Vermeiren,** Xenics A combination of LWIR and SWIR images allows you to fly under the most harsh weather conditions. Smart cameras allow to cope with intensity changes over 6 orders of magnitude (>200 000 to <0.04 Lux).	
2:30 PM	**Multispectral Sensing & Imaging | Innovations & Applications** **John Dougherty,** PIXELTEQ Find out how multispectral imaging & sensing are being used in ... - agriculture, biomedical, industrial &, security applications - application-specific cameras and sensors across UV, VIS, NIR, and SWIR.	**High Performance Software for Multisensor-Multitarget Tracking, Fusion and Track Analytics** **Dr Thia Kirubarajan,** TrackGen Solutions Inc. We present our high-performance software products & APIs for real-world large-scale multisensor-multitarget tracking using radar, sonar, GMTI, ESA, video, EO/IR, AIS, ADS-B, PCL and multistatic data.	**EXHIBITION CLOSED**
3:30 PM	**Fuchsia Series 50-500mm F/5 Motorized SWIR Continous Zoom Lens** **Jennifer Myers,** StingRay Optics, LLC Achromatically corrected SWIR lens ideal for long range surveillance, remote monitoring, haze penetration or laser detection compatible with high resolution InGaAs FPAs. Manual or motorized versions.	**TS-IR, Exceptional IR Image Accuracy and Intense Sensitivity in a Rugged IP67 Enclosure** **Vincent Farley,** Telops The NEW TS-IR camera complements Telops' high-speed, high-definition and multispectral models. This high-performance camera has been specifically designed to withstand harsh environments.	**EXHIBITION CLOSED**

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COURSE TECHNOLOGY TRACKS.

- IR Sensors and Systems
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- Laser Sensors and Systems
- Displays
- Sensor Data and Information Exploitation
- Information Systems and Networks: Processing, Fusion, and Knowledge Generation
- Imaging and Sensing Technologies
- Sensing for Industry, Environment, and Health
- Emerging Technologies
- Optical and Optomechanical Engineering
- Courses for Industry & Exhibitors

NEW COURSES INCLUDE.

- Introduction to Electro-Optical Systems Design
- Infrared Optics Design Principles
- Finite Element Analysis of Optics
- Laser Beam Formation and Propagation in Photonics Instruments and Sensor Systems
- Designing IR Instrumentation
- Multispectral Image Fusion and Night Vision Colorization
- Infrared Optical Materials, Fabrication and Testing for the Optical Engineer
- Atmospheric Codes (MODTRAN, FASCODE, and HITRAN) for Sensor Development and Evaluation

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DSS 2014 COURSE SCHEDULE

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
DEFENSE, HOMELAND SECURITY, AND LAW ENFORCEMENT				
SC1068 **Introduction to Night Vision** *(Browne)* 1:30 pm to 5:30 pm, $370/$420	SC952 **Applications of Detection Theory** *(Carrano)* 8:30 am to 5:30 pm, $590/$685	SC1137 NEW **Atmospheric Codes (MODTRAN, FASCODE, and HITRAN) for Sensor Development and Evaluation** *(Schroeder)* 8:30 am to 5:30 pm, $590/$685	SC995 **Target Detection Algorithms for Hyperspectral Imagery** *(Nasrabadi)* 8:30 am to 5:30 pm, $590/$685	SC972 **Basic Laser Technology** *(Sukuta)* 8:30 am to 12:30 pm, $370/$420
	SC1107 **IR Atmospheric Propagation for Sensor Systems** *(Thomas, Brown)* 8:30 am to 5:30 pm, $675/$770	SC789 **Introduction to Optical and Infrared Sensor Systems** *(Shaw)* 8:30 am to 5:30 pm, $590/$685		
	SC1135 NEW **Multispectral Image Fusion and Night Vision Colorization** *(Zheng, Blasch)* 1:30 pm to 5:30 pm, $370/$420			
DISPLAYS				
SC1068 **Introduction to Night Vision** *(Browne)* 1:30 pm to 5:30 pm, $370/$420	SC1069 **GPU for Defense Applications** *(Rogers)* 8:30 am to 12:30 pm, $370/$420			
	SC159 **Head-Mounted Displays: Design and Applications** *(Melzer, Browne)* 8:30 am to 5:30 pm, $625/$720			
	SC1135 NEW **Multispectral Image Fusion and Night Vision Colorization** *(Zheng, Blasch)* 1:30 pm to 5:30 pm, $370/$420			

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DSS 2014 COURSE SCHEDULE

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
EMERGING TECHNOLOGIES				
	SC1076 **Analog-to-Digital Converters for Digital ROICs** *(Veeder)* 8:30 am to 12:30 pm, $370/$420		SC1071 **Understanding Diffractive Optics** *(Soskind)* 8:30 am to 5:30 pm, $625/$720	
IMAGING AND SENSING TECHNOLOGIES				
SC713 **Engineering Approach to Imaging System Design** *(Holst)* 8:30 am to 5:30 pm, $640/$735	SC1076 **Analog-to-Digital Converters for Digital ROICs** *(Veeder)* 8:30 am to 12:30 pm, $370/$420	SC1137 NEW **Atmospheric Codes (MODTRAN, FASCODE, and HITRAN) for Sensor Development and Evaluation** *(Schroeder)* 8:30 am to 5:30 pm, $590/$685	SC995 **Target Detection Algorithms for Hyperspectral Imagery** *(Nasrabadi)* 8:30 am to 5:30 pm, $590/$685	SC154 **Electro-Optical Imaging System Performance** *(Holst)* 8:30 am to 5:30 pm, $670/$765
SC194 **Multispectral and Hyperspectral Image Sensors** *(Lomheim)* 8:30 am to 12:30 pm, $450/$500	SC952 **Applications of Detection Theory** *(Carrano)* 8:30 am to 5:30 pm, $590/$685	SC180 **Imaging Polarimetry** *(Miles, Sabatke, Kudenov)* 8:30 am to 12:30 pm, $370/$420	SC067 **Testing and Evaluation of E-O Imaging Systems** *(Holst)* 8:30 am to 5:30 pm, $670/$765	
SC066: **Fundamentals of Electronic Image Processing** *(Weeks)* 8:30 am to 5:30 pm $660/$755	SC1069 **GPU for Defense Applications** *(Rogers)* 8:30 am to 12:30 pm, $370/$420	SC1112 **Introduction to Electro-Optical Systems Design** *(Stotts)* 8:30 am to 5:30 pm, $655/$750	SC1071 **Understanding Diffractive Optics** *(Soskind)* 8:30 am to 5:30 pm, $625/$720	
	SC1107 **IR Atmospheric Propagation for Sensor Systems** *(Thomas, Brown)* 8:30 am to 5:30 pm, $675/$770	SC789 **Introduction to Optical and Infrared Sensor Systems** *(Shaw)* 8:30 am to 5:30 pm, $590/$685		
		SC1109 **Infrared Radiometric Calibration** *(Yoon, Eppeldauer, Kaplan, Gibson)* 1:30 pm to 5:30 pm, $370/$420		

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
IR SENSORS AND SYSTEMS				
SC713 **Engineering Approach to Imaging System Design** *(Holst)* 8:30 am to 5:30 pm, $640/$735	SC1076 **Analog-to-Digital Converters for Digital ROICs** *(Veeder)* 8:30 am to 12:30 pm, $370/$420	SC1137 NEW **Atmospheric Codes (MODTRAN, FASCODE, and HITRAN) for Sensor Development and Evaluation** *(Schroeder)* 8:30 am to 5:30 pm, $590/$685	SC1138 NEW **Infrared Optics Design Principles** *(Johnson)* 8:30 am to 5:30 pm, $640/$735	SC972 **Basic Laser Technology** *(Sukuta)* 8:30 am to 12:30 pm, $370/$420
SC278 **Infrared Detectors** *(Dereniak)* 8:30 am to 12:30 pm, $495/$545	SC835 **Infrared Systems - Technology & Design** *(Daniels)* 8:30 am to 5:30 pm, $1,120/$1,340		SC067 **Testing and Evaluation of E-O Imaging Systems** *(Holst)* 8:30 am to 5:30 pm, $670/$765	SC154 **Electro-Optical Imaging System Performance** *(Holst)* 8:30 am to 5:30 pm, $670/$765
SC194 **Multispectral and Hyperspectral Image Sensors** *(Lomheim)* 8:30 am to 12:30 pm, $450/$500	SC1107 **IR Atmospheric Propagation for Sensor Systems** *(Thomas, Brown)* 8:30 am to 5:30 pm, $675/$770	SC180 **Imaging Polarimetry** *(Miles, Sabatke, Kudenov)* 8:30 am to 12:30 pm, $370/$420	SC1071 **Understanding Diffractive Optics** *(Soskind)* 8:30 am to 5:30 pm, $625/$720	SC1136 NEW **Infrared Optical Materials, Fabrication and Testing for the Optical Engineer** *(DeGroote Nelson)* 8:30 am to 12:30 pm, $370/$420
SC900 **Uncooled Thermal Imaging Detectors and Systems** *(Hanson)* 8:30 am to 5:30 pm, $630/$725	SC1123 **The Building Blocks of IR Instrument Design** *(Grant)* 8:30 am to 12:30 pm, $370/$420	SC1112 NEW **Introduction to Electro-Optical Systems Design** *(Stotts)* 8:30 am to 5:30 pm, $730/$750		
SC152 **Infrared Focal Plane Arrays** *(Dereniak, Hubbs)* 1:30 pm to 5:30 pm, $370/$420	SC1135 NEW **Multispectral Image Fusion and Night Vision Colorization** *(Zheng, Blasch)* 1:30 pm to 5:30 pm, $370/$420	SC789 **Introduction to Optical and Infrared Sensor Systems** *(Shaw)* 8:30 am to 5:30 pm, $590/$685		
SC1068 **Introduction to Night Vision** *(Browne)* 1:30 pm to 5:30 pm, $370/$420		SC1109 **Infrared Radiometric Calibration** *(Yoon, Eppeldauer, Kaplan, Gibson)* 1:30 pm to 5:30 pm, $370/$420		

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DSS 2014 COURSE SCHEDULE

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
INFORMATION SYSTEMS AND NETWORKS: PROCESSING, FUSION, AND KNOWLEDGE GENERATION				
	SC952 **Applications of Detection Theory** *(Carrano)* 8:30 am to 5:30 pm, $590/$685			
	SC994 **Multisensor Data Fusion for Object Detection, Classification and Identification** *(Klein)* 8:30 am to 5:30 pm, $670/$765			
	SC1135 NEW **Multispectral Image Fusion and Night Vision Colorization** *(Zheng, Blasch)* 1:30 pm to 5:30 pm, $370/$420			
LASER SENSORS AND SYSTEMS				
SC1103 **3D Imaging Laser Radar** *(Kamerman)* 8:30 am to 5:30 pm, $590/$685		SC789 **Introduction to Optical and Infrared Sensor Systems** *(Shaw)* 8:30 am to 5:30 pm, $590/$685	SC1071 **Understanding Diffractive Optics** *(Soskind)* 8:30 am to 5:30 pm, $625/$720	SC972 **Basic Laser Technology** *(Sukuta)* 8:30 am to 12:30 pm, $370/$420
SC1032 **Direct Detection Laser Radar Systems for Imaging Applications** *(Richmond, Cain)* 8:30 am to 5:30 pm, $635/$730				
SC1121 NEW **Laser Beam Formation and Propagation in Photonics Instruments and Sensor Systems** *(Soskind)* 8:30 am to 5:30 pm, $590/$685				
SC160 **Precision Stabilized Pointing and Tracking Systems** *(Hilkert)* 8:30 am to 5:30 pm, $590/$685				

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DSS 2014 COURSE SCHEDULE

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
OPTICAL AND OPTOMECHANICAL ENGINEERING				
SC156 **Basic Optics for Engineers** *(Boreman)* 8:30 am to 5:30 pm, $630/$725	SC010 **Introduction to Optical Alignment Techniques** *(Castle)* 8:30 am to 5:30 pm, $590/$685	SC1120 **Finite Element Analysis of Optics** *(Doyle, Genberg)* 8:30 am to 5:30 pm, $590/$685	SC1138 **Infrared Optics Design Principles** *(Johnson)* 8:30 am to 5:30 pm, $640/$735	SC1136 **Infrared Optical Materials, Fabrication and Testing for the Optical Engineer** *(DeGroote Nelson)* 8:30 am to 12:30 pm, $370/$420
SC014 **Introduction to Optomechanical Design** *(Vukobratovich)* 8:30 am to 5:30 pm, $965/$1,185		SC1112 **Introduction to Electro-Optical Systems Design** *(Stotts)* 8:30 am to 5:30 pm, $655/$750	SC781 **Opto-mechanical Analysis** *(Hatheway)* 8:30 am to 5:30 pm, $590/$685	
SC1085 **Opto-mechanical Systems Engineering** *(Kasunic)* 8:30 am to 5:30 pm, $590/$685	SC1123 **The Building Blocks of IR Instrument Design** *(Grant)* 8:30 am to 12:30 pm, $370/$420	SC1052 **Optical Systems Engineering** *(Kasunic)* 8:30 am to 5:30 pm, $670/$765	SC015 **Structural Adhesives for Optical Bonding** *(Daly)* 8:30 am to 12:30 pm, $370/$420	
SC609 **Basic Optics for Non-Optics Personnel** *(Harding)* 1:30 pm to 4:00 pm, $175/$225		SC1109 **Infrared Radiometric Calibration** *(Yoon, Eppeldauer, Kaplan, Gibson)* 1:30 pm to 5:30 pm, $370/$420	SC1071 **Understanding Diffractive Optics** *(Soskind)* 8:30 am to 5:30 pm, $625/$720	

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DSS 2014 COURSE SCHEDULE

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
SENSING FOR INDUSTRY, ENVIRONMENT, AND HEALTH				
SC1121 NEW **Laser Beam Formation and Propagation in Photonics Instruments and Sensor Systems** *(Soskind)* 8:30 am to 5:30 pm, $590/$685	SC952 **Applications of Detection Theory** *(Carrano)* 8:30 am to 5:30 pm, $590/$685	SC1137 NEW **Atmospheric Codes (MODTRAN, FASCODE, and HITRAN) for Sensor Development and Evaluation** *(Schroeder)* 8:30 am to 5:30 pm, $590/$685	SC995 **Target Detection Algorithms for Hyperspectral Imagery** *(Nasrabadi)* 8:30 am to 5:30 pm, $590/$685	
	SC1107 **IR Atmospheric Propagation for Sensor Systems** *(Thomas, Brown)* 8:30 am to 5:30 pm, $675/$770	SC789 **Introduction to Optical and Infrared Sensor Systems** *(Shaw)* 8:30 am to 5:30 pm, $590/$685		
		SC1109 **Infrared Radiometric Calibration** *(Yoon, Eppeldauer, Kaplan, Gibson)* 1:30 pm to 5:30 pm, $370/$420		
SENSOR DATA AND INFORMATION EXPLOITATION				
SC194 **Multispectral and Hyperspectral Image Sensors** *(Lomheim)* 8:30 am to 12:30 pm, $450/$500	SC1076 **Analog-to-Digital Converters for Digital ROICs** *(Veeder)* 8:30 am to 12:30 pm, $370/$420		SC995 **Target Detection Algorithms for Hyperspectral Imagery** *(Nasrabadi)* 8:30 am to 5:30 pm, $590/$685	SC972 **Basic Laser Technology** *(Sukuta)* 8:30 am to 12:30 pm, $370/$420
SC160 **Precision Stabilized Pointing and Tracking Systems** *(Hilkert)* 8:30 am to 5:30 pm, $590/$685	SC994 **Multisensor Data Fusion for Object Detection, Classification and Identification** *(Klein)* 8:30 am to 5:30 pm, $670/$765			
	SC1135 NEW **Multispectral Image Fusion and Night Vision Colorization** *(Zheng, Blasch)* 1:30 pm to 5:30 pm, $370/$420			
COURSES FOR INDUSTRY & EXHIBITORS				
SC609 **Basic Optics for Non-Optics Personnel** *(Harding)* 1:30 pm to 4:00 pm, $175/$225			WS846 **Essential Skills for Engineering Project Leaders** *(Hinkle)* 1:30 pm to 5:30 pm, $370/$420	SC972 **Basic Laser Technology** *(Sukuta)* 8:30 am to 12:30 pm, $370/$420

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Defense + Security Daily Conference Schedule

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
IR SENSORS AND SYSTEMS				
9070 **Infrared Technology and Applications XL** *(Andresen/Fulop/Hanson/Norton)*				
	9071 **Infrared Imaging Systems: Design, Analysis, Modeling, and Testing XXV** *(Holst/Krapels)*			
DEFENSE, HOMELAND SECURITY, AND LAW ENFORCEMENT				
9072 **Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XIX** *(Bishop/Issacs)*				
	9073 **Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing XV** *(Fountain)*			
9074 **Sensors, and Command, Control, Communications, and Intelligence (C3I) Technologies for Homeland Security and Homeland Defense XIII** *(Carapezza)*			9075 **Biometric and Surveillance Technology for Human and Activity Identification XI** *(Kakadiaris/Scheirer/Busch)*	
	9097 **Cyber Sensing 2014** *(Ternovskiy/Chin)*			
INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE				
9089B **Motion Imagery for ISR and Situational Awareness II** *(Self)*		9076 **Airborne Intelligence, Surveillance, Reconnaissance (ISR) Systems and Applications XI** *(Henry)*		
9077 **Radar Sensor Technology XVIII** *(Ranney/Doerry)*			9078 **Passive and Active Millimeter-Wave Imaging XVII** *(Wikner/Luukanen)*	
9079 **Ground/Air Multisensor Interoperability, Integration, and Networking for Persistent ISR V** *(Kolodny/Priddy/Pham)*				
LASER SENSORS AND SYSTEMS				
	9080A **Laser Radar Technology and Applications XIX** *(Turner/Kamerman)*			
		9080B **Atmospheric Propagation XI** *(Wasiczko Thomas/Spillar)*		
	9081 **Laser Technology for Defense and Security X** *(Dubinskii/Post)*			
MONDAY PLENARY 5:00 to 6:00 pm		9082 **Active and Passive Signatures V** *(Gilbreath/Hawley)*		
WELCOME RECEPTION 6:15 to 7:45 pm				

Defense + Security Daily Conference Schedule

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
NEXT-GENERATION SENSORS AND SYSTEMS				
9083 **Micro- and Nanotechnology Sensors, Systems, and Applications VI** *(George/Islam/Dutta)*				
	9084 **Unmanned Systems Technology XVI** *(Karlsen/Gage/Shoemaker/Gerhart)*			
9085 **Sensors and Systems for Space Applications VII** *(Pham/Cox)*				
DISPLAYS				
		9086B **Head- and Helmet-Mounted Displays XIX: Design and Applications** *(Marasco/Havig/Browne/Melzer)*	9086A **Display Technologies and Applications for Defense, Security, and Avionics VIII** *(Desjardins/Sarma)*	
		9087 **Degraded Visual Environments (DVE): Enhanced, Synthetic, and External Vision Solutions (ESXVS) 2014** *(Güell/Sanders-Reed)*		
SENSOR DATA AND INFORMATION EXPLOITATION				
9088 **Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XX** *(Velez-Reyes/Kruse)*				
9089A **Geospatial InfoFusion and Video Analytics IV** *(Pellechia/Palaniappan/Deignan)*				
9091 **Signal Processing, Sensor/Information Fusion, and Target Recognition XXIII** *(Kadar)*				
		9092 **Signal and Data Processing of Small Targets 2014** *(Drummond)*		
		9093 **Algorithms for Synthetic Aperture Radar Imagery XXI** *(Zelnio/Garber)*		
IMAGERY AND PATTERN ANALYSIS				
9090 **Automatic Target Recognition XXIV** *(Sadjadi/Mahalanobis)*		9094 **Optical Pattern Recognition XXV** *(Casasent/Chao)*		

GREEN PHOTONICS

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

Watch for this icon next to conferences discussing innovative ways to help our planet.

Defense + Security Daily Conference Schedule

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
INFORMATION SYSTEMS AND NETWORKS: PROCESSING, FUSION, AND KNOWLEDGE GENERATION				
	9095 **Modeling and Simulation for Defense Systems and Applications IX** *(Kelmelis)*	**WEDNESDAY PLENARIES** 8:30 to 10:00 am		
9096 **Open Architecture/Open Business Model Net-Centric Systems and Defense Transformation 2014** *(Suresh)*				
	9122 **Next-Generation Analyst II** *(Broome/Hall/Llinas)*	9118 **Independent Component Analyses, Compressive Sampling, Wavelets, Neural Net, Biosystems, and Nanoengineering XII** *(Szu)*		
9120 **Mobile Multimedia/Image Processing, Security, and Applications 2014** *(Agaian/Jassim/Du)*			9119 **Machine Intelligence and Bio-inspired Computation: Theory and Applications VIII** *(Blowers/Williams)*	
	9121 **Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications 2014** *(Braun)*		9123 **Quantum Information and Computation XII** *(Donkor/Pirich/Brandt)*	
IMAGING AND SENSING TECHNOLOGIES				
9101 **Next-Generation Spectroscopic Technologies VII** *(Druy/Crocombe)*			9098 **Fiber Optic Sensors and Applications XI** *(Du/Pickrell/Udd)*	
9102 **Terahertz Physics, Devices, and Systems VIII: Advanced Applications in Industry and Defense** *(Anwar/Crowe/Manzur)*		9103 **Wireless Sensing, Localization, and Processing IX** *(Dianat/Zoltowski)*		
9099 **Polarization: Measurement, Analysis, and Remote Sensing XI** *(Chenault/Goldstein)*			9104 **Spectral Imaging Sensor Technologies: Innovation Driving Advanced Application Capabilities** *(Bannon)*	
		9109 **Compressive Sensing III** *(Ahmad)*		
SENSING FOR INDUSTRY, ENVIRONMENT, AND HEALTH				
	9111 **Ocean Sensing and Monitoring VI** *(Hou/Arnone)*			
9112 **Sensing Technologies for Global Health, Military Medicine, and Environmental Monitoring IV** *(Southern)*				
		9113 **Sensors for Extreme Harsh Environments** *(Senesky/Dekate)*		
EMERGING TECHNOLOGIES				
9115 **Energy Harvesting and Storage: Materials, Devices, and Applications V** *(Dhar/Balaya/Dutta)*		9114 **Advanced Photon Counting Techniques VIII** *(Itzler)*		

CONFERENCE 9070

LOCATION: CONV. CTR. ROOM 344

Monday - Thursday 5 - 8 May 2014 • Proceedings of SPIE Vol. 9070

Infrared Technology and Applications XL

Conference Chairs: **Bjørn F. Andresen,** Senso Optics Ltd. (Israel); **Gabor F. Fulop,** Maxtech International, Inc. (USA); **Charles M. Hanson,** Texas Instruments Inc. (USA); **Paul R. Norton,** U.S. Army Night Vision & Electronic Sensors Directorate (USA)

Program Committee: **Tayfun Akin,** Mikro-Tasarim Ltd. (Turkey), Middle East Technical Univ. (Turkey); **Christopher C. Alexay,** StingRay Optics, LLC (USA); **Jagmohan Bajaj,** Teledyne Imaging Sensors (USA); **Stefan T. Baur,** Raytheon Vision Systems (USA); **Philippe F. Bois,** Thales Research & Technology (France); **Wolfgang A. Cabanski,** AIM INFRAROT-MODULE GmbH (Germany); **John T. Caulfield,** Cyan Systems (USA); **Eric M. Costard,** SOFRADIR (France); **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); **Andrew Hood,** FLIR Electro-Optical Components (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); **Kevin C. Liddiard,** Electro-optic Sensor Design (Australia); **Wei Lu,** Shanghai Institute of Technical Physics (China); **Tara J. Martin,** UTC Aerospace Systems (USA); **Paul L. McCarley,** Air Force Research Lab. (USA); **R. Kennedy McEwen,** SELEX ES (United Kingdom); **John L. Miller,** FLIR Systems, Inc. (USA); **A. Fenner Milton,** U.S. Army RDECOM CERDEC NVESD (USA); **Mario O. Münzberg,** Cassidian 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); **Manijeh Razeghi,** Northwestern Univ. (USA); **Colin E. Reese,** U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Ingmar G. Renhorn,** Swedish Defense Research Agency (Sweden); **Patrick Robert,** ULIS (France); **Antoni Rogalski,** Military Univ. of Technology (Poland); **Ingo Rühlich,** AIM INFRAROT-MODULE GmbH (Germany); **Piet B. W. Schwering,** 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 Swaminathan,** U.S. Army Armament Research, Development and Engineering Ctr. (USA); **J. Ralph Teague,** Georgia Tech Research Institute (USA); **Simon Thibault,** Univ. Laval (Canada); **Gil A. Tidhar,** Israel Aerospace Industries-Elta Systems Ltd. (Israel); **Meimei Tidrow,** U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Alexander Veprik,** SCD Semiconductor Devices (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 5 MAY

OPENING REMARKS

LOCATION: CONV. CTR. ROOM 344 . . . . . 8:00 AM TO 8:10 AM

Chair: **Bjorn F. Andresen,** Senso Optics Ltd. (Israel)

SESSION 1

LOCATION: CONV. CTR. ROOM 344 . . . MON 8:10 AM TO 11:50 AM

NIR/SWIR FPAs and Applications

Session Chairs: **Tara J. Martin,** UTC Aerospace Systems (USA);
Eric M. Costard, Sofradir (France);
Andrew Hood, FLIR Electro-Optical Components (USA)

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

COUGAR: A liquid nitrogen cooled InGaAs camera for astronomy and electro-luminescence, Urbain Van Bogget, Vincent Vervenne, Rosa Maria Vinelli, Koen van der Zanden, Xenics NV (Belgium); Patrick J. Merken, Xenics NV (Belgium), RMA (Belgium); Jan P. Vermeiren, Xenics NV (Belgium) . . . . . [9070-134]

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

SWIR/MWIR dual-band imaging capability, John W. Devitt, Peter C. Roberts, David Acton, James W. Bangs, Jason S. Graham, Raytheon Vision Systems (USA) . . . . . [9070-138]

8:10 am: **Digital night vision: an IR CMOS solution to 1 mLux imaging**, Martin U. Pralle, James E. Carey III, Homayoon Haddad, SiOnyx Inc. (USA) . . . [9070-1]

8:30 am: **A monolithic 640 × 512 CMOS imager with high-NIR sensitivity**, Stefan C. Lauxtermann, Sensor Creations, Inc. (USA); John Fisher, Brandywine Photonics, LLC (USA); Michael H. MacDougal, Attollo Engineering, LLC (USA) . . . . . [9070-2]

8:50 am: **3D Influence of device geometry on dark current and modulation transfer functions by 3D numerical simulation of planar P+n InGaAs photodiodes in dense arrays**, Adam R. Wichman, Boston Univ. (USA); Roger E. DeWames, Corbin Co. (USA); Enrico Bellotti, Boston Univ. (USA) . . . . . [9070-3]

9:05 am: **3D numerical simulation of planar P+n heterojunction In0.53Ga0.47As photodiodes in dense arrays, part II: Modulation transfer functions modeling**, Adam R. Wichman, Boston Univ. (USA); Roger E. DeWames, Corbin Co. (USA); Enrico Bellotti, Boston Univ. (USA) . . . . . [9070-4]

9:20 am: **New developments on InGaAs focal plane array**, Jerome Coussement, Anne Rouvie, El Houcine Oubensaid, Odile Huet, Sébastien Hamard, Jean-Patrick Truffer, Maxime Pozzi, Patrick Maillart, Eric M. Costard, Yann Reibel, Thibault Augey, SOFRADIR (France) . . . . . [9070-5]

9:40 am: **Low-noise, small SWaP, SWIR imagers for light-starved high-sensitivity applications**, Michael W. Delamere, UTC Aerospace Systems (USA) . . . . . [9070-6]

Coffee Break . . . . . Mon 10:00 am to 10:30 am

10:30 am: **Low-dark current 1024×1280 InGaAs PIN arrays**, Ping Yuan, James J. Chang, Joseph C. Boisvert, Rengarajan Sudharsanan, Nasser H. Karam, Spectrolab, Inc. (USA) . . . . . [9070-7]

10:50 am: **SWIR detectors for night vision at AIM**, Heinrich Figgemeier, Matthias Benecke, Karl C. Hofmann, Reinhard Oelmaier, Alexander Sieck, Joachim C. Wendler, Johann Ziegler, AIM INFRAROT-MODULE GmbH (Germany) . . . . . [9070-8]

11:10 am: **High-performance SWIR HgCdTe FPA development on silicon substrates**, Ramana Bommena, Jeremy D. Bergeson, EPIR Technologies, Inc. (USA); Priyalal S. Wijewarnasuriya, U.S. Army Research Lab. (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA); Richard Kodama, Jun Zhao, Fikri Aqariden, Silviu Velicu, EPIR Technologies, Inc. (USA) . . [9070-9]

11:30 am: **A miniature VGA SWIR camera using MT6415CA ROIC**, Selim Eminoglu, Gokhan S. Yilmaz, Serhat Kocak, Mikro-Tasarim Ltd. (Turkey) . . . . . [9070-10]

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

SESSION 2

LOCATION: CONV. CTR. ROOM 344 . . . MON 1:00 PM TO 4:30 PM

Tomorrow's Systems Enabled by Today's Advanced Technologies

Session Chairs: **Mario O. Münzberg,** Cassidian Optronics GmbH (Germany); **Torbjorn Skauli,** Norwegian Defence Research Establishment (Norway)

1:00 pm: **Panoramic thermal imaging: challenges and tradeoffs**, Shimon Aburmad, Opgal Optronic Industries Ltd. (Israel) . . . . . [9070-11]

1:20 pm: **High-resolution panoramic images with megapixel MWIR FPA**, Vincent Leboucher, HGH Systèmes Infrarouges (France). . . . . [9070-12]

1:40 pm: **A long-range camera based on an HD MCT array of 12µm pixels**, Douglas J. Davy, Stuart F. N. Ashley, Bryan Davison, R. Kennedy McEwen, Andrew P. Ashcroft, Richard Moore, SELEX ES Ltd. (United Kingdom). [9070-13]

2:00 pm: **Experimental tomographic scanning (TOSCA) imagers**, Harald Hovland, Forsvarets Forsknings Institutt (Norway) . . . . . [9070-14]

CONFERENCE 9070
LOCATION: CONV. CTR. ROOM 344

2:20 pm: **Color night vision system for ground vehicle navigation**, Ehsan Ali, Hemain Qadir, Samuel Kozaitis, Florida Institute of Technology (USA) [9070-135]

2:40 pm: **Time-resolved thermal infrared multispectral imaging of gases and minerals**, Marc-André Gagnon, Karl-Alexandre Jahjah, Frédérick Marcotte, Pierre Tremblay, Vincent Farley, Philippe Lagueux, Martin Chamberland, Telops (Canada) . . . . . [9070-16]

Coffee Break . . . . . Mon 3:00 pm to 3:30 pm

3:30 pm: **Infrared light-field imaging using single carbon nanotube (CNT) detector**, Ning Xi, Michigan State Univ. (USA) . . . . . [9070-17]

3:50 pm: **Thermal imaging as a smartphone application: Exploring and implementing a new concept**, Omer Yanai, Opgal Optronic Industries Ltd. (Israel) . . . . . [9070-18]

4:10 pm: **Case study: using infrared technology for evidentiary purposes**, John Lester Miller, Noel D. Jolivet, Joel Hansen, FLIR Systems, Inc. (USA); Rico Beniga, Postland Police Dept. (USA); Rich Austria, Portland Police Dept. (USA) . . . . . [9070-19]

Defense + Security Plenary Presentation
MON 5:00 TO 6:00 PM
LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

TUESDAY 6 MAY

SESSION 3
LOCATION: CONV. CTR. ROOM 344 . . . TUE 8:00 AM TO 9:20 AM

Technologies for Advanced Applications
Session Chair: **John L. Miller,** FLIR Systems, Inc. (USA)

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

HySpex ODIN-1024: a new high-resolution airborne HSI system, Søren Blaaberg, Trond Løke, Ivar Baarstad, Andrei Fridman, Norsk Elektro Optikk AS (Norway) . . . . . [9070-136]

8:00 am: **Cooled IR detectors for military and space applications at i3system**, Sooho Bae, Young-Ho Kim, Byung-Hyuk Kim, Ho-Jun Lee, Han Jung, i3system, Inc. (Korea, Republic of) . . . . . [9070-20]

8:20 am: **Cooled and uncooled infrared detectors for missile seekers**, Udi Mizrahi, Rami Fraenkel, Jacob Haski, Lior Shkedy, Itay Shtrichman, SCD Semiconductor Devices (Israel) . . . . . [9070-21]

8:40 am: **A new joint laboratory between SOFRADIR and ONERA for the development of advanced DDCA with integrated optics**, Guillaume Druart, Nicolas Guérineau, ONERA (France); Yann Reibel, Serge Magli, Noura Matallah, SOFRADIR (France) . . . . . [9070-22]

9:00 am: **Smart filters: from VIS/NIR to MW/LWIR protection**, Ariela Donval, Tali Fisher, Ofir Lipman, Moshe Oron, KiloLambda Technologies, Ltd. (Israel) . . . . . [9070-23]

SESSION 4
LOCATION: CONV. CTR. ROOM 344 . . . TUE 9:20 AM TO 11:40 AM

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

9:20 am: **Antimonide-based superlattices for LWIR imaging** *(Invited Paper)*, Manijeh Razeghi, Northwestern Univ. (USA) . . . . . [9070-24]

9:50 am: **InAs/GaSb superlattice detectors for the long wavelength infrared regime**, Robert Rehm, Jan-Michael Masur, Johannes Schmitz, Jasmin Niemasz, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany); Petra Fries, Detlef Eich, AIM INFRAROT-MODULE GmbH (Germany); Martin Walther, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany) . . . . . [9070-25]

Coffee Break . . . . . Tue 10:10 am to 10:40 am

10:40 am: **InAs/GaSb Type II superlattice barrier devices with a low dark current and a high-quantum efficiency** *(Invited Paper)*, Philip Klipstein, Yael Benny, Rami Fraenkel, Alex Glozman, Steve Grossman, Olga Klin, Lidia Langoff, SCD Semiconductor Devices (Israel); Yoav Livneh, Israel Ministry of Defense (Israel); Inna Lukomsky, Michal Nitzani, Lior Shkedy, Itay Shtrichman, Noam Snapi, SCD Semiconductor Devices (Israel); Avi Tuito, Israel Ministry of Defense (Israel); Eliezer Weiss, SCD Semiconductor Devices (Israel) . . . . . [9070-26]

11:00 am: **Development of bi-spectral InAs/GaSb type II superlattice image detectors** *(Invited Paper)*, Tim O. Stadelmann, Andreas Wörl, Matthias Wauro, Volker Daumer, Jasmin Niemasz, Wolfgang Luppold, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany); Thomas Simon, Marc Riedel, AIM INFRAROT-MODULE GmbH (Germany); Robert Rehm, Martin Walther, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany) . . . . . [9070-27]

11:20 am: **Comparison of the electro-optical performances of MWIR InAs/GaSb superlattice pin photodiode and FPA with asymmetrical designs**, Edouard Giard, ONERA (France); Rachid Taalat, Marie Delmas, Jean-Baptiste Rodriguez, Philippe Christol, Univ. Montpellier 2 (France); Julien Jaeck, Isabelle Ribet-Mohamed, ONERA (France) . . . . . [9070-28]

SESSION 5
LOCATION: CONV. CTR. ROOM 344 . . . TUE 11:40 AM TO 12:10 PM

Keynote Session
Session Chair: **Bjorn F. Andresen,** Senso Optics Ltd. (Israel)

11:40 am: **On the origin of 1/f noise in electronic devices** *(Keynote Presentation)*, Paul R. Norton, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [9070-29]

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

SESSION 6
LOCATION: CONV. CTR. ROOM 344 . . . . TUE 1:30 PM TO 4:20 PM

Type II Superlattice FPAs II
Session Chairs: **Meimei 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: **MWIR superlattice detectors integrated with substrate side-illuminated plasmonic coupler**, Seyedeh Marziyeh Zamiri, Elena Plis, Jun Oh Kim, Seung-Chang Lee, Alexander Neumann, Steven. R. J. Brueck, Sanjay Krishna, Ctr. for High Technology Materials (USA) . . . . . [9070-30]

1:50 pm: **Pretreatment for surface leakage current reduction in type-II superlattice MWIR photodetectors**, Hiroshi Inada, Kenichi Machinaga, Sundararajan Balasekaran, Kouhei Miura, Yukihiro Tsuji, Masaki Migita, Yasuhiro Iguchi, Sumitomo Electric Industries, Ltd. (Japan); Haruyoshi Katayama, Japan Aerospace Exploration Agency (Japan); Masafumi Kimata, Ritsumeikan Univ. (Japan) and Japan Aerospace Exploration Agency (Japan) . . . . . [9070-31]

2:10 pm: **Passivation of long-wave infrared InAs/GaSb superlattice detectors with epitaxially grown ZnTe**, Elena Plis, Ctr. for High Technology Materials (USA) and SKINfrared, LLC (USA); Maya N. Kutty, Ctr. for High Technology Materials (USA); Sanjay Krishna, Ctr. for High Technology Materials (USA) and SKINfrared, LLC (USA); Stephen A. Myers, SKINfrared, LLC (USA); Chihyu J. Chen, Jamie D. Phillips, Univ. of Michigan (USA) . . . . . [9070-32]

2:30 pm: **Defect-related dark currents in III-V MWIR nBn detectors**, Gregory R. Savich, Daniel E. Sidor, Univ. of Rochester (USA); Christian P. Morath, Vincent M. Cowen, Air Force Research Lab. (USA); Gary W. Wicks, Univ. of Rochester (USA) . . . . . [9070-33]

2:50 pm: **Low dark current "N" structure superlattice MWIR photodetectors**, Ömer Salihoglu, Abdullah Muti, Bilkent Univ. (Turkey); Tunay Tansel, Rasit Turan, Middle East Technical Univ. (Turkey); Yuksel Ergun, Anadolu Univ. (Turkey); Atilla Aydinli, Bilkent Univ. (Turkey) . . . . . [9070-34]

Coffee Break . . . . . Tue 3:10 pm to 3:40 pm

3:40 pm: **New model for the ideal nBn infrared detector**, Marion B. Reine, Photon Detector Physics, LLC (USA); Benjamin Pinkie, Jonathan Schuster, Enrico Bellotti, Boston Univ. (USA) . . . . . [9070-35]

4:00 pm: **Performance comparison of barrier detectors and HgCdTe photodiodes** *(Invited Paper)*, Piotr Martyniuk, Antoni Rogalski, Military Univ. of Technology (Poland) . . . . . [9070-36]

SESSION 7
LOCATION: CONV. CTR. ROOM 344 . . . .TUE 4:20 PM TO 6:00 PM

Advances in Optical and Detector Materials

Session Chairs: **Lucy Zheng,** Institute for Defense Analyses (USA); **Troy A. Palmer,** StingRay Optics, LLC (USA)

4:20 pm: **Growth and characterization of 6" InSb substrates for use in large-area infrared-imaging applications**, Mark J. Furlong, IQE IR (United Kingdom); Gordon Dallas, James P. Flint, Greg Meshew, Galaxy Compound Semiconductors, Inc. (USA); Rebecca J. Martinez, David Small, Andrew Mowbray, Wafer Technology Ltd. (United Kingdom) . . . . . [9070-37]

4:40 pm: **Multiwafer growth of GaInAs photodetectors on 4" InP by MOCVD for SWIR imaging applications**, Mark J. Furlong, Mark Mattingley, Sung Wook Lim, Matthew Geen, Wynne Jones, IQE IR (United Kingdom) . . . . . [9070-38]

5:00 pm: **Characterization of moldable glasses for imaging lenses in the short-wave infrared (SWIR)**, Alan Symmons, LightPath Technologies, Inc. (USA) . . . . . [9070-39]

5:20 pm: **Examination of laser-induced heating on multi-component chalcogenide glass**, Laura Sisken, Joshua D. Bradford, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Peter F. Wachtel, Benn H. Gleason, Clemson Univ. (USA); Lawrence Shah, Martin C. Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Kathleen A. Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) and Clemson Univ. (USA) . . . . . [9070-40]

5:40 pm: **Laser damage resistant multiband high-reflective optics**, Jue Wang, Brian P. Roy, Joseph C. Crifasi, Corning Tropel Corp. (USA); Michael Orr, Corning NetOptix (USA) . . . . . [9070-41]

POSTERS-TUESDAY
LOCATION: CONV. CTR. HALL C . . . . . .TUE 6:00 PM 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 session. 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 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.

Extended wavelength InGaAs infrared detector arrays based on three types of material structures grown by MBE, Haimei Gong, Xue Li, Tao Li, Xiumei Shao, Shanghai Institute of Technical Physics (China) . . . . . [9070-109]

An uncooled capacitive sensor for IR detection, Georg Siebke, Kathrin Gerngroß, Peter Holik, Sam Schmitz, Markus Rohloff, Simon Tätzner, Siegfried Steltenkamp, Ctr. of Advanced European Studies and Research (Germany) . . . . . [9070-110]

Temperature dependence of junction performance for mid-wavelength n-on-p HgCdTe detectors by laser beam-induced current microscope, Weicheng Qiu, Weida Hu, Zhenhua Ye, Yueming Wang, Shanghai Institute of Technical Physics (China); Xiang-Ai Cheng, Rui Wang, National Univ. of Defense Technology (China); Fei Yin, Bo Zhang, Xiaoshuang Chen, Wei Lu, Shanghai Institute of Technical Physics (China) . . . . . [9070-111]

A fabrication and characterictics of microbolometer detectors using VO_x/ZnO/VO_x multilayer thin film processing, Myung-Soo Han, Dae Hyoen Kim, Hang-Ju Ko, Jae Cheol Shin, Hyo Jin Kim, Korea Photonics Technology Institute (Korea, Republic of) . . . . . [9070-112]

Three-dimensional plasmonic metamaterial absorbers for high-performance wavelength selective uncooled infrared sensors, Shinpei Ogawa, Daisuke Fujisawa, Tomohiro Maegawa, Masashi Ueno, Mitsubishi Electric Corp. (Japan); Masafumi Kimata, Ritsumeikan Univ. (Japan) . . . . . [9070-113]

Mercury cadmium telluride implanted junction profile measurement and depth control, Songmin Zhou, Chun Lin, Yanfeng Wei, Zhenhua Ye, Haibin Li, Dan Liu, Ruijun Ding, Li He, Shanghai Institute of Technical Physics (China) . . . . . [9070-115]

Dark current measurement of Type-II superlattice infrared focal plane array detector, Michito Sakai, Haruyoshi Katayama, Junpei Murooka, Japan Aerospace Exploration Agency (Japan); Masafumi Kimata, Ritsumeikan Univ. (Japan); Yasuhiro Iguchi, Sumitomo Electric Industries, Ltd. (Japan) . . [9070-117]

Ferroelectric infrared detector with nano-SiO_2 thermal isolation layer, Shuo Sun, Jinglan Sun, Shanghai Institute of Technical Physics (China); Yu Zhu, Suzhou Institute of Nano-tech and Nano-bionics (China); Jianlu Wang, Shanghai Institute of Technical Physics (China); Yaohui Zhang, Suzhou Institute of Nano-tech and Nano-bionics (China); Xiangjian Meng, Junhao Chu, Shanghai Institute of Technical Physics (China) . . . . . [9070-118]

Linear VO_x-Au thin film bolometer array with simultaneous low-resistivity and high TCR, Evan M. Smith, Univ. of Central Florida (USA) and Plasmonics, Inc. (USA); James C. Ginn III, Andrew Warren, Christopher J. Long, David Shelton, Plasmonics, Inc. (USA); Robert E. Peale, Univ. of Central Florida (USA) . . . . . [9070-120]

Recent improvements on mid-IR chalcogenide optical fibers, Christophe Lafond, Jean-François Couillard, Jean-Luc Delarosbil, Fernand Sylvain, CorActive High-Tech Inc. (Canada) . . . . . [9070-121]

Determination of combustion products by passive FTIR optical remote sensing, Steven V. Plowman, Midac Corp. (USA) . . . . . [9070-122]

On the use of magnesium alloys for aerospace and defense mirrors, Kenneth S. Woodard, Lovell E. Comstock, Leonard G. Wamboldt, Joseph C. Crifasi, Corning NetOptix (USA) . . . . . [9070-123]

ARINC 818 adds capabilities for high-speed video sensors and systems, Tim Keller, Great River Technology, Inc. (USA) . . . . . [9070-124]

Thermomechancial characterization in a radiant energy imager using null switching, Javaneh Boroumand Azad, Imen Rezadad, Evan M. Smith, Robert E. Peale, Univ. of Central Florida (USA) . . . . . [9070-125]

Multistep plasma etching process for the development of highly detective InSb mid-IR sensor arrays, Chulkyun Seok, Seoul National Univ. (Korea, Republic of); Minkyung Choi, Ewha Woman's Univ. (Korea, Republic of); Jinwook Jung, Sehun Park, Seoul National Univ. (Korea, Republic of); In-Sang Yang, Ewha Woman's Univ. (Korea, Republic of); Yongjo Park, Advanced Institutes of Convergence Technology (Korea, Republic of); Euijoon Yoon, Seoul National Univ. (Korea, Republic of) . . . . . [9070-126]

Mid-wavelength infrared focal plane arrays based on type-II InAs/GaSb superlattice, Yanqiu Lv, Junjie Si, Luoyang Optoelectro Technology Development Ctr. (China) . . . . . [9070-127]

Vanadium oxide thin film with improved sheet resistance uniformity, Francis Genereux, Francis Provençal, Bruno Tremblay, Marc-André Boucher, Christine Alain, INO (Canada) . . . . . [9070-128]

Implementation of high-dynamic range pixel architecture for SWIR applications, Melik Yazici, Huseyin Kayahan, Omer Ceylan, Sohaib S. Afridi, Atia Shafique, Yasar Gurbuz, Sabanci Univ. (Turkey) . . . . . [9070-129]

Using quantum filters as edge detectors in infrared images, Daniela D. B. M. Bolaños Marin, Univ. EAFIT (Colombia) . . . . . [9070-130]

Lightweight ZERODUR®: A cost-effective thermally-stable approach to both large and small spaceborne telescopes, Tony Hull, The Univ. of New Mexico (USA); Thomas Westerhoff, SCHOTT AG (Germany) . . . . . [9070-131]

Theoretical modelling of LWIR nBn HgCdTe photodetector, Zhenhua Ye, Yiyu Chen, Shanghai Institute of Technical Physics (China) . . . . . [9070-132]

A 4-channel mixed-signal ASIC for analog ROICs and FPAs, Selim Eminoglu, Murat Isikhan, Nusret Bayhan, S. Tuncer Soyer, Serhat Kocak, Cem Yalcin, Mikro-Tasarim (Turkey) . . . . . [9070-133]

SWIR/MWIR dual-band imaging capability, John W. Devitt, Peter C. Roberts, David Acton, James W. Bangs, Jason S. Graham, Raytheon Vision Systems (USA) . . . . . [9070-138]

POSTERS/ORAL STANDBYS
LOCATION: CONV. CTR. HALL C . . . . . .TUE 6:00 PM TO 7:30 PM

COUGAR: A liquid nitrogen cooled InGaAs camera for astronomy and electro-luminescence, Urbain Van Bogget, Vincent Vervenne, Rosa Maria Vinelli, Koen van der Zanden, Xenics NV (Belgium); Patrick J. Merken, Xenics NV (Belgium) and RMA (Belgium); Jan P. Vermeiren, Xenics NV (Belgium) . . . . . [9070-134]

HySpex ODIN-1024: a new high-resolution airborne HSI system, Søren Blaaberg, Trond Løke, Ivar Baarstad, Andrei Fridman, Norsk Elektro Optikk AS (Norway) . . . . . [9070-136]

CONFERENCE 9070

LOCATION: CONV. CTR. ROOM 344 & 342

WEDNESDAY 7 MAY

Sessions 8, 9, 10, and 11 run concurrently with sessions 12, 13, 14, 15, and 16.

SESSION 8

LOCATION: CONV. CTR. ROOM 344 . . WED 8:00 AM TO 11:30 AM

HOT: High Operating Temperature FPAs

Session Chairs: **Michael T. Eismann,** Air Force Research Lab. (USA); **Philip Klipstein,** SCD Semiconductor Devices (Israel)

8:00 am: **Improved high-operating temperature MCT MWIR modules**, Holger Lutz, Rainer Breiter, Heinrich Figgemeier, Timo Schallenberg, Wilhelm Schirmacher, Richard Wollrab, AIM INFRAROT-MODULE GmbH (Germany) . . . . . [9070-42]

8:20 am: **Ultra-low power HOT MCT grown by MOVPE for handheld applications**, Luke Pillans, Selex ES Infrared Ltd (United Kingdom); Les G. Hipwood, R. Kennedy McEwen, Andy D. Parsons, Jay Harji, SELEX Galileo Infrared Ltd. (United Kingdom) . . . . . [9070-43]

8:40 am: **Large format 15µm pitch XBn detector**, Yoram Karni, Philip Klipstein, Eran Avnon, Eyal Berkowitz, Omer Cohen, Yossi Cohen, Roman Dobromislin, Itay Hirsh, Olga Klin, Inna Lukomsky, Igor Pivnik, Omer Rozenberg, Itay Shtrichman, Michael T. Singer, Shay Sulimani, Eliezer Weiss, SCD Semiconductor Devices (Israel). . . . . [9070-44]

9:00 am: **Lead salt TE-cooled imaging sensor development**, Kenton A. Green, Sung-Shik Yoo, Christopher Kauffman, Northrop Grumman Electronic Systems (USA). . . . . [9070-45]

9:20 am: **Type-II superlattices for HOT infrared imagers** *(Invited Paper)*, Manijeh Razeghi, Northwestern Univ. (USA) . . . . . [9070-46]

9:50 am: **Molecular beam epitaxy grown GaSb-based IR photodetectors**, Dmitri Loubychev, Joel M. Fastenau, Yueming Qiu, Amy W. K. Liu, IQE Inc. (USA); Edwin J. Koerperick, Jon T. Olesberg, Dennis Norton Jr., ASL Analytical, Inc. (USA); Mark J. Furlong, IQE IR (United Kingdom) . . . . . [9070-47]

Coffee Break . . . . . .Wed 10:10 am to 10:40 am

10:40 am: **Absorption characteristics of mid-wave infared strained layer superlattices**, Gamini Ariyawansa, Elizabeth H. Steenbergen, Joshua M. Duran, Luke J. Bissell, John E. Scheihing, Michael T. Eismann, Air Force Research Lab. (USA) . . . . . [9070-48]

11:00 am: **Midwave infrared interband cascade photodetectors and focal plane arrays** *(Invited Paper)*, Zhaobing Tian, Sebastian E. Godoy, Theodore Schuler-Sandy, Clark Kadlec, Erin Dughie, Ha Sul Kim, Sanjay Krishna, The Univ. of New Mexico (USA) . . . . . [9070-49]

Lunch/Exhibition Break . . . . . .Wed 11:30 am to 1:30 pm

SESSION 12

LOCATION: CONV. CTR. ROOM 342 . . . . .WED 8:00 TO 10:00 AM

IR Optics I: Technologies and Design

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

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

HySpex ODIN-1024: a new high-resolution airborne HSI system, Søren Blaaberg, Trond Løke, Ivar Baarstad, Andrei Fridman, Norsk Elektro Optikk AS (Norway) . . . . . [9070-136]

8:00 am: **Technical considerations for designing low-cost, long-wave infrared objectives**, Gerard M. Desroches, Kristy Dalzell, Blaise Robitaille, Raytheon ELCAN Optical Technologies (Canada) . . . . . [9070-63]

8:20 am: **Compact multispectral continuous zoom camera for colour and SWIR vision with integrated laser range finder**, Martin Huebner, Martin Gerken, Bertram Achtner, Mario O. Münzberg, Cassidian Optronics GmbH (Germany) . . . . . [9070-64]

8:40 am: **Design challenges of variable magnification/variable object distance (VMODO) systems**, Steven H. Vogel, Christopher C. Alexay, Troy A. Palmer, Naomi J. Pollica, StingRay Optics, LLC (USA). . . . . [9070-65]

9:00 am: **Folded path LWIR system for SWAP constrained platforms**, Erin F. Fleet, Dale Linne von Berg, Michael L. Wilson, U.S. Naval Research Lab. (USA); Thomas G. Giallorenzi, DCS Corp. (USA); Barry M. Mathieu, Barry Design Associates, Inc. (USA) . . . . . [9070-66]

9:20 am: **Implementation of a durable multispectral mirror coating for light-weighted ISR systems**, Leonard G. Wamboldt, Corning NetOptix (USA); Robin M. Walton, Corning Inc. (USA); Jue Wang, Corning Specialty Materials, Inc. (USA); Gary A. Hart, Corning Tropel Corp. (USA); Jason Ballou, Timothy R. Soucy, Kenneth S. Woodard, Joseph C. Crifasi, Shane M. Stephens, Corning NetOptix (USA) . . . . . [9070-67]

9:40 am: **Fast, electrically tunable filters for hyperspectral imaging**, V. Liberman, Lalitha Parameswaran, Christopher Gear, Alberto Cabral, Mordechai Rothschild, MIT Lincoln Lab. (USA). . . . . [9070-68]

Coffee Break . . . . . .Wed 10:00 am to 10:30 am

SESSION 13

LOCATION: CONV. CTR. ROOM 342 . WED 10:30 AM TO 12:00 PM

IR Optics II: Breakthroughs in Multiband Moldable Glasses

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

10:30 am: **Comparison of the thermal effects on LWIR optical designs utilizing different infrared optical materials** *(Invited Paper)*, Alan Symmons, Raymond J. Pini, LightPath Technologies, Inc. (USA) . . . . . [9070-69]

10:50 am: **Optical glasses transparent in visible and thermal infrared region for multispectral imaging** *(Invited Paper)*, Xiang-Hua Zhang, Laurent Calvez, Antoine Brehault, Univ. de Rennes 1 (France); Joël Rollin, Thales Angénieux S.A. (France); Philippe Adam, Délégation Générale pour l'Armement (France) . . . . . [9070-70]

11:10 am: **Multispectral optics designs using expanded glass map** *(Invited Paper)*, Shyam S. Bayya, Daniel J. Gibson, Vinh Q. Nguyen, Erin F. Fleet, Jas S. Sanghera, U.S. Naval Research Lab. (USA); Jay N. Vizgaitis, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [9070-71]

11:40 am: **Sulfur copolymers for infrared optical imaging** *(Invited Paper)*, S. Namnabat, College of Optical Sciences, The Univ. of Arizona (USA); J. Griebel, College of Optical Sciences, Univ. of Arizona (USA); J. Pyun, The Univ. of Arizona (USA); R. A. Norwood, E. Dereniak, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [9070-72]

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

Sessions 8, 9, 10, and 11 run concurrently with sessions 12, 13, 14, 15, and 16.

SESSION 9
LOCATION: CONV. CTR. ROOM 344 . . . . WED 1:30 PM TO 3:10 PM

Uncooled FPAs and Applications

Session Chairs: **Masafumi Kimata,** Ritsumeikan Univ. (Japan); **Chuan C. Li,** DRS Technologies, Inc. (USA)

1:30 pm: **Uncooled digital IRFPA-family with 17µm pixel-pitch based on amorphous silicon with massively parallel Sigma-Delta-ADC readout**, Dirk Weiler, Frank Hochschulz, Daniel Würfel, Renee Lerch, Thomas Geruschke, Simone Wall, Jennifer Heß, Qiang Wang, Holger Vogt, Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme (Germany) . . . . . [9070-50]

1:50 pm: **Latest improvements in µ-bolometer thin film packaging: paving the way for low-cost consumer applications**, Jean-Jacques Yon, Geoffroy Dumont, Valérie Goudon, Sébastien Becker, Agnès Arnaud, CEA-LETI-Minatec (France); Sébastien Cortial, Christel-Loïc Tisse, ULIS (France) . . . . . [9070-51]

2:10 pm: **A miniature low-cost LWIR camera with a 160x120 microbolometer FPA**, Murat Tepegoz, Selim Eminoglu, Tayfun Akin, MikroSens Ltd. (Turkey). . . . . [9070-52]

2:30 pm: **Evaluation of 1/f noise in prospective IR imaging thin films**, Hitesh A. Basantani, David Saint-John, Myung Yoon-Lee, Thomas N. Jackson, Mark W. Horn, The Pennsylvania State Univ. (USA) . . . . . [9070-53]

2:50 pm: **High-G launch testing of a low-cost un-cooled LWIR imager**, Jason E. Tiffany, Don E. King, Kyle C. Manning, Francis C. Brown, David G. Drewry Jr., Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9070-54]

Coffee Break . . . . . .Wed 3:10 pm to 3:40 pm

SESSION 10
LOCATION: CONV. CTR. ROOM 344 . . . WED 3:40 PM TO 5:00 PM

Emerging Uncooled Technologies

Session Chairs: **Colin E. Reese,** U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Kevin C. Liddiard,** Electro-optic Sensor Design (Australia); **Charles M. Hanson,** Texas Instruments Inc. (USA)

3:40 pm: **Nickel oxide and molybdenum oxide thin films for infrared-imaging prepared by biased target ion-beam deposition**, Yao Jin, Thomas N. Jackson, Mark W. Horn, The Pennsylvania State Univ. (USA) . . . . . [9070-55]

4:00 pm: **Polarization selective uncooled infrared sensor using an asymmetric two-dimensional plasmonic absorber**, Shinpei Ogawa, Mitsubishi Electric Corp. (Japan); Kyohei Masuda, Yousuke Takagawa, Masafumi Kimata, Ritsumeikan Univ. (Japan). . . . . [9070-56]

4:20 pm: **Repulsive electrostatic force in MEMS cantilever IR sensors**, Imen Rezadad, Javaneh Boroumand Azad, Evan M. Smith, Ammar Alhasan, Robert E. Peale, Univ. of Central Florida (USA) . . . . . [9070-57]

4:40 pm: **Design of a nanomachined pyroelectric detector for low-thermal conductance**, Md Muztoba, Noureddine Melikechi, Mukti Rana, Delaware State Univ. (USA) . . . . . [9070-58]

SESSION 11
LOCATION: CONV. CTR. ROOM 344 . . . WED 5:00 PM TO 6:20 PM

ROIC

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

5:00 pm: **A new digital readout integrated circuit (DROIC) with pixel parallel A/D conversion with reduced quantization noise**, Huseyin Kayahan, Omer Ceylan, Melik Yazici, Yasar Gurbuz, Sabanci Univ. (Turkey) . . . . . [9070-59]

5:20 pm: **A high-dynamic range ROIC for SLS and other IR focal planes**, Eugene M. Petilli, Scott TeWinkle, Intrinsix Corp. (USA). . . . . [9070-60]

5:40 pm: **ROIC for uncooled microbolometer FPAs/ mixed-signal ASIC for analog ROICs and FPAs**, Selim Eminoglu, Mikro-Tasarim (Turkey) . . . [9070-61]

6:00 pm: **Implementation of pixel level digital TDI for scanning type LWIR FPAs**, Omer Ceylan, Huseyin Kayahan, Melik Yazici, Atia Shafique, Sohaib S. Afridi, Yasar Gurbuz, Sabanci Univ. (Turkey) . . . . . [9070-62]

SESSION 14
LOCATION: CONV. CTR. ROOM 342 . . . . WED 1:30 PM TO 2:10 PM

IR Optics III: Multiband IR-GRIN Lenses

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

1:30 pm: **Layered chalcogenide glass structures for IR lenses** *(Invited Paper)*, Daniel J. Gibson, Shyam S. Bayya, Jas S. Sanghera, Vinh Q. Nguyen, U.S. Naval Research Lab. (USA); Dean A. Scribner, Northrop Grumman Mission Systems (USA); Velimir M. Maksimovic, Northrop Grumman Information Systems (USA); John A. Gill, Northrop Grumman Corp. (USA); Allen Yi, The Ohio State Univ. (USA); John P. Deegan, Rochester Precision Optics, LLC (USA); Blair L. Unger, BLU Optics, LLC (USA) . . . . . [9070-73]

1:50 pm: **IR GRIN optics for SWaP sensitive platforms** *(Invited Paper)*, Daniel J. Gibson, Shyam S. Bayya, Jas S. Sanghera, Erin F. Fleet, U.S. Naval Research Lab. (USA) . . . . . [9070-74]

SESSION 15
LOCATION: CONV. CTR. ROOM 342 . . . . WED 2:10 PM TO 3:10 PM

Emerging Cryogenic Coolers

Session Chairs: **Alexander Veprik,** SCD Semiconductor Devices (Israel); **Ingo Rühlich,** AIM INFRAROT-MODULE GmbH (Germany); **Richard Rawlings,** DRS Technologies, Inc. (USA)

2:10 pm: **Optical cryocoolers outshine thermoelectrics** *(Invited Paper)*, Richard I. Epstein, Thermodynamic Films (USA) and The Univ. of New Mexico (USA); Mansoor Sheik-Bahae, The Univ. of New Mexico (USA); Markus P. Hehlen, Los Alamos National Lab. (USA) . . . . . [9070-76]

2:40 pm: **Lanthanide-doped materials for solid state optical refrigeration** *(Invited Paper)*, Markus P. Hehlen, Los Alamos National Lab. (USA); Mansoor Sheik-Bahae, The Univ. of New Mexico (USA); Seth D. Melgaard, The Univ. of New Mexico (USA) and Air Force Research Lab. (USA); Richard I. Epstein, The Univ. of New Mexico (USA) and ThermoDynamic Films, LLC (USA) . . [9070-137]

Coffee Break . . . . . .Wed 3:10 pm to 3:40 pm

SESSION 16
LOCATION: CONV. CTR. ROOM 342 . . . WED 3:40 PM TO 6:00 PM

Cryogenic Coolers

Session Chairs: **Alexander Veprik,** SCD Semiconductor Devices (Israel); **Ingo Rühlich,** AIM INFRAROT-MODULE GmbH (Germany); **Richard Rawlings,** DRS Technologies, Inc. (USA)

3:40 pm: **Adaptive vibration reduction on dual-opposed piston free displacer Stirling cooler**, Roel Arts, Bram de Bruin, Daniel Willems, Garmt de Jonge, Tonny Benschop, Thales Cryogenics B.V. (Netherlands) . . . . . [9070-78]

4:00 pm: **RICOR's cryocoolers development and optimization for HOT IR detectors**, Amiram Katz, RICOR-Cryogenic & Vacuum Systems (Israel)[9070-79]

4:20 pm: **Ruggedizing infrared integrated Dewar-detector-cooler assemblies for harsh environmental conditions**, Alexander Veprik, Nataniel Ashush, Baruch Shlomovich, Yaakov Oppenheim, Yaakov Gridish, Ezra Kahanov, Alina Koifman, SCD Semiconductor Devices (Israel); Avi Tuito, SIBAT (Israel) . . . . . [9070-80]

4:40 pm: **AIM cryocooler developments for HOT detectors**, Ingo Rühlich, Markus Mai, Carsten Rosenhagen, Andreas Withopf, AIM INFRAROT-MODULE GmbH (Germany). . . . . [9070-81]

5:00 pm: **High-efficiency digital cooler electronics for aerospace applications**, Thomas T. Luong, Lauren Shaw, J. Brian Murphy, Edgar A. Moody, Andrew L. Lisiecki, Michael J. Ellis, Carl S. Kirkconnell, Iris Technology Corp. (USA) . . . . . [9070-82]

5:20 pm: **A linear drive cryocooler for ultra-small infrared sensor systems**, Richard Rawlings, Graham Averitt, Jessica Aguilar, DRS Technologies, Inc. (USA) . . . . . [9070-83]

5:40 pm: **Analysis of life demonstration test results and field data for RICOR's high-reliable cryocoolers**, Racheli Moshe, RICOR-Cryogenic & Vacuum Systems (Israel) . . . . . [9070-84]

CONFERENCE 9070
LOCATION: CONV. CTR. ROOM 344

THURSDAY 8 MAY

SESSION 17
LOCATION: CONV. CTR. ROOM 344 . . THU 8:00 AM TO 10:20 AM

HgCdTe

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

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

SWIR/MWIR dual-band imaging capability, John W. Devitt, Peter C. Roberts, David Acton, James W. Bangs, Jason S. Graham, Raytheon Vision Systems (USA) . . . . . [9070-138]

8:00 am: **Hemispherical curved monolithic cooled and uncooled infrared focal plane arrays for compact cameras**, Kevin Tekaya, Manuel Fendler, Delphine Dumas, Commissariat à l'Énergie Atomique (France); Karim Inal, Elisabeth Massoni, Mines ParisTech (France); Guillaume Druart, ONERA (France); David Henry, Commissariat à l'Énergie Atomique (France) . . . [9070-85]

8:20 am: **Mercury cadmium telluride focal plane array developments at Selex ES for astronomy and spectroscopy**, Ian M. Baker, SELEX Galileo Infrared Ltd. (United Kingdom); Gert Finger, European Southern Observatory (Germany); Keith Barnes, SELEX Galileo Infrared Ltd. (United Kingdom)[9070-86]

8:40 am: **Optimized MCT IR-modules for high-performance imaging applications**, Rainer Breiter, Holger Lutz, Stefan Rutzinger, Timo Schallenberg, Joachim C. Wendler, Detlef Eich, Heinrich Figgemeier, Ingo Rühlich, AIM INFRAROT-MODULE GmbH (Germany) . . . . . [9070-87]

9:00 am: **Sofradir's recent improvements regarding the reliability and performance of HgCdTe IR detectors**, Xavier Brenière, SOFRADIR (France) . . . . . [9070-88]

9:20 am: **Dual-band photon sorting plasmonic MIM metamaterial sensor**, Young Uk Jung, The City College of New York (USA); Igor Bendoym, National Science Foundation (USA); Andrii B. Golovin, David T. Crouse, The City College of New York (USA) and National Science Foundation (USA) . . . . . [9070-89]

9:40 am: **Latest developments in the p-on-n architecture at DEFIR**, Laurent Mollard, Pierre Castelein, Florent Rochette, CEA-LETI (France) [9070-90]

10:00 am: **Advances in MCT APDs**, Michael D. Jack, Raytheon Vision Systems (USA) . . . . . [9070-91]

Coffee Break . . . . . Thu 10:20 am to 10:50 am

SESSION 18
LOCATION: CONV. CTR. ROOM 344 . . . . . THU 10:50 AM TO 12:30 PM

HgCdTe: Reducing the Pitch

Session Chair: **Ronald G. Driggers,** St. Johns Optical Systems (USA)

10:50 am: **The rationale for ultra-small pitch IR systems** *(Invited Paper)*, Michael A. Kinch, DRS Sensors & Targeting Systems, Inc. (USA) . . . . . [9070-92]

11:10 am: **HDVIP five-micron pitch HgCdTe focal plane arrays**, John M. Armstrong, Mark R. Skokan, Michael A. Kinch, Joseph D. Luttmer, DRS Sensors & Targeting Systems, Inc. (USA) . . . . . [9070-93]

11:30 am: **Getting small**, Yann Reibel, Nicolas Ricard, Eric Mallet, Laurent Rubaldo, David Billon-Lanfrey, SOFRADIR (France); Nicolas Guérineau, ONERA (France); Guillaume Druart, ONERA (France); Olivier Gravrand, CEA-LETI (France); Gérard L. Destéfanis, CEA-LETI (France) and ONERA (France) . . . . . [9070-94]

11:50 am: **Benefits of oversampled small pixel Focal Plane Arrays (FPAs)**, John T. Caulfield, Jerry Wilson, Cyan Systems (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA). . . . . [9070-95]

12:10 pm: **MTF issues in planar small pixel pitch quantum IR detectors**, Olivier Gravrand, Alexandre Ferron, Florent Rochette, Laurent Mollard, CEA-LETI-Minatec (France); Jocelyn Berthoz, Laurent Rubaldo, SOFRADIR (France) . . . . . [9070-96]

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

SESSION 19
LOCATION: CONV. CTR. ROOM 344 . . . . THU 1:30 PM TO 2:30 PM

QWIP and Q-DOT

Session Chair: **Henk Martijn,** IRnova AB (Sweden)

1:30 pm: **Resonator-QWIPs and FPAs** *(Invited Paper)*, Kwong-Kit Choi, U.S. Army Research Lab. (USA); Murzy D. Jhabvala, NASA Goddard Space Flight Ctr. (USA); Jason Sun, U.S. Army Research Lab. (USA); Christine A. Jhabvala, Augustyn Waczynski, NASA Goddard Space Flight Ctr. (USA); Kimberley Olver, U.S. Army Research Lab. (USA) . . . . . [9070-97]

1:50 pm: **Comparison of two complementary surface plasmonic structures and their enhancement on infrared photodetectors**, Guiru Gu, Xuejun Lu, Univ. of Massachusetts Lowell (USA) . . . . . [9070-98]

2:10 pm: **Low-cost SWIR sensors: advancing the performance of ROIC-integrated colloidal quantum dot photodiode arrays**, Ethan J. D. Klem, Jay S. Lewis, Chris W. Gregory, Dorota S. Temple, RTI International (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA); Priyalal S. Wijewarnasuriya, U.S. Army Research Lab. (USA) . . . . . [9070-99]

SESSION 20
LOCATION: CONV. CTR. ROOM 344 . . . . THU 2:30 PM TO 4:40 PM

Smart Processing

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

2:30 pm: **Low latency image processing**, Derek Robison, BAE Systems (USA). . . . . [9070-100]

2:50 pm: **Digital CMOS focal plane array with on-chip multiple-accumulate units for low-latency image processing**, Jeff Little, Brian M. Tyrrell, Richard D'Onofrio, Christy Fernandez-Cull, MIT Lincoln Lab. (USA) . . . . . [9070-101]

Coffee Break . . . . . Thu 3:10 pm to 3:40 pm

3:40 pm: **Hardware acceleration of Lucky-Region Fusion (LRF) algorithm for imaging**, Christopher R. Jackson, Garrett A. Ejzak, Univ. of Delaware (USA); Mathieu Aubailly, Jony Jiang Liu, Gary W. Carhart, U.S. Army Research Lab. (USA) . . . . . [9070-102]

4:00 pm: **Smart pixel imaging with computational arrays (SPICA)** *(Invited Paper)*, Christy Fernandez-Cull, Brian M. Tyrrell, Richard D'Onofrio, Megan Blackwell, Andrew Bolstad, Mike Kelly, Joseph H. Lin, Jeff Little, MIT Lincoln Lab. (USA) . . . . . [9070-103]

4:20 pm: **A bio-inspired IR sensor with on chip object computation**, Paul L. McCarley, Air Force Research Lab. (USA); John T. Caulfield, Cyan Systems (USA) . . . . . [9070-104]

SESSION 21
LOCATION: CONV. CTR. ROOM 344 . . . . THU 4:40 PM TO 5:35 PM

Face Recognition

Session Chair: **Brian E. Lemoff,** West Virginia High Technology Consortium Foundation (USA)

4:40 pm: **Multispectral image fusion for face recognition at a distance**, Fang Hua, Stephanie Schuckers, Clarkson Univ. (USA) . . . . . [9070-105]

4:55 pm: **Near-infrared face recognition utilizing open CV software**, Louiza Sellami, Hau Ngo, U.S. Naval Academy (USA) . . . . . [9070-107]

5:15 pm: **Automated, long-range, night/day, active-SWIR face recognition system**, Brian E. Lemoff, Robert B. Martin, Mikhail Sluch, Kristopher M. Kafka, Andrew Dolby, Robert V. Ice, West Virginia High Technology Consortium Foundation (USA) . . . . . [9070-108]

CONFERENCE ENDS . . . . . THU 5:35 PM

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CONFERENCE 9071

LOCATION: CONV. CTR. ROOM 341

Tuesday - Thursday 6 - 8 May 2014 • Proceedings of SPIE Vol. 9071

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

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

Program Committee: **Gary H. Ballard,** U.S. Army Research, Development and Engineering Command (USA); **Gisele Bennett,** Georgia Institute of Technology (USA); **Piet Bijl,** TNO Defence, Security and Safety (Netherlands); **James A. Buford Jr.,** U.S. Army Research, Development and Engineering Command (USA); **James A. Dawson,** Dynetics, Inc. (USA); **Ronald G. Driggers,** St. Johns Optical Systems (USA); **Richard L. Espinola,** U.S. Army Night Vision & Electronic Sensors Directorate (USA); **David P. Forrai,** L-3 Communications Cincinnati Electronics (USA); **Jonathan G. Hixson,** U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Alan Irwin,** Santa Barbara Infrared, Inc. (USA); **Eddie L. Jacobs,** Univ. of Memphis (USA); **Terrence S. Lomheim,** The Aerospace Corp. (USA); **R. Lee Murrer Jr.,** Millennium Engineering and Integration Co. (USA); **Teresa L. Pace,** SenTech, LLC- A DSCI Co. (USA); **Hector M. Reyes,** Raytheon Co. (USA); **Endre Repasi,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Joseph P. Reynolds,** U.S. Army 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 6 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 341 . . TUE 8:00 AM TO 10:00 AM

Modeling I

Session Chairs: **Keith A. Krapels,** U.S. Army RDECOM CERDEC NVESD (USA); **Gisele Bennett,** Georgia Institute of Technology (USA); **Jonathan G. Hixson,** U.S. Army Night Vision & Electronic Sensors Directorate (USA)

8:00 am: **Comparison of IRST systems by SNR**, Charles Kim, Ron K. Meyer, Northrop Grumman Electronic Systems (USA) . . . . . [9071-1]

8:20 am: **Field of view selection for optimal airborne imaging sensor performance**, Tristan M. Goss, P. Werner Barnard, ASELSAN Inc. (South Africa); Halidun Fildis, Mustafa Erbudak, Tolga Senger, Mehmet E. Alpman, ASELSAN Inc. (Turkey) . . . . . [9071-2]

8:40 am: **Thermal imager sources of nonuniformities: modeling of static and dynamic contributions during operations**, Barbara Sozzi, Monica Olivieri, Claudio Giunti, Paolo Mariani, Stefano Zatti, Antonio Porta, SELEX Galileo S.p.A. (Italy) . . . . . [9071-3]

9:00 am: **Accounting for chromatic variations in system modeling and its influence on system performance**, Jonathan G. Hixson, David P. Haefner, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [9071-4]

9:20 am: **Method for quantifying image quality in push-broom hyperspectral cameras**, Gudrun Hoeye, Trond Løke, Andrei Fridman, Norsk Elektro Optikk AS (Norway) . . . . . [9071-5]

9:40 am: **Direct optimization of LWIR system for maximized detection range and minimized SWAP**, Robert M. Bates, FiveFocal LLC (USA). . . . . [9071-6]

Coffee Break . . . . . Tue 10:00 am to 10:20 am

SESSION 2

LOCATION: CONV. CTR. ROOM 341 . . TUE 10:20 AM TO 12:00 PM

Modeling II

Session Chairs: **James A. Dawson,** Dynetics, Inc. (USA); **Ronald G. Driggers,** St. Johns Optical Systems (USA); **David P. Forrai,** L-3 Communications Cincinnati Electronics (USA)

10:20 am: **Performance trade space analysis for multifunction EO-IR systems**, Keith A. Krapels, U.S. Army RDECOM CERDEC NVESD (USA); Ronald G. Driggers, St. Johns Optical Systems (USA) . . . . . [9071-7]

10:40 am: **Observer analysis and its impact on task performance modeling,** Eddie L. Jacobs, Jeremy B. Brown, The Univ. of Memphis (USA) . . . . . [9071-8]

11:00 am: **Lab and field measurements to evaluate a differential polarimetric IR (DPIR) search sensor**, Roger W. Thompson Jr., Van A. Hodgkin, Kevin R. Leonard, Bradley L. Preece, Keith A. Krapels, U.S. Army RDECOM CERDEC NVESD (USA) . . . . . [9071-9]

11:20 am: 10:40 am: **Modeling segmentation algorithm performance in NV-IPM**, Micah J. Lies, Eddie L. Jacobs, The Univ. of Memphis (USA) . . . . [9071-64]

11:40 am: **Predicted NETD performance of a polarized infrared imaging sensor**, Bradley L. Preece, Van A. Hodgkin, Roger W. Thompson Jr., Kevin R. Leonard, Keith A. Krapels, U.S. Army RDECOM CERDEC NVESD (USA) . . . . . [9071-11]

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

SESSION 3

LOCATION: CONV. CTR. ROOM 341 . . . . TUE 1:20 PM TO 3:00 PM

Modeling III: Algorithms

Session Chairs: **Eddie L. Jacobs,** The Univ. of Memphis (USA); **Terrence S. Lomheim,** The Aerospace Corp. (USA); **Teresa L. Pace,** SenTech, LLC- A DSCI Co. (USA)

1:20 pm: **Technologies for low-bandwidth, high-latency unmanned ground vehicle control**, Teresa L. Pace, SenTech, LLC- A DSCI Co. (USA); Lee Hunt, Prioria Robotics, Inc. (USA); Ken Cogan, SenTech, LLC- A DSCI Co. (USA) . . . . . [9071-12]

1:40 pm: **High-dynamic range and high-speed imaging in the TELOPS FAST-IR 1500 midwave infrared camera**, Frédérick Marcotte, Vincent Farley, Telops (Canada); Myron R. Pauli, U.S. Naval Research Lab. (USA) . . . . [9071-40]

2:00 pm: **A virtual environment for modeling and testing sensemaking with multisensor information**, Denise M. Nicholson, Sae Schatz, Robert Hoppenfeld, DSCI (USA) . . . . . [9071-14]

2:20 pm: **Performance assessment of compressive sensing imaging**, Todd W. Du Bosq, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [9071-15]

2:40 pm: **Low-cost computational imaging infrared imaging**, Kyle R. Bryant, U.S. Army Research, Development and Engineering Command (USA); Ryan K. Rogers, William Derrick Edwards, Dynetics, Inc. (USA) . . . . . [9071-16]

Coffee/Exhibition Break. . . . . Tue 3:00 pm to 3:40 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 341 . . . .TUE 3:40 PM TO 5:00 PM

Modeling IV: Night Vision Integrated Performance Model

Session Chairs: **Hector M. Reyes,** Raytheon Co. (USA); **Joseph P. Reynolds,** U.S. Army RDECOM CERDEC NVESD (USA); **Michael A. Soel,** FLIR Systems, Inc. (USA)

3:40 pm: **Night vision integrated performance model for camera calibration and prediction**, David P. Haefner, Jonathan D. Fanning, Brian P. Teaney, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [9071-18]

4:00 pm: **Imaging system sensitivity analysis with NV-IPM**, Jonathan D. Fanning, Brian P. Teaney, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [9071-19]

4:20 pm: **Modeling laser radar systems in the Night Vision Integrated Performance Model (NV-IPM)**, Kevin R. Leonard, Van A. Hodgkin, Bradley L. Preece, Roger W. Thompson Jr., Keith A. Krapels, U.S. Army RDECOM CERDEC NVESD (USA). . . . . [9071-20]

4:40 pm: **NV-IPM components for full-spectrum irradiance and path radiance using Modtran**, Joseph P. Reynolds, Brian P. Teaney, U.S. Army RDECOM CERDEC NVESD (USA) . . . . . [9071-21]

CONFERENCE 9071
LOCATION: CONV. CTR. ROOM 341

WORKSHOP
LOCATION: CONV. CTR. ROOM 341 . . TUE 5:00 TO 6:00 PM

Night Vision Integrated Performance Model (NV-IPM) Workshop

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

The Night Vision Integrated Performance Model (NV-IPM) version 1.1 was recently released by NVESD. The aim of this new model is to provide a flexible and extensible engineering tool for system design which encapsulates all of the capabilities of the existing Night Vision model suite along with many new design tools and features. This workshop will introduce some common NV-IPM modeling cases and discuss the model features and capabilities in greater detail. The workshop will also introduce users to future development goals for NV-IPM, including image generation, a fully 2-D implementation, and improved Modtran support. Attendees are encouraged to provide feedback and suggestions throughout the course of the workshop.

WEDNESDAY 7 MAY

SESSION 5
LOCATION: CONV. CTR. ROOM 341 . . .WED 8:30 AM TO 9:50 AM

Modeling V

Session Chairs: **Keith A. Krapels,** U.S. Army RDECOM CERDEC NVESD (USA); **Gisele Bennett,** Georgia Institute of Technology (USA); **Jonathan G. Hixson,** U.S. Army Night Vision & Electronic Sensors Directorate (USA)

8:30 am: **Modeling static and dynamic detection of humans in rural terrain**, Eric A. Flug, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [9071-22]

8:50 am: **Uncertainty analysis of sensor abilities in the short-wave infrared spectral region based on nightglow as the main lightsource**, Thomas Svensson, Swedish Defence Research Agency (Sweden) . . . . . [9071-23]

9:10 am: **A uniform method for modeling target acquisition with indepentent networkd imaging sensors**, Melvin H. Friedman, U.S. Army RDECOM CERDEC NVESD (USA) . . . . . [9071-24]

9:30 am: **SWIR range performance prediction for long-range applications**, Emanuele Guadagnoli, Piero Ventura, Gianni Barani, Antonio Porta, SELEX Galileo S.p.A. (Italy) . . . . . [9071-26]

Coffee Break . . . . . .Wed 9:50 am to 10:20 am

SESSION 6
LOCATION: CONV. CTR. ROOM 341 . . . . . WED 10:20 AM TO 12:00 PM

Testing I

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

10:20 am: **NIST traceable measurements of radiance and luminance levels of night-vision-goggle test-instruments**, George P. Eppeldauer, Vyacheslav B. Podobedov, National Institute of Standards and Technology (USA) . [9071-34]

10:40 am: **Methodology for lens transmission measurement in the 8-13 micron waveband: Integrating sphere versus camera-based**, Norbert Schuster, Jan Verplancke, Bergeron S. Salethaiyan, John W. Franks, Umicore Electro-Optic Materials (Belgium) . . . . . [9071-27]

11:00 am: **Modulation transfer function measurement of microbolometer focal plane array by Lloyd's mirror method,** Guillaume Druart, Sylvain Rommeluère, Viale Thibault, Nicolas Guérineau, Isabelle Ribet-Mohamed, ONERA (France); Arnaud A. Crastes, Alain Durand, ULIS (France); Jean Taboury, Lab. Charles Fabry (France) . . . . . [9071-28]

11:20 am: **Reporting NETD: why measurement techniques matter**, William Derrick Edwards, Ryan K. Rogers, Dynetics, Inc. (USA); Kyle R. Bryant, Christopher L. Dobbins, Samuel B. Wood, U.S. Army Research, Development and Engineering Command (USA). . . . . [9071-29]

11:40 am: **Test equipment and method to characterize a SWIR digital imaging system**, John Green, Tim Robinson, Esterline Control Systems (USA) . . . . . [9071-30]

12:00 pm: **Calibration of uncooled LWIR microbolometer imagers to enable long-term field deployment**, Paul W. Nugent, Joseph A. Shaw, Montana State Univ. (USA) . . . . . [9071-31]

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

SESSION 7
LOCATION: CONV. CTR. ROOM 341 . . . WED 1:40 PM TO 3:00 PM

Testing II

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

1:40 pm: **IR microbolometer array spectral response measurement and angular effect using FTIR**, Aurelie Touvignon, Fabien Romanens, Julien Favreau, Alain Durand, ULIS (France); Olivier Gravrand, CEA-LETI (France); Christel-Loïc Tisse, ULIS (France). . . . . [9071-32]

2:00 pm: **NVLabCAP: an NVESD-developed software tool to determine EO system performance**, Stephen D. Burks, Joshua M. Doe, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [9071-33]

2:20 pm: **An alternate method for performing MRTD measurements**, Alan Irwin, Jack T. Grigor, Santa Barbara Infrared, Inc. (USA) . . . . . [9071-35]

2:40 pm: **Testing military sensor systems in the laboratory and field**, James McKechnie, Jack T. Grigor, Alan Irwin, Santa Barbara Infrared, Inc. (USA) . . . . . [9071-36]

Coffee/Exhibition Break. . . . . .Wed 3:00 pm to 3:40 pm

SESSION 8
LOCATION: CONV. CTR. ROOM 341 . . . WED 3:40 PM TO 4:20 PM

Testing III

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

3:40 pm: **Characterization of SWIR cameras by MRC measurements**, Martin Gerken, Harry H. Schlemmer, Hubertus A. Haan, Christofer Siemens, Mario O. Münzberg, Cassidian Optronics GmbH (Germany). . . . . [9071-37]

4:00 pm: **Wafer level test solutions for IR sensors**, Sebastian Giessmann, Frank-Michael Werner, Cascade Microtech GmbH (Germany). . . . . [9071-38]

SESSION 9
LOCATION: CONV. CTR. ROOM 341 . . . WED 4:20 PM TO 4:40 PM

Systems

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

4:20 pm: **Performance analysis of panoramic infrared systems,** Orges Furxhi, Ronald G. Driggers, St. Johns Optical Systems (USA); Gerald C. Holst, JCD Publishing Co. (USA); Keith A. Krapels, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [9071-65]

THURSDAY 8 MAY

SESSION 10
LOCATION: CONV. CTR. ROOM 341 . . THU 8:20 AM TO 10:00 AM

Targets, Backgrounds, and Atmospherics I

Session Chairs: **Richard L. Espinola,** U.S. Army RDECOM CERDEC NVESD (USA); **Endre Repasi,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Bernard M. Rosier,** ONERA (France)

8:20 am: **Evaluation of turbulence mitigation methods**, Adam W. M. van Eekeren, TNO Defence, Security and Safety (Netherlands); Claudia S. Huebner, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Judith Dijk, Klamer Schutte, Piet B. W. Schwering, TNO Defence, Security and Safety (Netherlands) . . . . . [9071-41]

8:40 am: **Fourier transform infrared (FTIR) spectroscopy and micro-pulse lidar (MPL) atmospheric inversion technique to characterize path radiance**, Michael E. Thomas, Andrea M. Brown, David M. Brown, Cadence A. Martin, Shadrian B. Strong, Marc B. Airola, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9071-42]

9:00 am: **Developing a broad spectrum atmospheric aerosol characterization for remote sensing platforms over desert regions**, Shadrian B. Strong, Andrea M. Brown, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9071-43]

9:20 am: **Spectrally dependent hydrated aerosol signatures observed in maritime environments**, Shadrian B. Strong, Michael E. Thomas, Andrea M. Brown, Mary R. Keller, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9071-44]

9:40 am: **Fourier transform infrared spectroscopy (FTIR) characterization of atmospheric fluctuations along slant paths**, Cadence A. Martin, Michele B. Lohr, Michael E. Thomas, David M. Brown, Shadrian B. Strong, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9071-45]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

SESSION 11
LOCATION: CONV. CTR. ROOM 341 . . THU 10:30 AM TO 12:10 PM

Targets, Backgrounds, and Atmospherics II

Session Chairs: **Richard L. Espinola,** U.S. Army RDECOM CERDEC NVESD (USA); **Endre Repasi,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Bernard M. Rosier,** ONERA (France)

10:30 am: **Validation of atmospheric turbulence simulations of extended scenes**, Kevin R. Leonard, Richard L. Espinola, U.S. Army RDECOM CERDEC NVESD (USA). . . . . [9071-46]

10:50 am: **Aerosol MTF revisited**, Natan S. Kopeika, Arkadi Zilberman, Yitzhak Yitzhaky, Ben-Gurion Univ. of the Negev (Israel) . . . . . [9071-47]

11:10 am: **DARPA superresolution vision system (SRVS) robust turbulence data collection and analysis**, Richard L. Espinola, Kevin R. Leonard, Roger W. Thompson Jr., U.S. Army Night Vision & Electronic Sensors Directorate (USA); David H. Tofsted, Michael S. D'Arcy, U.S. Army Research Lab. (USA) . [9071-48]

11:30 am: **Multiple angle analysis of optical backscatter measurements for determination of cloud particulates for UAV/weather balloon applications**, Rahul Dixit, David J. Klotzkin, Binghamton Univ. (USA) . . . . . [9071-49]

11:50 am: **Three-dimensional temperature estimation of a fire plume using multiple longwave infrared camera views**, Michele B. Lohr, Michael E. Thomas, Todd M. Neighoff, Daniel T. Prendergast, Austin Dress, Sean Happel, Karen M. Siegrist, Yale Chang, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9071-50]

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

SESSION 12
LOCATION: CONV. CTR. ROOM 341 . . . . THU 1:30 PM TO 3:30 PM

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

Session Chairs: **James A. Buford Jr.,** U.S. Army Research, Development and Engineering Command (USA); **R. Lee Murrer Jr.,** Millennium Engineering and Integration Co. (USA); **Gary H. Ballard,** U.S. Army Research, Development and Engineering Command (USA)

1:30 pm: **Development and evaluation of technologies for testing infrared imaging sensors**, Heard S. Lowry, Sid L. Steely, Ken D. Bynum, Randy A. Nicholson, Aerospace Testing Alliance (USA). . . . . [9071-52]

1:50 pm: **Real-time scene and signature generation for ladar and imaging sensors**, Leszek Swierkowski, Chad L. Christie, Leonid Antanovskii, Efthimios T. Gouthas, Defence Science and Technology Organisation (Australia). [9071-53]

2:10 pm: **Real-time simulation of combined short-wave and long-wave infrared vision on a head-up display**, Niklas Peinecke, Sven Schmerwitz, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [9071-55]

2:30 pm: **Carrier transport in type-II long-wavelength infrared superlattice LEDs and implications for array design**, David Westerfeld, Youxi Lin, Sergey Suchalkin, Gela Kipshidze, Takashi Hosoda, Stony Brook Univ. (USA); Boris Laikhtman, Power Photonic Corp. (USA); Leon Shterengas, Gregory Belenky, Stony Brook Univ. (USA) . . . . . [9071-56]

2:50 pm: **Ultrahigh-temperature emitter pixel development for scene projectors: performance data**, Joseph D. LaVeigne, Santa Barbara Infrared, Inc. (USA). . . . . [9071-57]

3:10 pm: **Scalable emitter array development for infrared scene projector systems**, Joseph D. LaVeigne, Santa Barbara Infrared, Inc. (USA) . . . . [9071-58]

POSTERS-THURSDAY
LOCATION: CONV. CTR. HALL C . . . . . .THU 6:00 PM 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 session. 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 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.

Background character research for synthetical performance of thermal imaging systems, Jihui Wang, Xiaowei Wang, Songlin Chen, Weiqi Jin, Beijing Institute of Technology (China) . . . . . [9071-60]

Application of responsivity and noise evaluation method to infrared thermal imaging sensors, Dong-Ik Kim, Ghiseok Kim, Geonhee Kim, Ki-Soo Chang, Korea Basic Science Institute (Korea, Republic of). . . . . [9071-61]

WAHRSIS: a low-cost, high-resolution whole sky imager, Soumyabrata Dev, Nanyang Technological Univ. (Singapore); Alexandros Fragkiadakis, Advanced Digital Sciences Ctr. (Singapore); Yee Hui Lee, Nanyang Technological Univ. (Singapore); Stefan Winkler, Advanced Digital Sciences Ctr. (Singapore) . . . . . [9071-63]

CONFERENCE 9072

LOCATION: CONV. CTR. ROOM 346

Monday - Wednesday 5 - 7 May 2014 • Proceedings of SPIE Vol. 9072

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

Conference Chairs: **Steven S. Bishop,** U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Jason C. Isaacs,** Naval Surface Warfare Ctr. Panama City Div. (USA)

Program Committee: **Benjamin E. Barrowes,** U.S. Army Engineer Research and Development Ctr. (USA); **James Tory Cobb,** Naval Surface Warfare Ctr. Panama City Div. (USA); **Leslie M. Collins,** Duke Univ. (USA); **Gerald J. Dobeck,** Naval Surface Warfare Ctr. Panama City Div. (USA); **Anthony A. Faust,** Defence Research and Development Canada, Suffield (Canada); **James M. Keller,** Univ. of Missouri-Columbia (USA); **Aaron LaPointe,** U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Henric Östmark,** Swedish Defence Research Agency (Sweden); **Motoyuki Sato,** Tohoku Univ. (Japan); **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 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 346 . . . . . MON 8:30 TO 10:10 AM

Sonar and Acoustic Vibration Measurement I

Session Chairs: **Christopher R. Ratto,** Johns Hopkins Univ. Applied Physics Lab. (USA); **Peter A. Torrione,** Duke Univ. (USA)

8:30 am: **Automatic target recognition for autonomous systems**, Jason C. Isaacs, Naval Surface Warfare Ctr. Panama City Div. (USA) . . . . . [9072-1]

8:50 am: **Representational learning for object recognition in sonar imagery**, Jason C. Isaacs, Naval Surface Warfare Ctr. Panama City Div. (USA) . . . [9072-2]

9:10 am: **Coherent change detection technique for synthetic aperture sonar**, Tesfaye G-Michael, Naval Surface Warfare Ctr. Panama City Div. (USA) . . . . . [9072-3]

9:30 am: **Feature-based recognition of submerged objects in holographic imagery**, Christopher R. Ratto, Nathaniel Beagley, Kevin C. Baldwin, Kara R. Shipley, Wayne I. Sternberger, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9072-4]

9:50 am: **Target identification using synthetic aperture acoustics**, Mary Knox, Stacy Tantum, Leslie M. Collins, Duke Univ. (USA). . . . . [9072-5]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

SESSION 2

LOCATION: CONV. CTR. ROOM 346 . . . . . MON 10:40 TO 11:20 AM

Sonar and Acoustic Vibration Measurement II

Session Chairs: **Kenneth D. Morton Jr.,** Duke Univ. (USA); **Bradley W. Libbey,** U.S. Army Night Vision & | Electronic Sensors Directorate (USA)

10:40 am: **Digital shearography as a ground vibration sensor for acoustic detection of buried mines**, Vyacheslav Aranchuk, Ina Aranchuk, James M. Sabatier, Univ. of Mississippi (USA) . . . . . [9072-6]

11:00 am: **Exploiting spatial and phase correlations for seismic mine detection**, Jordan M. Malof, Mary Knox, Peter A. Torrione, Leslie M. Collins, Kenneth D. Morton Jr., Duke Univ. (USA) . . . . . [9072-7]

Lunch Break . . . . . Mon 11:20 am to 1:30 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 346 . . . . . MON 1:30 TO 3:10 PM

EMI I

Session Chairs: **Michael B. Steer,** North Carolina State Univ. (USA); **Frank Navish III,** U.S. Army Night Vision & Electronic Sensors Directorate (USA)

1:30 pm: **High to very high-frequency metal/anomaly detector**, Daniel C. Heinz, U.S. Army CERDEC Intelligence and Information Warfare Directorate (USA); Michael L. Brennan, CACI International Inc. (USA); Michael B. Steer, North Carolina State Univ. (USA); Adam W. Melber, John T. Cua, U.S. Army CERDEC Intelligence and Information Warfare Directorate (USA) . . . . . [9072-8]

1:50 pm: **Homemade explosives in the subsurface as intermediate electrical conductivity materials: a new physical principle for their detection**, Steven A. Grant, Benjamin E. Barrowes, Steven A. Arcone, U.S. Army Engineer Research and Development Ctr. (USA). . . . . [9072-9]

2:10 pm: **The magnetic polarizability of thin shells**, Jonathan E. Gabbay, Waymond R. Scott Jr., Georgia Institute of Technology (USA). . . . . [9072-10]

2:30 pm: **Experimental detection and discrimination of buried targets using an improved broadband CW electromagnetic induction sensor**, Waymond R. Scott Jr., Gregg D. Larson, Georgia Institute of Technology (USA) . . [9072-11]

2:50 pm: **Implementation of optimized electromagnetic induction coils**, Mark A. Reed, Waymond R. Scott Jr., Georgia Institute of Technology (USA) . . . . . [9072-12]

Coffee Break . . . . . Mon 3:10 pm to 3:40 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 346 . . . . . MON 3:40 TO 4:40 PM

EMI II

Session Chairs: **Johnny B. Sigman,** Thayer School of Engineering at Dartmouth (USA); **Zeke Topolosky,** U.S. Army Night Vision & Electronic Sensors Directorate (USA)

3:40 pm: **Optimizing electromagnetic induction sensors for dynamic munitions classification surveys**, Jonathan S. Miller, Gregory Schultz, White River Technologies, Inc. (USA) . . . . . [9072-13]

4:00 pm: **Automatic classification of unexploded ordnance applied to live sites for MetalMapper sensor**, Johnny B. Sigman, Benjamin E. Barrowes, Kevin A. O'Neill, Yinlin Wang, Fridon Shubitidze, Dartmouth College (USA) . . . . . [9072-14]

4:20 pm: **A combined joint diagonalization: MUSIC algorithm for subsurface targets localization**, Yinlin Wang, Johnny B. Sigman, Thayer School of Engineering at Dartmouth (USA); Benjamin E. Barrowes, Kevin A. O'Neill, Thayer School of Engineering at Dartmouth (USA) and U.S. Army Engineer Research and Development Ctr. (USA); Fridon Shubitidze, Thayer School of Engineering at Dartmouth (USA) and Sky Research, Inc. (USA) . . . . . [9072-15]

Defense + Security Plenary Presentation

MON 5:00 TO 6:00 PM
LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

TUESDAY 6 MAY

SESSION 5
LOCATION: CONV. CTR. ROOM 346 . . TUE 8:20 AM TO 10:00 AM

EMI III

Session Chairs: **Joe Keranen,** White River Technologies, Inc. (USA); **Richard C. Weaver,** U.S. Army Night Vision & Electronic Sensors Directorate (USA)

8:20 am: **Acquisition and processing of advanced sensor data for ERW and UXO detection and classification**, Gregory Schultz, Joe Keranen, White River Technologies, Inc. (USA); Zeke Topolosky, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Jonathan S. Miller, White River Technologies, Inc. (USA) . . . . . [9072-16]

8:40 am: **Detecting and classifying small and deep targets using improved EMI hardware and data processing approach**, Fridon Shubitidze, Dartmouth College (USA); Benjamin E. Barrowes, U.S. Army Engineer Research and Development Ctr. (USA); Johnny B. Sigman, Yinlin Wang, Dartmouth College (USA); Irma Shamatava, White River Technology, Inc. (USA); Kevin A. O'Neill, Dartmouth College (USA) . . . . . [9072-17]

9:00 am: **Advanced EMI models for survey data processing: targets detection and classification**, Fridon Shubitidze, Dartmouth College (USA); Benjamin E. Barrowes, U.S. Army Engineer Research and Development Ctr. (USA); Irma Shamatava, White River Technology, Inc. (USA); Johnny B. Sigman, Yinlin Wang, Kevin A. O'Neill, Dartmouth College (USA) . . . . . [9072-18]

9:20 am: **Multichannel transmit/receive metal detector coil array for vehicular applications**, Korkut Yegin, Yeditepe Univ. (Turkey); Hasan Bellikli, TÜBITAK BILGEM (Turkey); Hilmi Öztürk, TÜBITAK National Research Institute of Electronics and Cryptology (Turkey); Hakki Nazli, Mahmut Da?, TÜBITAK BILGEM (Turkey) . . . . . [9072-19]

9:40 am: **Geometric approach of planar spiral mono-coil design to maximize the detection range of time-domain electromagnetic induction landmine detector**, Bobae Kim, Seung-gyu Yang, Gwangju Institute of Science and Technology (Korea, Republic of); Seunghoon Han, Seung-eui Lee, Samsung Thales Co., Ltd. (Korea, Republic of); Kangwook Kim, Gwangju Institute of Science and Technology (Korea, Republic of) . . . . . [9072-20]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

SESSION 6
LOCATION: CONV. CTR. ROOM 346 . . TUE 10:30 AM TO 12:10 PM

GPR I

Session Chairs: **Waymond R. Scott Jr.,** Georgia Institute of Technology (USA); **Pete Howard,** U.S. Army Night Vision & Electronic Sensors Directorate (USA)

10:30 am: **Experiment design for measuring the probability of detection in remote sensing: How many objects? How many passes?**, Peter A. Torrione, Leslie M. Collins, Kenneth D. Morton Jr., Duke Univ. (USA) . . . . . [9072-21]

10:50 am: **Improved resistive-vee dipole-based arbitrary polarization antenna system for ground penetrating radar**, James W. Sustman, Waymond R. Scott Jr., Georgia Institute of Technology (USA) . . . . . [9072-22]

11:10 am: **Comparison of ring resonator relative permittivity measurements to GPR data**, Marie Fishel, Erik Rosen, Phillip Koehn, Institute for Defense Analyses (USA) . . . . . [9072-23]

11:30 am: **Physics-based deformations of ground penetrating radar signals to improve the detection of buried explosives**, Rayn T. Sakaguchi, Kenneth D. Morton Jr., Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) . . [9072-24]

11:50 am: **Target localization and signature extraction in GPR data using expectation-maximization and principal component analysis**, Daniel Reichman, Kenneth D. Morton Jr., Peter A. Torrione, Leslie M. Collins, Duke Univ. (USA) . . . . . [9072-25]

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

SESSION 7
LOCATION: CONV. CTR. ROOM 346 . . . . TUE 1:40 PM TO 3:00 PM

GPR II

Session Chairs: **Peter A. Torrione,** Duke Univ. (USA); **Brian C. Barlow,** U.S. Army Night Vision & Electronic Sensors Directorate (USA)

1:40 pm: **A robust Bayesian approach to target detection applied to explosive threat detection in handheld ground penetrating radar data**, Kenneth D. Morton Jr., Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) . . . . . [9072-26]

2:00 pm: **Change detection using down-looking ground-penetrating radar**, Erik Rosen, Marie Fishel, Elizabeth Ayers, Phillip Koehn, Institute for Defense Analyses (USA) . . . . . [9072-27]

2:20 pm: **Context-dependent multiple kernel learning for explosive hazards detection in forward-looking ground-penetrating radar**, John Becker, Timothy C. Havens, Timothy J. Schulz, Michigan Technological Univ. (USA) . . . . . [9072-29]

2:40 pm: **Hyperbolic and PLSDA filter algorithms to detect buried threats in GPR data**, Dmitry Kalika, Kenneth D. Morton Jr., Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) . . . . . [9072-30]

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

SESSION 8
LOCATION: CONV. CTR. ROOM 346 . . . .TUE 4:00 PM TO 5:40 PM

GPR III

Session Chairs: **Leslie M. Collins,** Duke Univ. (USA); **Ravij Suri,** U.S. Army RDECOM CERDEC NVESD (USA)

4:00 pm: **Fusion of multiple algorithms for detecting buried objects using fuzzy inference**, Hichem Frigui, Amine B. Khalifa, Univ. of Louisville (USA) . . . . . [9072-31]

4:20 pm: **Fusion of forward-looking infrared and ground-penetrating radar for improved stopping distances in landmine detection**, Jordan M. Malof, Kenneth D. Morton Jr., Leslie M. Collins, Peter A. Torrione, Duke Univ. (USA) . . . . . [9072-32]

4:40 pm: **Shallow depth subsurface imaging with microwave holography**, Andrey Zhuravlev, Sergey I. Ivashov, Vladimir Razevig, Igor Vasiliev, Bauman Moscow State Technical Univ. (Russian Federation) . . . . . [9072-33]

5:00 pm: **Deep learning algorithms for detecting explosive hazards in ground-penetrating radar**, Lance E. Besaw, Philip J. Stimac, Applied Research Associates, Inc. (USA); Brian P. Burns, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [9072-34]

5:20 pm: **Vehicle-mounted ground penetrating radar (Mine Stalker III) field evaluation in Angola**, Stephen J. Laudato, U.S. Army Night Vision & Electronic Sensors Directorate (USA). . . . . [9072-35]

CONFERENCE 9072

LOCATION: CONV. CTR. ROOM 346

WEDNESDAY 7 MAY

SESSION 9

LOCATION: CONV. CTR. ROOM 346 . . . . . WED 8:00 TO 9:00 AM

Chemical Sensing

Session Chairs: **Anthony A. Faust,** Defence Research and Development Canada, Suffield (Canada); **Aaron LaPointe,** U.S. Army Night Vision & Electronic Sensors Directorate (USA)

8:00 am: **Towards eye-safe standoff Raman imaging systems**, Martin Glimtoft, Petra Bååth, Swedish Defence Research Agency (Sweden); Heikki K. Saari, Jussi Mäkynen, Antti Näsilä, VTT Technical Research Ctr. of Finland (Finland); Henric Östmark, Swedish Defence Research Agency (Sweden) . . . . . [9072-36]

8:20 am: **An excimer-based FAIMS detector for detection of ultra-low concentrations of explosives**, Gennadiy E. Kotkovskiy, Alexander A. Chistyakov, Alexey V. Sychev, National Research Nuclear Univ. MEPhI (Russian Federation); Anatoly N. Perederii, Moscow State Institute of Radiotechnics, Electronics and Automation (Russian Federation); Vitaly L Budovich, Dmitry V Budovich, Chromdet Analytical Instruments Ltd. (Russian Federation) . [9072-37]

8:40 am: **Filter-based chemical sensors for hazardous materials**, Kevin J. Major, The Univ. of North Carolina at Charlotte (USA); Kenneth J. Ewing, U.S. Naval Research Lab. (USA); Menelaos K. Poutous, The Univ. of North Carolina at Charlotte (USA); Jas S. Sanghera, U.S. Naval Research Lab. (USA); Ishwar D. Aggarwal, The Univ. of North Carolina at Charlotte (USA) . . . . . [9072-38]

SESSION 10

LOCATION: CONV. CTR. ROOM 346 . . . . . WED 9:00 TO 10:00 AM

RF and X-ray Sensing

Session Chairs: **Benjamin Barrowes,** U.S. Army Engineer Research and Development Ctr. (USA); **Brian P. Burns,** U.S. Army Night Vision & Electronic Sensors Directorate (USA)

9:00 am: **FRI for standoff detection of IED**, Khosrow Bakhtar, Bakhtar Technologies, LLC (USA) . . . . . [9072-39]

9:20 am: **Low-cost detection of RC-IED activation signals in VHF band**, Victor H. Camargo, Jose I. Marulanda, Univ. EAFIT (Colombia) . . . . . [9072-40]

9:40 am: **Prospect for standoff detection using a coherent high-harmonic x-ray beam**, Henry C. Kapteyn, Margaret M. Murnane, Univ. of Colorado at Boulder (USA) . . . . . [9072-41]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

SESSION 11

LOCATION: CONV. CTR. ROOM 346 . . . . . WED 10:30 AM TO 12:10 PM

Laser and LWIR Applications I

Session Chairs: **Mihail Popescu,** Univ. of Missouri-Columbia (USA); **Ryan R. Close,** U.S. Army RDECOM CERDEC NVESD (USA)

10:30 am: **Ladar-based IED detection**, Philip Engström, Håkan Larsson, Dietmar Letalick, Swedish Defence Research Agency (Sweden) . . . . . [9072-42]

10:50 am: **Investigation of different localization strategies for spatial and spectral features for buried explosive hazard detection in FL-LWIR**, Stanton R. Price, Derek T. Anderson, Mississippi State Univ. (USA); Kevin E. Stone, James M. Keller, Univ. of Missouri-Columbia (USA) . . . . . [9072-43]

11:10 am: **A method of evolving novel feature extraction algorithms for detecting buried objects in FLIR imagery using genetic programming**, Alex Paino, James M. Keller, Mihail Popescu, Kevin E. Stone, Univ. of Missouri-Columbia (USA) . . . . . [9072-44]

11:30 am: **Convolutional neural network approach for buried target recognition in FL-LWIR imagery**, Kevin E. Stone, James M. Keller, Univ. of Missouri-Columbia (USA) . . . . . [9072-45]

11:50 am: **Road recognition in poor quality environments for forward looking buried object detection**, Pooparat Plodpradista, James M. Keller, Mihail Popescu, Tomothy Madison, Univ. of Missouri-Columbia (USA) . [9072-46]

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

SESSION 12

LOCATION: CONV. CTR. ROOM 346 . . . . . WED 1:40 TO 3:00 PM

Laser and LWIR Applications II

Session Chairs: **Michael J. DeWeert,** BAE Systems (USA); **Neal E. Blackwell,** U.S. Army Night Vision & Electronic Sensors Directorate (USA)

1:40 pm: **Detection of obscured and partially covered objects using partial network matching and an image feature network-based object recognition algorithm**, Jeremy Straub, The Univ. of North Dakota (USA) . . . . . [9072-47]

2:00 pm: **3D LASE-M three-dimensional-lidar airborne system emulator maritime**, Michael J. DeWeert, BAE Systems (USA) . . . . . [9072-48]

2:20 pm: **Detection of obscured targets with IR polarimetric imaging**, David B. Chenault, Joseph L. Pezzaniti, Polaris Sensor Technologies, Inc. (USA) . . . . . [9072-49]

2:40 pm: **Investigation of disturbed earth detection in the very long wavelength infrared (VLWIR)**, Kenneth J. Ewing, Jas S. Sanghera, U.S. Naval Research Lab. (USA) . . . . . [9072-50]

CONFERENCE 9073

LOCATION: CONV. CTR. ROOM 348

Tuesday - Thursday 6 - 8 May 2014 • Proceedings of SPIE Vol. 9073

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

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

Program Committee: **Jerome J. Braun,** MIT Lincoln Lab. (USA); **James P. Carney,** Sandia National Labs. (USA); **Christopher C. Carter,** Johns Hopkins Univ. Applied Physics Lab. (USA); **Jason A. Guicheteau,** U.S. Army Edgewood Chemical Biological Ctr. (USA); **Eric J. Houser,** U.S. Dept. of Homeland Security (USA); **Chris R. Howle,** Defence Science and Technology Lab. (United Kingdom); **Harry Ing,** Bubble Technology Industries, Inc. (Canada); **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 Placke Jr.,** Y-12 National Security Complex (USA); **Cynthia R. Swim,** U.S. Army Edgewood Chemical Biological Ctr. (USA); **Anna Tedeschi,** Strategic Analysis, Inc. (USA), U. S. Dept. of Homeland Security (USA); **Steven W. Waugh,** Defense Threat Reduction Agency (USA)

TUESDAY 6 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 348 .. TUE 9:00 AM TO 12:00 PM

Chemical Detection I

Session Chair: **Christopher R. Howle,** Defence Science and Technology Lab. (United Kingdom)

9:00 am: **Active FTIR-based standoff detection in the 3-4-micron region using broadband femtosecond optical parametric oscillators** *(Invited Paper)*, Derryck T. Reid, Zhaowei Zhang, Heriot-Watt Univ. (United Kingdom); Christopher R. Howle, Defence Science and Technology Lab. (United Kingdom) . . . . . [9073-1]

9:30 am: **Quantitative total and diffuse reflectance laboratory measurements for remote and standoff sensing**, Thomas A. Blake, Carolyn S. Brauer, Yin-Fong Su, Bruce E. Bernacki, Tanya L. Myers, Brenda M. Kunkel, Timothy J. Johnson, Pacific Northwest National Lab. (USA) . . . . . [9073-2]

9:50 am: **Development of an ultrahigh-performance infrared detector platform for advanced spectroscopic sensing systems**, Manish Jain, Amethyst Research Inc. (United Kingdom); Gary W. Wicks, Amethyst Research Inc. (USA) and Univ. of Rochester (USA); Andrew R. J. Marshall, Adam Craig, Lancaster Univ. (United Kingdom); Terry Golding, Amethyst Research Inc. (USA) and Amethyst Research Ltd. (United Kingdom); Khalid Hossain, Amethyst Research Inc. (USA); Christopher R. Howle, Kenneth J. McEwan, Defence Science and Technology Lab. (United Kingdom) . . . . . [9073-3]

Coffee Break . . . . . Tue 10:10 am to 10:40 am

10:40 am: **Real-time identification of aerosol sized particles using single-beam CARS**, Stephen D. Roberson, EOIR Technologies (USA); Paul M. Pellegrino, U.S. Army Research Lab. (USA) . . . . . [9073-4]

11:00 am: **The application of adhesive coatings for trace sampling, chemical detection, and forensics**, Jessica Staymates, National Institute of Standards and Technology (USA) . . . . . [9073-5]

11:20 am: **Photoacoustic chemical sensing: ultracompact sources and standoff detection**, Logan S. Marcus, Ellen L. Holthoff, John F. Schill, Paul M. Pellegrino, U.S. Army Research Lab. (USA) . . . . . [9073-6]

11:40 am: **Multispectral imaging of CBRNE threats using micro-optics**, Michele Hinnrichs, Pacific Advanced Technology, Inc. (USA); James O. Jensen, U.S. Army Edgewood Chemical Biological Ctr. (USA) . . . . . [9073-7]

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

SESSION 2

LOCATION: CONV. CTR. ROOM 348 .... TUE 1:30 PM TO 3:30 PM

Chemical Detection II

Session Chair: **Christopher C. Carter,** Johns Hopkins Univ. Applied Physics Lab. (USA)

1:30 pm: **A neural network structure for prediction of chemical agent fate**, Homayun K. Navaz, Kettering Univ. (USA); Nasser Kehtarnavaz, Univ. of Texas at Dallas (USA); Zoran Jovic, Kettering Univ. (USA) . . . . . [9073-8]

1:50 pm: **Fate of sessile chemical agent droplet on porous environmental substrates in the presence of physiochemical processes**, Homayun K. Navaz, Anthony Dang, Theresa Atkinson, Ali Zand, Albert Nowakowski, Kristina Kamensky, Kettering Univ. (USA) . . . . . [9073-9]

2:10 pm: **Modeling the long-wave infrared reflectance signatures from contaminated surfaces**, Travis R. Myers, Anish Goyal, William Herzog, Matthew Aernecke, MIT Lincoln Lab. (USA) . . . . . [9073-10]

2:30 pm: **Measurements of Raman scattering in the middle ultraviolet band from persistent chemical warfare agents**, Fredrik Kullander, Lars Landström, Hampus Lundén, Abdesalam Mohammed, Göran Olofsson, Pär Wästerby, Swedish Defence Research Agency (Sweden) . . . . . [9073-11]

2:50 pm: **Application of a Fourier-transform infrared imaging system to deciphering obliterated writings for forensic purposes**, Shigeru Sugawara, National Research Institute of Police Science (Japan) . . . . . [9073-12]

3:10 pm: **Acoustic resonance in MEMS scale cylindrical tubes with side branches**, John F. Schill, Ellen L. Holthoff, Paul M. Pellegrino, Logan S. Marcus, U.S. Army Research Lab. (USA) . . . . . [9073-15]

WEDNESDAY 7 MAY

SESSION 3

LOCATION: CONV. CTR. ROOM 348 .....WED 8:00 TO 10:00 AM

Explosives Detection Using Raman Spectroscopy

Session Chair: **Jason A. Guicheteau,** U.S. Army Edgewood Chemical Biological Ctr. (USA)

8:00 am: **Proximal detection of energetic materials on fabrics by UV-Raman spectroscopy**, Roberto Chirico, Salvatore Almaviva, Francesco Colao, Luca Fiorani, Marcello Nuvoli, ENEA (Italy); Wenka Schweikert, Frank Schnuerer, Fraunhofer ICT (Germany); Luigi Cassioli, Silvana Grossi, Leonardo Mariani, Aeronautica Militare (Italy); Federico Angelini, Ivano Menicucci, Antonio Palucci, ENEA (Italy) . . . . . [9073-16]

8:20 am: **Stand-off imaging Raman spectroscopy for forensic analysis of post-blast scenes: trace detection of ammonium nitrate and 2,4,6-trinitrotoluene**, Ema Ceco, Hans Oennerud, Dennis Menning, FOI (Sweden); John L. Gilljam, Stockholm Univ. (Sweden); Henric Östmark, Petra Bååth, FOI (Sweden) . . . . . [9073-18]

8:40 am: **High-sensitivity explosives detection using dual-excitation-wavelength resonance-Raman detector**, Balakishore Yellampalle, William B. McCormick, Hai-Shan Wu, Mikhail Sluch, Robert B. Martin, Robert V. Ice, Brian E. Lemoff, West Virginia High Technology Consortium Foundation (USA) . . . . . [9073-19]

9:00 am: **Improved sensing using simultaneous deep-UV Raman and fluorescence detection-II**, William F. Hug, Photon Systems, Inc. (USA); Rohit Bhartia, Jet Propulsion Lab. (USA); Kripa Sijapati, Ray D. Reid, Photon Systems, Inc. (USA). . . . . [9073-20]

9:20 am: **Spatially offset hyperspectral stand-off Raman imaging for explosive detection inside containers**, Bernhard Zachhuber, Henric Östmark, Swedish Defence Research Agency (Sweden); Torgny Carlsson, FOI, Swedish Defence Research Agency (Sweden) . . . . . [9073-21]

9:40 am: **Improving sensitivity and source attribution of homemade explosives with low-frequency/THz-Raman**, James T. A. Carriere, Frank Havermeyer, Randy A. Heyler, Ondax, Inc. (USA). . . . . [9073-22]

Coffee/Exhibition Break. . . . . .Wed 10:00 am to 10:50 am

CONFERENCE 9073

LOCATION: CONV. CTR. ROOM 348

SESSION 4

LOCATION: CONV. CTR. ROOM 348 . . . . . WED 10:50 AM TO 12:10 PM

Spectroscopy and Imaging for Explosives Detection I

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

10:50 am: **Hyperspectral imaging using novel LWIR OPO for hazardous material detection and identification**, Keith Ruxton, Gordon Robertson, Bill Miller, Graeme P. A. Malcolm, Gareth T. Maker, M Squared Lasers (United Kingdom) . . . . . [9073-23]

11:10 am: **The challenge of changing signatures in infrared stand-off detection of trace explosives**, Robert Furstenberg, Christopher A. Kendziora, Michael R. Papantonakis, Viet Nguyen, R. Andrew McGill, U.S. Naval Research Lab. (USA) . . . . . [9073-24]

11:30 am: **STARR: shortwave-infrared targeted agile Raman robot for the identification and confirmation of emplaced explosives**, Nathaniel R. Gomer, Charles W. Gardner, ChemImage Corp. (USA) . . . . . [9073-25]

11:50 am: **Continued development of a portable widefield hyperspectral imaging (HSI) sensor for standoff detection of explosive, chemical, and narcotic residues**, Oksana Klueva, Matthew P. Nelson, Charles W. Gardner, Patrick J. Treado, ChemImage Corp. (USA) . . . . . [9073-26]

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

SESSION 5

LOCATION: CONV. CTR. ROOM 348 . . . WED 1:40 PM TO 2:20 PM

Spectroscopy and Imaging for Explosives Detection II

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

1:40 pm: **Bottled liquid explosives scanning by near infrared**, Hideo Itozaki, Hideo Sato-Akaba, Osaka Univ. (Japan) . . . . . [9073-27]

2:00 pm: **Detecting explosive substances by the IR spectrography**, Jaana R. Kuula, Heikki J. Rinta, Ilkka Pölönen, Hannu-Heikki Puupponen, Univ. of Jyväskylä (Finland); Tuomas Teravainen, Finnish Police (Finland); Marko Haukkamaki, Finnish Air Force (Finland) . . . . . [9073-28]

SESSION 6

LOCATION: CONV. CTR. ROOM 348 . . . WED 2:20 PM TO 4:30 PM

Considerations of Explosive Detection

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

2:20 pm: **Fate and effects of trace particulate explosives**, Viet Nguyen, Robert Furstenberg, Nora C. Carr, Rachel C. McGill, Michael R. Papantonakis, Christopher A. Kendziora, R. Andrew McGill, U.S. Naval Research Lab. (USA) . . . . . [9073-29]

2:40 pm: **The external aerodynamics of canine olfaction and implications for improved vapor sampling and detection**, Matthew Staymates, National Institute of Standards and Technology (USA) . . . . . [9073-30]

Coffee Break . . . . . .Wed 3:00 pm to 3:30 pm

3:30 pm: **Observation of atomic carbon during photodissociation of nitrotoluenes in the vapor phase**, Hergen Eilers, Helena Diez-y-Riega, Washington State Univ. (USA). . . . . [9073-31]

3:50 pm: **Analysis of nonstandard and home-made explosives and post-blast residues in forensic practice**, Marek Kotrlý, Institute of Criminalistics Prague (Czech Republic) and Charles Univ. in Prague (Czech Republic); Ivana Turková, Institute of Criminalistics Prague (Czech Republic) . . . . [9073-32]

4:10 pm: **Design and validation of inert homemade explosive simulants for x-ray-based inspection systems**, Anthony A. Faust, Defence Research and Development Canada, Suffield (Canada); Sabatino Nacson, VisionTec Systems (Canada); Bruce Koffler, VisionTec Systems Ltd. (Canada); Eric Bourbeau, Optosecurity Inc. (Canada); Louis Gagné, Robin Laing, John Anderson, Defence Research and Development Canada, Suffield (Canada) . . . . . [9073-33]

THURSDAY 8 MAY

SESSION 7

LOCATION: CONV. CTR. ROOM 348 . . . THU 8:00 AM TO 11:50 AM

Biological Detection

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

8:00 am: **Discriminating bacterial spores from inert airborne particulate matter by classification of optical scattering patterns**, Giovanni Franco Crosta, Univ. degli Studi di Milano-Bicocca (Italy); Yongle Pan, Gorden Videen, U.S. Army Research Lab. (USA) . . . . . [9073-34]

8:20 am: **Modeling fluorescence of bioaerosols using improved estimates of concentrations and optical properties of the relevant molecules**, Steven C. Hill, Chatt C. Williamson, Yongle Pan, U.S. Army Research Lab. (USA); Joshua L. Santarpia, Sandia National Labs. (USA) . . . . . [9073-35]

8:40 am: **Atmospheric aerosol sensing using rotating drum impactor-dual wavelength UV laser-induced fluorescence spectra**, Chuji Wang, Mississippi State Univ. (USA); Yongle Pan, Deryck James, Alan Wetmore, U.S. Army Research Lab. (USA); Brandon Redding, Yale Univ. (USA). . . . . [9073-36]

9:00 am: **Standoff detection: classification of biological aerosols using laser-induced fluorescence (LIF) technique**, Anita Hausmann, Frank Duschek, Thomas Fischbach, Carsten Pargmann, Jürgen Handke, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Sergey Babichenko, Laser Diagnostic Instruments AS (Estonia) . . . . . [9073-37]

9:20 am: **Consumer of concern early entry program (C-CEEP) biological surveillance: protecting against the suicidal biological warfare host**, Janet Fish, Capella Univ. (USA) . . . . . [9073-38]

9:40 am: **A microfluidic platform with integrated arrays for immunologic assays for biological pathogen detection**, Richard Klemm, Claudia Gärtner, Sebastian Schattschneider, Holger Becker, Nadine Hlawatsch, microfluidic ChipShop GmbH (Germany); Sandra Julich, Herbert Tomaso, Friedrich-Loeffler-Institut (Germany) . . . . . [9073-39]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

10:30 am: **Detection and monitoring of CWA and BWA using LIBS**, Lars Landström, Anders Larsson, Per-Åke Gradmark, Lillermor Örebrand, Per O. Andersson, Pär Wästerby, Torbjörn Tjärnhage, FOI (Sweden) . . [9073-40]

10:50 am: **Silver nanorods modified filters for rapid on-chip pre-concentration and SERS sensing of bacterial whole cells**, Jing Chen, Xiaomeng Wu, Yaowen Huang, Yiping Zhao, The Univ. of Georgia (USA) . . . . . [9073-41]

11:10 am: **Portable diagnostic kit for the detection of Bacillus anthracis in ultra-low resource environments**, Jason C. Harper, Melissa Finley, Bryan Carson, George D. Bachand, Thayne L. Edwards, William Arndt, Sandia National Labs. (USA); Julie Lovchik, The Univ. of New Mexico (USA) . . . . . [9073-42]

11:30 am: **Measurement of 100 B. anthracis Ames spores within 15 minutes by SERS at the US Army Edgewood Chemical Biological Center**, Stuart R. Farquharson, Chetan S. Shende, Wayne W. Smith, Real-Time Analyzers, Inc. (USA); Jason A. Guicheteau, U.S. Army Edgewood Chemical Biological Ctr. (USA) . . . . . [9073-43]

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

SESSION 8

LOCATION: CONV. CTR. ROOM 348 . . . . THU 1:20 PM TO 4:50 PM

Radiological and Nuclear Detection

Session Chair: **James Placke Jr.,** Y-12 National Security Complex (USA)

1:20 pm: **Utilization of advanced clutter suppression algorithms for improved standoff detection of radionuclide threats**, Bogdan R. Cosofret, Kirill Shokhirev, Phillip Mulhall, Physical Sciences Inc. (USA); David Payne, Raytheon Integrated Defense Systems (USA); Bernard Harris, Raytheon Co. (USA) . . . . . [9073-44]

1:40 pm: **Image characterization metrics for large field of view muon tomography**, Michael J. Sossong, Decision Sciences International Corp. (USA); Weidong Luo, Joel Kindem, Matt Steiger, Gemini Design, LLC (USA) . . [9073-45]

2:00 pm: **Muon tomography imaging improvement using optimized limited angle data**, Michael J. Sossong, Decision Sciences International Corp. (USA); Joel Kindem, Weidong Luo, Matt Steiger, Gemini Design, LLC (USA) . . [9073-46]

2:20 pm: **Improved nuclear material detection using joint neutron and gamma ray analysis**, Amanda C. Madden, The Univ. of New Hampshire (USA) . . . . . [9073-47]

2:40 pm: **Operator-based integration of information in multimodal radiological search mission with applications to anomaly detection**, John J. Benedetto, Alexander Cloninger, Wojciech Czaja, Timothy Doster, Univ. of Maryland, College Park (USA); Kevin Kochersberger, Virginia Polytechnic Institute and State Univ. (USA); Thomas L. McCullough, Lance K. McLean, National Security Technologies, LLC (USA) . . . . . [9073-48]

Coffee Break . . . . . Thu 3:00 pm to 3:30 pm

3:30 pm: **Wavelet-assisted variance reduction anomaly detection**, Thomas L. McCullough, National Security Technologies, LLC (USA) and Univ. of Maryland (USA); Matthew R. Kiser, National Security Technologies, LLC (USA); Lance K. McLean, National Security Technologies, LLC (USA) and Univ. of Maryland (USA) . . . . . [9073-49]

3:50 pm: **Spectral clustering for aerial radiological surveys via nonlinear dimension reduction**, Thomas L. McCullough, Lance K. McLean, National Security Technologies, LLC (USA) and Univ. of Maryland (USA) . . . . . [9073-50]

4:10 pm: **Algorithms for directional ionizing radiation detection systems**, Lance K. McLean, National Security Technologies, LLC (USA) and Univ. of Maryland (USA); Matthew R. Kiser, Thomas L. McCullough, National Security Technologies, LLC (USA) . . . . . [9073-51]

4:30 pm: **Nuclear detection and monitoring using plants electricity**, Mohammad M. Islam, Univ. of Maryland, Baltimore County (USA); Wenze Xi, Thomas Jefferson National Accelerator Facility (USA); David J. Y. Feng, National Univ. of Kaohsiung (Taiwan); Fow-Sen Choa, Univ. of Maryland, Baltimore County (USA). . . . . [9073-52]

FRIDAY 9 MAY

SESSION 9
LOCATION: CONV. CTR. ROOM 336 . . . . FRI 2:00 PM TO 3:00 PM

NOTE ROOM CHANGE

Micro/Nanotechnologies for Lasers and Standoff Detection I

Joint Session with Conferences 9083/9073/9106

Session Chair: **Michael K. Rafailov,** Univ. of Alberta (Canada)

2:00 pm: **Re-engineering defense and homeland security applications using MWIR and LWIR QCLs** *(Keynote Presentation)*, C. Kumar N. Patel, Pranalytica, Inc. (USA) . . . . . [9083-90]

2:20 pm: **Ultrafast laser bleaching technique for stand-off characterization and augmentation** *(Invited Paper)*, Inna Zakharova, Univ. of Alberta (Canada) and Volyn State Univ. (Ukraine). . . . . [9083-91]

2:40 pm: **Approaches to generation of tunable mid-IR ultrafast pulses with fiber sources** *(Invited Paper)*, Igor Pastirk, TOPTICA Photonics Inc. (USA); Andreas Brodschelm, Alexander Sell, TOPTICA Photonics AG (Germany) . . . . . [9083-92]

Coffee Break . . . . . Fri 3:00 pm to 3:30 pm

SESSION 10
LOCATION: CONV. CTR. ROOM 336 . . . . . FRI 3:30 PM TO 5:10 PM

NOTE ROOM CHANGE

Micro/Nanotechnologies for Lasers and Standoff Detection II

Joint Session with Conferences 9083/9073/9106

Session Chair: **Michael K. Rafailov,** Univ. of Alberta (Canada)

3:30 pm: **Ultrafast fiber lasers: practical applications** *(Invited Paper)*, Igor Pastirk, TOPTICA Photonics Inc. (USA) . . . . . [9083-93]

3:50 pm: **Standoff laser photoacoustic spectroscopic-based sensor for remote sensing** *(Invited Paper)*, Ramesh C. Sharma, Anil K. Maini, Laser Science and Technology Ctr. (India) . . . . . [9083-94]

4:10 pm: **A mobile platform for infrared photothermal imaging of trace explosives** *(Invited Paper)*, Christopher A. Kendziora, Robert Furstenberg, Michael R. Papantonakis, Viet Nguyen, Jeff M. Byers, R. Andrew McGill, U.S. Naval Research Lab. (USA) . . . . . [9083-95]

4:30 pm: **Point and standoff detection of trace explosives using quantum cascade lasers** *(Invited Paper)*, Seonghwan Kim, Univ. of Calgary (Canada); Dongkyu Lee, Xunchen Liu, Charles W. Van Neste, Thomas G. Thundat, Univ. of Alberta (Canada) . . . . . [9083-96]

4:50 pm: **Recent advances in quantum cascade external cavity laser systems for sensing applications** *(Invited Paper)*, Leigh J. Bromley, David B. Arnone, David B. Caffey, William B. Chapman, Sam Crivello, Timothy Day, Allen Priest, Michael Pushkarsky, Daylight Solutions Inc. (USA); Charles C. Harb, The Univ. of New South Wales (Australia) . . . . . [9083-97]

CONFERENCE 9074

LOCATION: CONV. CTR. ROOM 349

Monday - Tuesday 5 - 6 May 2014 • Proceedings of SPIE Vol. 9074

Sensors, and Command, Control, Communications, and Intelligence (C3I) Technologies for Homeland Security and Homeland Defense XIII

Conference Chair: **Edward M. Carapezza,** EMC Consulting, LLC (USA)

Program Committee: **Zoraida P. Aguilar,** Ocean NanoTech (USA); **John G. Blitch,** Colorado State Univ. (USA); **George Cybenko,** Thayer School of Engineering at Dartmouth (USA); **Panos G. Datskos,** Oak Ridge National Lab. (USA); **Michael J. DeWeert,** BAE Systems (USA); **Susan F. Hallowell,** Transportation Security Lab. (USA), 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 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 349 . . . MON 1:30 PM TO 4:40 PM

Infrastructure Protection and Counter Terrorism Systems and Technologies I

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Tariq Manzur,** Naval Undersea Warfare Ctr. (USA)

1:30 pm: **Inverse synthetic aperture radar imaging for concealed object detection on a naturally walking person**, Andrey Zhuravlev, Sergey I. Ivashov, Vladimir Razevig, Igor Vasiliev, Bauman Moscow State Technical Univ. (Russian Federation) . . . . . [9074-1]

1:50 pm: **Infrared polarimetric sensor for infrastructure protection**, David B. Chenault, Joseph L. Pezzaniti, Polaris Sensor Technologies, Inc. (USA) . [9074-2]

2:10 pm: **A key to success: optimizing the planning process**, Hüseyin Türk, Kamil Karakaya, Harp Akademileri Komutanligi (Turkey) . . . . . [9074-3]

2:30 pm: **Fly eye radar or micro-radar sensor technology**, Pavlo A. Molchanov, Compass Systems, Inc. (USA); Olha V. Asmolova, AETHER Inc. (USA) . . . . . [9074-4]

2:50 pm: **Unattended real-time re-establishment of visibility in high dynamic range video and stills**, Besma R. Abidi, Phelps2020, Inc. (USA) . . . . . [9074-5]

Coffee Break . . . . . Mon 3:10 pm to 3:40 pm

3:40 pm: **Improving performance of EMP surge arrester response time, clamping voltage and joules rating by implementation of primary sensor and a delay line**, Akbar Rahmani-Nejad, Independent Researcher (Iran, Islamic Republic of) . . . . . [9074-6]

4:00 pm: **What are the advantages and disadvantages of centralized control of air power at the operational level?**, Uğur Arisoy, İker Hazinedar, Turkish Air War College (Turkey) . . . . . [9074-7]

4:20 pm: **Analysis of a developed analog trilateration system of impulsive sounds**, Juan M. López R., Jose I. Marulanda, Univ. EAFIT (Colombia) . [9074-8]

Defense + Security Plenary Presentation

MON 5:00 TO 6:00 PM
LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

TUESDAY 6 MAY

SESSION 2

LOCATION: CONV. CTR. ROOM 349 . . . TUE 9:00 AM TO 11:20 AM

Counter Sniper, Small Projectiles, and Gunfire Localization Systems and Technologies

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Tariq Manzur,** Naval Undersea Warfare Ctr. (USA)

9:00 am: **Technology of uncooled fast polycrystalline PbSe focal plane arrays in systems for muzzle flash detection**, Mariusz Kastek, Tadeusz Piatkowski, Henryk Polakowski, Jaroslaw Barela, Krzysztof Firmanty, Piotr Trzaskawka, Military Univ. of Technology (Poland); German Vergara, Rodrigo Linares Herrero, Raul Gutierrez Alvarez, Carlos Fernandez-Montojo, Maria Teresa Montojo Supervielle, New Infrared Technologies, S.L. (Spain) . . . [9074-9]

9:20 am: **Gunshot identification system by integration of open source consumer electronics**, Juan M. López R., Jose I. Marulanda, Univ. EAFIT (Colombia) . . . . . [9074-10]

9:40 am: **Spray-on antisoiling coatings that exhibit high-transparency and mechanical durability**, Daniel Schaeffer, Oak Ridge National Lab. (USA) . . . . . [9074-11]

Coffee/Exhibition Break. . . . . Tue 10:00 am to 10:40 am

10:40 am: **Long-range optical projectile tracking**, Slobodan Rajic, Oak Ridge National Lab. (USA) . . . . . [9074-12]

11:00 am: **Low-cost localization system of impulsive sounds for urban environments**, Juan M. López R., Jose I. Marulanda, Univ. EAFIT (Colombia) . . . . . [9074-13]

SESSION 3

LOCATION: CONV. CTR. ROOM 349 . . TUE 11:20 AM TO 12:00 PM

Cyber Crimes and Cyberterrorism Systems and Technologies

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Tariq Manzur,** Naval Undersea Warfare Ctr. (USA)

11:20 am: **Cyber threat detection and analysis mechanism**, Alexander Milovanov, Leonid Bukshpun, Ranjit D. Pradhan, Physical Optics Corp. (USA) . . . . . [9074-14]

11:40 am: **Securing wireless networks: distributed network intrusion detection**, David Tahmoush, U.S. Army Research Lab. (USA). . . . . [9074-15]

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

SESSION 4
LOCATION: CONV. CTR. ROOM 349 . . . . . TUE 1:30 PM TO 3:10 PM

Information and Communication Systems and Technologies

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr. (USA);
Tariq Manzur, Naval Undersea Warfare Ctr. (USA)

1:30 pm: **A survey on electromagnetic interferences on aircraft avionics systems and a GSM on board system overview**, Peppino Fazio, Natale Vinto, Mauro Tropea, Univ. della Calabria (Italy); Miroslav Voznak, VŠB-Technical Univ. of Ostrava (Czech Republic) . . . . . [9074-16]

1:50 pm: **Term selection for an induction motor via nonlinear Lasso**, Mohammad Rasouli, Penn State Erie, The Behrend College (USA) . . . . [9074-17]

2:10 pm: **A data-delivery system using sensor technology and wireless devices for port security**, Manuel R. Saldaña, Vidya B. Manian, Javier R. Rivera, Univ. de Puerto Rico Mayagüez (USA) . . . . . [9074-18]

2:30 pm: **Smart army helmet: A glitch in what soldier helmets can become in the near future by integrating present technologies**, Gilberto Osorio, Alejandro Mejía, J. Alejandro Betancur, Univ. EAFIT (Colombia) . . . . . [9074-19]

2:50 pm: **Data storage management in a distributed database with deterministic limited communications windows between data storage nodes**, Jeremy Straub, The Univ. of North Dakota (USA). . . . . [9074-20]

Coffee Break . . . . . Tue 3:10 pm to 3:40 pm

SESSION 5
LOCATION: CONV. CTR. ROOM 349 . . . . TUE 3:40 PM TO 5:20 PM

C3I Systems and Technologies

Session Chairs: **Myron E. Hohil,** U.S. Army Armament Research, Development and Engineering Ctr. (USA);
Tariq Manzur, Naval Undersea Warfare Ctr. (USA)

3:40 pm: **Bayesian truthing and experimental validation in homeland security and defense**, Tomasz P. Jannson, Thomas C. Forrester, Andrew A. Kostrzewski, Wenjian Wang, Physical Optics Corp. (USA). . . . . [9074-21]

4:00 pm: **Decision generation tools and Bayesian inference**, Tomasz P. Jannson, Wenjian Wang, Thomas C. Forrester, Andrew A. Kostrzewski, Christian Veeris, Thomasz Nielsen, Physical Optics Corp. (USA) . . . . . [9074-23]

4:20 pm: **Toward an automated checked-baggage inspection system augmented with robots**, Taskin Padir, Mathew P. DeDonato, Velin Dimitrov, Worcester Polytechnic Institute (USA) . . . . . [9074-22]

4:40 pm: **Comprehensive approach**, Ozuz Sayin, Bilal Seymen, Münir Gedikli, Turkish Air War College (Turkey). . . . . [9074-25]

5:00 pm: **Modern air and space power and political goals at war**, Gungor Ozer, Turkish Air Force (Turkey). . . . . [9074-26]

CONFERENCE 9075

LOCATION: CONV. CTR. ROOM 350

Thursday 8 May 2014 • Proceedings of SPIE Vol. 9075

Biometric and Surveillance Technology for Human and Activity Identification XI

Conference Chairs: **Ioannis A. Kakadiaris,** Univ. of Houston (USA); **Walter J. Scheirer,** Harvard Univ. (USA); **Christoph Busch,** Fraunhofer-Institut für Graphische Datenverarbeitung (Germany)

Program Committee: **J. Ross Beveridge,** Colorado State Univ. (USA); **Terrance E. Boult,** Univ. of Colorado at Colorado Springs (USA); **Rama Chellappa,** Univ. of Maryland, College Park (USA); **Bernadette Dorizzi,** TELECOM & Management SudParis (France); **Julian Fierrez,** Univ. Autónoma de Madrid (Spain); **Patrick J. Flynn,** Univ. of Notre Dame (USA); **Brian C. Heflin,** Univ. of Colorado at Colorado Springs (USA); **Ajay Kumar,** The Hong Kong Polytechnic Univ. (Hong Kong, China); **Daniel P. Lopresti,** Lehigh Univ. (USA); **Norman Poh,** Univ. of Surrey (United Kingdom); **Nalini K. Ratha,** IBM Thomas J. Watson Research Ctr. (USA); **Anderson Rocha,** Univ. Estadual de Campinas (Brazil); **Arun A. Ross,** Michigan State Univ. (USA); **Natalia A. Schmid,** West Virginia Univ. (USA); **Stephanie Schuckers,** Clarkson Univ. (USA); **William R. Schwartz,** UFMG (Brazil); **Shishir Shah,** Univ. of Houston (USA); **Kar-Ann Toh,** Yonsei Univ. (Korea, Republic of); **Raymond N. J. Veldhuis,** Univ. Twente (Netherlands); **Ruigang Yang,** Univ. of Kentucky (USA)

THURSDAY 8 MAY

SESSION 1
LOCATION: CONV. CTR. ROOM 350 . . . THU 8:00 AM TO 8:40 AM

Keynote Session I

Session Chair: **Ioannis A. Kakadiaris,** Univ. of Houston (USA)

8:00 am: **Video understanding** *(Keynote Presentation)*, Larry S. Davis, Univ. of Maryland, College Park (USA) . . . . . [9075-1]

SESSION 2
LOCATION: CONV. CTR. ROOM 350 . . . THU 8:40 AM TO 9:40 AM

Fingerprint Biometrics

Session Chair: **Ioannis A. Kakadiaris,** Univ. of Houston (USA)

8:40 am: **Finger image quality based on singular point localization**, Jinghua Wang, Technical Univ. of Denmark (Denmark); Martin A. Olsen, Ctr. for Advanced Security Research Darmstadt (Germany); Christoph Busch, Gjøvik Univ. College (Norway) . . . . . [9075-2]

9:00 am: **On the fly finger knuckle print authentication**, Narishige Abe, Takashi Shinzaki, Fujitsu Labs., Ltd. (Japan) . . . . . [9075-3]

9:20 am: **Interpretation of fingerprint image quality features extracted by self-organizing maps**, Ivan Danov, Technical Univ. of Denmark (Denmark) and Ctr. for Advanced Security Research Darmstadt (Germany); Martin A. Olsen, Ctr. for Advanced Security Research Darmstadt (Germany); Christoph Busch, Gjøvik Univ. College (Norway) . . . . . [9075-4]

POSTER SPOTLIGHTS I
LOCATION: CONV. CTR. ROOM 350 . . 9:40 AM TO 10:00 AM

Authors of posters 9075-14, 15, 16, 17, 23 will give a 4-minute overview of their poster, which can include 1 slide only.

Coffee Break . . . . . Thu 10:00 am to 10:50 am

SESSION 3
LOCATION: CONV. CTR. ROOM 350 . . THU 10:50 AM TO 11:50 AM

Face and Iris Biometrics

Session Chair: **Ioannis A. Kakadiaris,** Univ. of Houston (USA)

10:50 am: **Multimodal biometrics system based on face profile and ear**, Iman S. Youssef, Cairo Univ. (Egypt); Ayman A. Abaza, West Virginia High Technology Consortium Foundation (USA) and Cairo Univ. (Egypt); Mohamed E. Rasmy, Ahmed M. Badawi, Cairo Univ. (Egypt) . . . . . [9075-5]

11:10 am: **3D face recognition based on the hierarchical score-level fusion classifiers**, Štěpán Mráček, Jan Vána, Karolína Lankašová, Martin Drahanský, Michal Doležel, Brno Univ. of Technology (Czech Republic) . . . . . [9075-6]

11:30 am: **A statistical investigation into the stability of iris recognition in diverse population sets**, John Howard, Delores M. Etter, Southern Methodist Univ. (USA) . . . . . [9075-7]

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

SESSION 4
LOCATION: CONV. CTR. ROOM 350 . . . . THU 1:20 PM TO 2:00 PM

Keynote Session II

Session Chair: **Walter J. Scheirer,** Harvard Univ. (USA)

1:20 pm: **Keynote Presentation** *(Keynote Presentation)*, Ross Michaels, National Institute of Standards and Technology (USA) . . . . . [9075-8]

SESSION 5
LOCATION: CONV. CTR. ROOM 350 . . . THU 2:00 PM TO 2:40 PM

Novel Modalities

Session Chair: **Walter J. Scheirer,** Harvard Univ. (USA)

2:00 pm: **Template aging in eye movement-driven biometrics**, Oleg V. Komogortsev, Corey D. Holland, Alex Karpov, Texas State Univ. (USA) . [9075-9]

2:20 pm: **Human thermal modeling to augment MWIR image analysis in surveillance applications**, Renee L. Woodyard, Julie A. Skipper, Wright State Univ. (USA) . . . . . [9075-10]

POSTER SPOTLIGHTS II
LOCATION: CONV. CTR. ROOM 350 . . . .2:40 PM TO 3:00 PM

Authors of posters 9075-18, 19, 20, 21, 22 will give a 4-minute overview of their poster, which can include 1 slide only.

Coffee Break . . . . . Thu 3:00 pm to 3:30 pm

SESSION 6
LOCATION: CONV. CTR. ROOM 350 . . . . THU 3:30 PM TO 4:30 PM

Biometric Security

Session Chair: **Walter J. Scheirer,** Harvard Univ. (USA)

3:30 pm: **Scrambling faces for privacy protection using background self-similarities**, Andrea Melle, Jean-Luc Dugelay, EURECOM (France) . . . [9075-11]

3:50 pm: **Secure fingerprint hashes using subsets of local structures**, Tom Effland, Mariel Schneggenburger, Jim Schuler, Univ. at Buffalo (USA); Bingsheng Zhang, National and Kapodistrian Univ. of Athens (Greece) and Univ. at Buffalo (USA); Jesse L. Hartloff, James Dobler, Sergey Tulyakov, Atri Rudra, Venu Govindaraju, Univ. at Buffalo (USA) . . . . . [9075-12]

4:10 pm: **En-face full-field optical coherence tomography for fast and efficient fingerprints acquisition**, Claude Boccara, Institut Langevin (France); Eugénie Dalimier, Fabrice Harms, LLTECH SAS (France). . . . . [9075-13]

POSTERS-THURSDAY
LOCATION: CONV. CTR. HALL C . . . . . THU 6:00 PM 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 session. 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 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.

Exploiting quality and texture-based characteristics to predict age and gender through fingerprint images, Emanuela Marasco, Luca Lugini, Bojan Cukic, West Virginia Univ. (USA) . . . . . [9075-14]

Robust human facial feature detection on mobile platform for human-robot interaction, Chang-Woo Park, Korea Electronics Technology Institute (Korea, Republic of) . . . . . [9075-15]

Detection of latent fingerprints by near-infrared spectral imaging, Wei Huang, Xiaojing Xu, Guiqiang Wang, Institute of Forensic Science (China) . . . . . [9075-16]

Designing low-cost prosthetic arm, Samira Rezaei, Portland State Univ. (USA); Frank Fields, Portland State Univ. (USA) and Mt. Tabor Middle School (USA); Tamara DePue, Marek A. Perkowski, Portland State Univ. (USA) [9075-17]

Facial biometrics based on 2D vector geometry, Obaidul Malek, Anastasios Venetsanopoulos, Dimitrios Androutsos, Ryerson Univ. (Canada) . . . . . [9075-18]

Remote authentication using vaulted fingerprint verification, Hamdan A. Alzahrani, Terrance E. Boult, Univ. of Colorado at Colorado Springs (USA) . . . . . [9075-21]

Mobile user identity sensing using the motion sensor, Xi Zhao, Tao Feng, Weidong Shi, Univ. of Houston (USA) . . . . . [9075-22]

Biometric recognition via fixation density maps, Ioannis Rigas, Oleg V. Komogortsev, Texas State Univ. (USA). . . . . [9075-23]

CONFERENCE 9076

LOCATION: CONV. CTR. ROOM 326

Wednesday - Thursday 7 - 8 May 2014 • Proceedings of SPIE Vol. 9076

Airborne Intelligence, Surveillance, Reconnaissance (ISR) Systems and Applications XI

Conference Chair: **Daniel J. Henry,** Rockwell Collins, Inc. (USA)

Conference Co-Chairs: **Davis A. Lange,** UTC Aerospace Systems (USA); **Dale Linne von Berg,** U.S. Naval Research Lab. (USA); **S. Danny Rajan,** Exelis Inc. (USA); **Thomas J. Walls,** U.S. Naval Research Lab. (USA); **Darrell L. Young,** Raytheon Intelligence & Information Systems (USA)

WEDNESDAY 7 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 326 . . . WED 1:20 PM TO 2:40 PM

ISR Image Processing

Session Chair: **Sreekanth Danny Rajan,**
Exelis Visual Information Solutions (USA)

1:20 pm: **High-performance electronic image stabilisation for shift and rotation correction**, Steve J. Parker, RFEL Ltd. (United Kingdom); Duncan L. Hickman, Tektonex Ltd. (United Kingdom); Fan Wu, RFEL Ltd. (United Kingdom) . . . . . [9076-2]

1:40 pm: **Identification of spatially corresponding imagery using content-based image retrieval in the context of UAS video exploitation**, Stefan T. Bruestle, Daniel Manger, Klaus Mueck, Norbert F. Heinze, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [9076-3]

2:00 pm: **Meta-image navigation augmenters for GPS denied mountain navigation of small UAS**, Koray Celik, Teng Wang, Iowa State Univ. (USA); Bernard A. Schnaufer, Patrick Y. Hwang, Rockwell Collins, Inc. (USA); Arun K. Somani, Iowa State Univ. (USA); Gary A. McGraw, Jeremy E. Nadke, Rockwell Collins, Inc. (USA) . . . . . [9076-4]

2:20 pm: **Parallax visualization of full motion video using the Pursuer GUI**, Christopher A. Mayhew, Mark B. Forgus, Vision III Imaging, Inc. (USA). . [9076-5]

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

SESSION 2

LOCATION: CONV. CTR. ROOM 326 . . . WED 3:40 PM TO 5:20 PM

ISR Video Processing

Session Chair: **Darrell L. Young,**
Raytheon Intelligence & Information Systems (USA)

3:40 pm: **Effect of video decoder errors on video interpretability**, Darrell L. Young, Raytheon Intelligence & Information Systems (USA) . . . . . [9076-6]

4:00 pm: **Multiframe image processing with panning cameras and moving subjects**, Aaron L. Paolini, Petersen F. Curt, John R. Humphrey Jr., Eric J. Kelmelis, EM Photonics, Inc. (USA). . . . . [9076-7]

4:20 pm: **Marine object detection in UAV full-motion video**, Shibin Parameswaran, Corey Lane, Bryan Bagnall, Heidi L. Buck, Space and Naval Warfare Systems Ctr. Pacific (USA) . . . . . [9076-8]

4:40 pm: **A comparison of moving object detection methods for real-time moving object detection**, Aditya Roshan, Yun Zhang, Univ. of New Brunswick (Canada) . . . . . [9076-9]

5:00 pm: **Improved frame differencing based moving object detection using feet-step sound**, Aditya Roshan, Yun Zhang, Univ. of New Brunswick (Canada) . . . . . [9076-10]

THURSDAY 8 MAY

SESSION 3

LOCATION: CONV. CTR. ROOM 326 . . . THU 8:20 AM TO 9:20 AM

ISR Strategies and Training

Session Chair: **Daniel J. Henry,** Rockwell Collins, Inc. (USA)

8:20 am: **The trap on the process of modern reconnaissance: reconnaissance gap**, Bekir Arapsun, Adem Bora, Turkish Air Force (Turkey) . . . . . [9076-11]

8:40 am: **Near-space airships against terrorist activities**, Ceylan Kesenek, Harp Akademileri Komutanligi (Turkey) . . . . . [9076-12]

9:00 am: **IITET and shadow TT: an innovative approach to training at the point of need**, Andy W. Gross, Trideum Corp. (USA); Susan Harkrider, Christopher M. May, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Favio Lopez, Trideum Corp. (USA); Stephen Berglie, KINEX (USA); James Dirkse, Darran Anderson, Trideum Corp. (USA) . . . . . [9076-13]

SESSION 4

LOCATION: CONV. CTR. ROOM 326 . . THU 9:20 AM TO 10:20 AM

ISR Optics and Gimbals

Session Chair: **Davis A. Lange,** UTC Aerospace Systems (USA)

9:20 am: **Line-of-sight pointing and stabilization using gimbaled mirror systems**, Satyam Satyarthi, IJK Controls LLC (USA) . . . . . [9076-14]

9:40 am: **Line-of-sight kinematics and corrections for fast-steering mirrors used in precision pointing and tracking systems**, James M. Hilkert, Univ. of Texas at Dallas (USA) and Alpha-Theta Technologies (USA); Gavin Kanga, Kevin Kinnear, Lockheed Martin Missiles and Fire Control (USA) . . . . . [9076-15]

10:00 am: **Application of phase matching autofocus in airborne long-range oblique photography camera**, Vladimir Petrushevsky, Asaf Guberman, Elbit Systems Electro-Optics El-Op Ltd. (Israel) . . . . . [9076-16]

Coffee/Exhibition Break. . . . . Thu 10:20 am to 11:00 am

SESSION 5

LOCATION: CONV. CTR. ROOM 326 . . THU 11:00 AM TO 12:00 PM

ISR Sensors I

Session Chair: **Thomas J. Walls,** U.S. Naval Research Lab. (USA)

11:00 am: **Automated multi-INT fusion for tactical reconnaissance**, Drew J. Boudreau, Thomas J. Walls, Michael L. Wilson, U.S. Naval Research Lab. (USA); Jonathan R. Haws, Troy Johnson, Brad Petersen, Space Dynamics Lab. (USA) . . . . . [9076-17]

11:20 am: **NV-CMOS HD camera for day/night imaging**, Thomas L. Vogelsong, John R. Tower, Thomas Sudol, Thomas Senko, David Chodelka, SRI International Sarnoff (USA) . . . . . [9076-18]

11:40 am: **Visulaized remote automatic aiming system through cooperative dual-field imaging**, Yuqing He, Kun Huang, Shan Wei, Siyuan Wang, Jing Pan, Beijing Institute of Technology (China) . . . . . [9076-20]

Lunch/Exhibition Break . . . . . Thu 12:00 pm to 1:50 pm

SESSION 6
LOCATION: CONV. CTR. ROOM 326 . . . . THU 1:50 PM TO 2:50 PM

ISR Sensors II

Session Chair: **Dale Linne von Berg,** U.S. Naval Research Lab. (USA)

1:50 pm: **Polarimetric sensor systems for airborne ISR**, David B. Chenault, Joseph L. Pezzaniti, John S. Harchanko, Polaris Sensor Technologies, Inc. (USA) . . . . . [9076-21]

2:10 pm: **Real-time aerial multispectral imaging solutions using dichroic filter arrays**, Dave Fish, John Dougherty, Pixelteq, Inc. (USA). . . . . [9076-22]

2:30 pm: **9-band SWIR multispectral sensor providing full-motion video**, Mary R. Kutteruf, Michael K. Yetzbacher, Andrey V. Kanaev, U.S. Naval Research Lab. (USA); Michael J. DePrenger, Tekla Research, Inc. (USA); Larry Vair, Jeffrey J. Pool, Pixelteq, Inc. (USA) . . . . . [9076-23]

POSTERS-THURSDAY
LOCATION: CONV. CTR. HALL C . . . . . .THU 6:00 PM 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 session. 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 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.

Robust real-time horizon detection in full-motion video, Grace B. Young, La Jolla High School (USA); Bryan Bagnall, Corey Lane, Shibin Parameswaran, Space and Naval Warfare Systems Ctr. Pacific (USA) . . . . . [9076-25]

Fusion of thermal infrared and visible spectrum for robust pedestrian tracking, Moulay A. Akhloufi, Ctr. of Robotics and Vision (Canada) and Laval Univ. (Canada); Abdelhakim Bendada, Xavier P. V. Maldague, Univ. Laval (Canada) . . . . . [9076-26]

GREEN PHOTONICS

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

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CONFERENCE 9077

LOCATION: CONV. CTR. ROOM 322

Monday - Wednesday 5 - 7 May 2014 • Proceedings of SPIE Vol. 9077

Radar Sensor Technology XVIII

Conference Chairs: **Kenneth I. Ranney,** U.S. Army Research Lab. (USA); **Armin Doerry,** Sandia National Labs. (USA)

Program Committee: **Fauzia Ahmad,** Villanova Univ. (USA); **Moeness G. Amin,** Villanova Univ. (USA); **Joseph C. Deroba,** U.S. Army CERDEC Intelligence and Information Warfare Directorate (USA); **Mark Govoni,** U.S. Army CERDEC Intelligence and Information Warfare Directorate (USA); **Majeed Hayat,** The Univ. of New Mexico (USA); **Chandra Kambhamettu,** Univ. of Delaware (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); **Neeraj Magotra,** Western New England Univ. (USA); **Anthony F. Martone,** U.S. Army Research Lab. (USA); **Gregory J. Mazzaro,** The Citadel (USA); **George J. Moussally,** Mirage Systems (USA); **Ram M. Narayanan,** The Pennsylvania State Univ. (USA); **Lam H. Nguyen,** U.S. Army Research Lab. (USA); **Hector A. Ochoa,** The Univ. of Texas at Tyler (USA); **Ann M. Raynal,** Sandia National Labs. (USA); **Jerry Silvious,** U.S. Army Research Lab. (USA); **Brian Smith,** U.S. Army Armament Research, Development and Engineering Ctr. (USA); **David Tahmoush,** U.S. Army Research Lab. (USA); **Berenice Verdin,** The Univ. of Texas at El Paso (USA); **Frank Yakos,** SELEX Galileo, Inc. (USA); **Yan Zhang,** The Univ. of Oklahoma (USA)

MONDAY 5 MAY

LOCATION: CONV. CTR. ROOM 322 . . . . . .8:30 AM TO 8:40 AM

Remarks

Session Chairs: **Armin Doerry,** Sandia National Labs. (USA); **Kenneth I. Ranney,** U.S. Army Research Lab. (USA)

SESSION 1

LOCATION: CONV. CTR. ROOM 322 . MON 8:40 AM TO 10:00 AM

Phenomenology and Technology

Session Chair: **Anthony F. Martone,** U.S. Army Research Lab. (USA)

8:40 am: **FPGA architectures for electronically scanned wideband RF beams using 3D FIR/IIR digital filters for rectangular array aperture receivers**, Sewwandi Wijayaratna, Brandon D. Beall, Arjuna Madanayake, The Univ. of Akron (USA); Len Bruton, Univ. of Calgary (Canada) . . . . . [9077-1]

9:00 am: **Linearization of a harmonic radar transmitter by feed-forward filter reflection**, Kyle A. Gallagher, The Pennsylvania State Univ. (USA); Gregory J. Mazzaro, The Citadel (USA); Kelly D. Sherbondy, U.S. Army Research Lab. (USA); Ram M. Narayanan, The Pennsylvania State Univ. (USA) . . . . . [9077-2]

9:20 am: **Characterization of carbon fiber composite materials for RF applications**, Elliot J. Riley, Erik H. Lenzing, Ram M. Narayanan, The Pennsylvania State Univ. (USA). . . . . [9077-3]

9:40 am: **Tapered slot array antenna design for vehicular GPR applications**, Korkut Yeğin, Yeditepe Univ. (Turkey); Emrullah Bicak, Hakkı Nazlı, Mahmut Dağ, TÜBITAK BILGEM (Turkey). . . . . [9077-4]

Coffee Break . . . . . .Mon 10:00 am to 10:40 am

SESSION 2

LOCATION: CONV. CTR. ROOM 322 . MON 10:40 AM TO 11:50 AM

Programs and Systems

Session Chair: **Gregory J. Mazzaro,** The Citadel (USA)

10:40 am: **Multi-mission, autonomous, synthetic aperture radar**, Thomas J. Walls, Michael L. Wilson, U.S. Naval Research Lab. (USA); David Madsen, Mark D. Jensen, Stephanie W. Sullivan, Space Dynamics Lab. (USA) . . . [9077-5]

11:00 am: **A wideband holographic radar system for multi-dimensional high-resolution imaging**, Scott A. Wilson, Ram M. Narayanan, The Pennsylvania State Univ. (USA). . . . . [9077-7]

11:20 am: **Design and performance of an ultra-wideband stepped-frequency radar with precise frequency control for landmine and IED detection**, Brian R. Phelan, The Pennsylvania State Univ. (USA); Kelly D. Sherbondy, Kenneth I. Ranney, U.S. Army Research Lab. (USA); Ram M. Narayanan, The Pennsylvania State Univ. (USA). . . . . [9077-8]

Lunch Break . . . . . .Mon 11:40 am to 1:30 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 322 . . . . MON 1:30 PM TO 3:10 PM

Algorithms and Processing I

Session Chair: **Seong-Hwoon Kim,** Raytheon Space & Airborne Systems (USA)

1:30 pm: **Design of a synthetic aperture radar synthetic scene generator**, Cameron Musgrove, Richard M. Naething, John Schilling, Sandia National Labs. (USA) . . . . . [9077-10]

1:50 pm: **Improving target position and velocity estimation for air-to-air radar**, Guoqing Liu, Naiel K. Askar, General Atomic Systems, Inc. (USA) [9077-11]

2:10 pm: **Identification of maritime target objects from high resolution TerraSAR-X data using SAR simulation**, Harald Anglberger, Helmut Suess, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [9077-12]

2:30 pm: **A complete ensemble empirical mode decomposition for GPR signal time-frequency analysis**, Jing Li, Fengshan Liu, Delaware State Univ. (USA) . . . . . [9077-13]

2:50 pm: **Spectrum sensing techniques for nonlinear radar**, Anthony F. Martone, Kenneth I. Ranney, U.S. Army Research Lab. (USA); Gregory J. Mazzaro, The Citadel (USA); David McNamara, U.S. Army Research Lab. (USA) . . . . . [9077-66]

Coffee Break . . . . . .Mon 3:10 pm to 3:40 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 322 . . . MON 3:40 PM TO 4:40 PM

Algorithms and Processing II

Session Chair: **Jerry L. Silvious,** U.S. Army Research Lab. (USA)

3:40 pm: **Indoor clutter spectral characteristics and radar waveform design**, Travis D. Bufler, Ram M. Narayanan, Erik H. Lenzing, The Pennsylvania State Univ. (USA); Traian V. Dogaru, U.S. Army Research Lab. (USA). . . . . [9077-15]

4:00 pm: **Textural feature selection for enhanced detection of stationary humans in through-the-wall radar imagery**, Ahmad Chaddad, Fauzia Ahmad, Moeness G. Amin, Villanova Univ. (USA); Pascale Sevigny, David J. DiFilippo, Defence Research and Development Canada (Canada). . . . . [9077-16]

4:20 pm: **High-order approximation compact schemes for forward subsurface scattering problems**, Yury A. Gryazin, Idaho State Univ. (USA) . . . . . [9077-17]

Defense + Security Plenary Presentation

MON 5:00 TO 6:00 PM

LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

TUESDAY 6 MAY

SESSION 5
LOCATION: CONV. CTR. ROOM 322 . . TUE 8:00 AM TO 10:00 AM

Noise and Low-Probability of Intercept Radar

Session Chair: **Yan Zhang,** The Univ. of Oklahoma (USA)

8:00 am: **GNSS-based passive airborne radar: Hybrid-aperture sensing and airborne test plans**, Yan Zhang, Hernan Suarez, Randall Silver, Yih-Ru Huang, The Univ. of Oklahoma (USA) . . . . . [9077-18]

8:20 am: **A universal hardware-based adaptive correlation receiver architecture**, Hernan Suarez, Zaidi Zhu, Yan Zhang, The Univ. of Oklahoma (USA) . . . . . [9077-19]

8:40 am: **Ultra-wideband noise radar imaging of a cylindrical PEC object using diffraction tomography**, Hee Jung Shin, Ram M. Narayanan, The Pennsylvania State Univ. (USA); Muralidhar Rangaswamy, Air Force Research Lab. (USA) . . . . . [9077-20]

9:00 am: **SAR image quality using advanced pulse compression noise (APCN)**, Mark A. Govoni, Ryan A. Elwell, U.S. Army Research, Development and Engineering Command (USA) . . . . . [9077-21]

9:20 am: **Influence of signal parameters in noise radar sensor technologies used for sensing through dispersive media**, Ana V. Alejos, Muhammad Dawood, New Mexico State Univ. (USA) . . . . . [9077-22]

9:40 am: **Superresolution processing for multifunctional LPI waveforms**, Zhengzheng Li, Shang Wang, Jingxiao Cai, Yan Zhang, The Univ. of Oklahoma (USA) . . . . . [9077-23]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

SESSION 6
LOCATION: CONV. CTR. ROOM 322 . . TUE 10:30 AM TO 11:50 AM

Multiple Apertures and MIMO

Session Chair: **Mark A. Govoni,** U.S. Army CERDEC Intelligence and Information Warfare Directorate (USA)

10:30 am: **A combined STAP/DPCA algorithm for enhanced endoclutter target detection**, Thomas E. Medl, General Atomics Aeronautical Systems, Inc. (USA) . . . . . [9077-24]

10:50 am: **Image reconstruction and compressed sensing in MIMO radar**, Jacob Banda, Fernando Cavazos, Qitong Li, Alejandro F. Martinez, Zhijun G. Qiao, The Univ. of Texas-Pan American (USA) . . . . . [9077-26]

11:10 am: **Optimal waveform design under employment of generalized detector in MIMO radar systems**, Vyacheslav P. Tuzlukov, Kyungpook National Univ. (Korea, Republic of) . . . . . [9077-27]

11:30 am: **Indoor facility for airborne synthetic aperture radar (SAR) explosive hazard experimentation: rail-SAR**, Getachew A. Kirose, U.S. Army Research Lab. (USA); Brian R. Phelan, The Pennsylvania State Univ. (USA); Kelly D. Sherbondy, Kenneth I. Ranney, Francois J. Koenig, U.S. Army Research Lab. (USA); Ram M. Narayanan, The Pennsylvania State Univ. (USA) . . . . . [9077-28]

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

SESSION 7
LOCATION: CONV. CTR. ROOM 322 . . . . TUE 1:20 PM TO 3:00 PM

Applications and Exploitation

Session Chair: **Ann M. Raynal,** Sandia National Labs. (USA)

1:20 pm: **Superpixel segmentation using multiple SAR image products**, Mary M. Moya, Mark W. Koch, Roger D. West, David N. Perkins, Sandia National Labs. (USA) . . . . . [9077-29]

1:40 pm: **Detection and tracking of personnel using a high-speed 94 GHz surveillance radar**, David G. Macfarlane, Duncan A. Robertson, Univ. of St. Andrews (United Kingdom); Ben Jones, Anthony S. Clark, Home Office Ctr. for Applied Science and Technology (United Kingdom). . . . . [9077-30]

2:00 pm: **Design considerations for quantum radar implementation**, Matthew J. Bradsema, Ram M. Narayanan, Erik H. Lenzing, The Pennsylvania State Univ. (USA); Marco Lanzagorta, U.S. Naval Research Lab. (USA) [9077-31]

2:20 pm: **Stepped-frequency nonlinear radar simulation**, Gregory J. Mazzaro, The Citadel (USA); Kyle A. Gallagher, The Pennsylvania State Univ. (USA); Anthony F. Martone, U.S. Army Research Lab. (USA); Ram M. Narayanan, The Pennsylvania State Univ. (USA). . . . . [9077-32]

2:40 pm: **Determining snow depth using Ku-band interferometric synthetic aperture radar (InSAR)**, Jack R. Evans, Fred A. Kruse, Naval Postgraduate School (USA); Douglas L. Bickel, Sandia National Labs. (USA); Ralf Dunkel, General Atomics Aeronautical Systems, Inc. (USA) . . . . . [9077-25]

Coffee Break . . . . . Tue 3:00 pm to 3:30 pm

SESSION 8
LOCATION: CONV. CTR. ROOM 322 . . . . TUE 3:30 PM TO 5:50 PM

Medical Application of Radar

Session Chair: **Ram M. Narayanan,** The Pennsylvania State Univ. (USA)

3:30 pm: **Medical radar considerations for detecting Crohn's disease**, Sonny Smith, Ram M. Narayanan, The Pennsylvania State Univ. (USA); Evangelos Messaris, Penn State Milton S. Hershey Medical Ctr. (USA). [9077-33]

3:50 pm: **Development of wearable microwave bladder monitor for the management and treatment of urinary incontinence**, Finn P. Krewer, Fearghal Morgan, Edward Jones, Martin Glavin, Martin O'Halloran, National Univ. of Ireland, Galway (Ireland). . . . . [9077-34]

4:10 pm: **Development of anatomically and dielectrically accurate breast phantoms for microwave breast imaging applications**, Martin O'Halloran, Stefan Lohfeld, National Univ. of Ireland, Galway (Ireland); Giuseppe Ruvio, Univ. de Lisboa (Portugal); Finn P. Krewer, C. O. Ribeiro, V. C. Inácio Pita, National Univ. of Ireland, Galway (Ireland); Raquel C. Conceicao, Univ. de Lisboa (Portugal); Edward Jones, Martin Glavin, National Univ. of Ireland, Galway (Ireland). . . . . [9077-35]

4:30 pm: **Estimation of respiratory rhythm during night sleep using a bio-radar**, Alexander Tataraidze, Lesya Anishchenko, Maksim Alekhin, Bauman Moscow State Technical Univ. (Russian Federation); Lyudmila Korostovtseva, Yurii Sviryaev, Almazov Federal Heart, Blood & Endocrinology Ctr. (Russian Federation) . . . . . [9077-36]

4:50 pm: **Simulation of holographic radar application in detection of breast tumors**, Irina Alborova, Lesya Anishchenko, Bauman Moscow State Technical Univ. (Russian Federation). . . . . [9077-37]

5:10 pm: **Comparison between UWB and CW radar sensors for breath activity monitoring**, Stefano Pisa, Paolo Bernardi, Renato Cicchetti, Roberto Giusto, Erika Pittella, Emanuele Piuzzi, Orlandino Testa, Univ. degli Studi di Roma La Sapienza (Italy) . . . . . [9077-38]

5:30 pm: **Fall detection and classifications based on time-scale radar signal characteristics**, Ajay Gadde, Moeness G. Amin, Yimin D. Zhang, Fauzia Ahmad, Villanova Univ. (USA) . . . . . [9077-39]

POSTERS-TUESDAY
LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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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Some comments on performance requirements for DMTI radar, Armin W. Doerry, Douglas L. Bickel, Ann M. Raynal, Sandia National Labs. (USA)[9077-55]

Backprojection for GMTI processing, Armin W. Doerry, Sandia National Labs. (USA) . . . . . [9077-56]

Correcting radar range measurements for atmospheric propagation effects, Armin W. Doerry, Sandia National Labs. (USA). . . . . [9077-57]

Digital synthesis of linear-FM chirp waveforms: comments on performance and enhancements, Armin W. Doerry, Sandia National Labs. (USA); John M. Andrews, Stephen M. Buskirk, General Atomics Aeronautical Systems, Inc. (USA). . . . . [9077-58]

A novel approach in automatic estimation of rats loco-motor activity, Lesya Anishchenko, Sergey I. Ivashov, Igor Vasiliev, Bauman Moscow State Technical Univ. (Russian Federation). . . . . [9077-59]

CONFERENCE 9077
LOCATION: CONV. CTR. ROOM 322

Application of step-frequency radars in medicine, Lesya Anishchenko, Maksim Alekhin, Alexander Tataraidze, Sergey I. Ivashov, Bauman Moscow State Technical Univ. (Russian Federation); Francesco Soldovieri, Istituto per il Rilevamento Elettromagnetico dell'Ambiente (Italy); Alexander S. Bugaev, Bauman Moscow State Technical Univ. (Russian Federation) . . . . . [9077-60]

Distortion effects in a switch array UWB radar for time-lapse imaging of human heartbeats, Sverre Brovoll, Tor Berger, Øyvind Aardal, Forsvarets Forsknings Institute (Norway); Tor S. Lande, Univ. I Oslo (Norway); Svein-Erik Hamran, Forsvarets Forsknings Institute (Norway) and Univ. I Oslo (Norway) . . . . . [9077-61]

Regularized Burg algorithm for small sample-size space-time adaptive processing, Bhashyam Balaji, Defence Research and Development Canada (Canada); Alexis Decurninge, Frederic Barbaresco, Thales Air Systems S.A. (France) . . . . . [9077-62]

Radar measurements of moving objects around corners in a realistic scene, Tommy Johansson, Anders Örbom, Ain Sume, Jonas Rahm, Stefan L. Nilsson, Magnus Herberthson, Magnus Gustafsson, Åsa Andersson, Swedish Defence Research Agency (Sweden) . . . . . [9077-63]

Investigations of probabilistic data association class of multiple target tracking algorithms for airborne ground moving target indication radars, Bhashyam Balaji, Defence Research and Development Canada (Canada); Kai Wang, MDA Systems Ltd. (Canada) . . . . . [9077-64]

Power-line characterization from an airborne data collection with a millimeter-wave radar, Darren S. Goshi, Long Bui, Honeywell International Inc. (USA) . . . . . [9077-65]

Detection of exudates in fundus imagery using a constant false-alarm rate (CFAR) detector, Elina Kapoor, Manish Khanna, The Sinus Institute of Northern Virginia (USA). . . . . [9077-68]

WEDNESDAY 7 MAY

SESSION 9
LOCATION: CONV. CTR. ROOM 322 . WED 8:00 AM TO 10:00 AM

Radar Micro-Doppler Signatures I

Joint Session with Conferences 9077 and 9082

Session Chair: **Ram M. Narayanan,** The Pennsylvania State Univ. (USA)

8:00 am: **Performance bounds on micro-Doppler estimation and adaptive waveform design using OFDM signals**, Satyabrata Sen, Jacob Barhen, Charles W. Glover, Oak Ridge National Lab. (USA) . . . . . [9077-40]

8:20 am: **Characterization of micro-Doppler radar signature of commercial wind turbines**, Fanxing Kong, Yan Zhang, Robert Palmer, The Univ. of Oklahoma (USA) . . . . . [9077-41]

8:40 am: **Micro-Doppler classification of rider and riderless horses**, David Tahmoush, U.S. Army Research Lab. (USA). . . . . [9077-42]

9:00 am: **Effect of wind turbine micro-Doppler on SAR and GMTI signatures**, Rajan Bhalla, Leidos (USA); Hao Ling, The Univ. of Texas at Austin (USA) . . . . . [9077-43]

9:20 am: **Detection of small UAV helicopters using micro-Doppler**, David Tahmoush, U.S. Army Research Lab. (USA). . . . . [9077-44]

9:40 am: **Extracting radar micro-Doppler signatures of helicopter rotating rotor blades using K-band radars**, Rachel Chen, Baokun Liu, Ancortek Inc. (USA) . . . . . [9082-1]

Coffee Break . . . . . .Wed 10:00 am to 10:30 am

SESSION 10
LOCATION: CONV. CTR. ROOM 322 . WED 10:30 AM TO 12:30 PM

Radar Micro-Doppler Signatures II

Joint Session with Conferences 9077 and 9082

Session Chair: **David Tahmoush,** U.S. Army Research Lab. (USA)

10:30 am: **Software-defined radar and waveforms for studying micro-Doppler signatures**, Baokun Liu, Rachel Chen, Ancortek Inc. (USA) . . [9077-45]

10:50 am: **Very low-phase noise, coherent 94 GHz radar for micro-Doppler and vibrometry studies**, Duncan A. Robertson, Univ. of St. Andrews (United Kingdom); Graham M. Brooker, The Univ. of Sydney (Australia); Patrick D. L. Beasley, QinetiQ Ltd. (United Kingdom) . . . . . [9077-46]

11:10 am: **Comparative of signal processing techniques for micro-Doppler signature extraction with automotive radar systems**, Berta Rodriguez Hervas, The Univ. of Texas at El Paso (USA) and Mercedes-Benz Research & Development North America, Inc. (USA); Michael Maile, Mercedes-Benz Research & Development North America, Inc. (USA); Benjamin C. Flores, The Univ. of Texas at El Paso (USA) . . . . . [9077-47]

11:30 am: **Stationary and moving target shadow characteristics in synthetic aperture radar**, Ann M. Raynal, Douglas L. Bickel, Armin W. Doerry, Sandia National Labs. (USA) . . . . . [9077-48]

11:50 am: **Extremely high-frequency micro-Doppler measurements of humans**, Charles R. Dietlein, Abigail S. Hedden, U.S. Army Research Lab. (USA); Jeremy A. Green, Univ. of Maryland, College Park (USA); Jerry L. Silvious, David A. Wikner, U.S. Army Research Lab. (USA) . . . . . [9077-49]

12:10 pm: **Determining human target orientation and classifying human motion using bistatic radar micro-Doppler signals**, Dustin P. Fairchild, Ram M. Narayanan, The Pennsylvania State Univ. (USA). . . . . [9082-2]

Lunch/Exhibition . . . . . .Wed 12:30 pm to 1:40 pm

SESSION 11
LOCATION: CONV. CTR. ROOM 322 . . . WED 1:40 PM TO 3:20 PM

Compressive Sensing for Radar I

Joint Session with 9077 and 9109

Session Chair: **Lam H. Nguyen,** U.S. Army Research Lab. (USA)

1:40 pm: **SAR moving target imaging in complex scenes using sparse and low-rank decomposition**, Kang-Yu Ni, Shankar R. Rao, HRL Labs., LLC (USA) . . . . . [9077-50]

2:00 pm: **Lidar compressive sensing using chaotic waveform**, Berenice Verdin, Ricardo von Borries, The Univ. of Texas at El Paso (USA) . . . . . [9077-51]

2:20 pm: **Off-grid compressive sensing ultra-wideband radar imaging**, Shugao Xia, Delaware State Univ. (USA) . . . . . [9077-52]

2:40 pm: **Wideband aperture array using RF channelizers and massively-parallel digital 2D IIR filterbank**, Arindam Sengupta, Arjuna Madanayake, The Univ. of Akron (USA); Roberto Gómez-García, Univ. de Alcalá (Spain); Erik Engeberg, The Univ. of Akron (USA) . . . . . [9077-53]

3:00 pm: **Signal processing techniques for stepped frequency ultra-wideband radar**, Lam H. Nguyen, U.S. Army Research Lab. (USA) . . . [9077-54]

Coffee Break . . . . . .Wed 3:20 pm to 3:50 pm

SESSION 12
LOCATION: CONV. CTR. ROOM 322 . . . WED 3:50 PM TO 5:30 PM

Compressive Sensing for Radar II

Joint Session with 9077 and 9109

Session Chair: **Eric L. Mokole,** U.S. Naval Research Lab. (USA)

3:50 pm: **Multi-static passive SAR imaging based on Bayesian compressive sensing**, Qisong Wu, Yimin D. Zhang, Moeness G. Amin, Villanova Univ. (USA); Braham Himed, Air Force Research Lab. (USA) . . . . . [9109-1]

4:10 pm: **Multi-target compressive laser ranging**, Pushkar P. Pandit, Zeb Barber, W. Randall Babbitt, Jason Dahl, Montana State Univ. (USA). . . . [9109-2]

4:30 pm: **Sparsity-based ranging for dual-frequency radars**, Khodour Al Kadry, Moeness G. Amin, Fauzia Ahmad, Villanova Univ. (USA) . . . . . [9109-3]

4:50 pm: **Experimental results concerning compressive noise radar**, Mahesh C. Shastry, 3M Co. (USA); Ram M. Narayanan, The Pennsylvania State Univ. (USA); Muralidhar Rangaswamy, Air Force Research Lab. (USA). . . . . [9109-4]

5:10 pm: **Through-the-wall imaging using CS-MIMO radars**, Yao Yu, Rutgers, The State Univ. of New Jersey (USA); Fauzia Ahmad, Villanova Univ. (USA); Athina P. Petropulu, Rutgers, The State Univ. of New Jersey (USA); Moeness G. Amin, Villanova Univ. (USA). . . . . [9109-5]

CONFERENCE 9078

LOCATION: CONV. CTR. ROOM 316

Thursday - Friday 8 - 9 May 2014 • Proceedings of SPIE Vol. 9078

Passive and Active Millimeter-Wave Imaging XVII

Conference Chairs: **David A. Wikner,** U.S. Army Research Lab. (USA); **Arttu R. Luukanen,** Asgella Corp. (Finland)

Program Committee: **Roger Appleby,** Queen's Univ. Belfast (United Kingdom); **Erich N. Grossman,** National Institute of Standards and Technology (USA); **Christopher A. Martin,** Trex Enterprises Corp. (USA); **Duncan A. Robertson,** Univ. of St. Andrews (United Kingdom); **Bruce Wallace,** Defense Advanced Research Projects Agency (USA)

THURSDAY 8 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 316 . . THU 8:00 AM TO 10:00 AM

Systems and Phenomenology I

Session Chair: **Arttu R. Luukanen,**
VTT Technical Research Ctr. of Finland (Finland)

8:00 am: **TeraSCREEN: multi-frequency multi-mode Terahertz screening for border checks**, Naomi E. Alexander, Alfa Imaging S.A. (Spain); Byron Alderman, Teratech Components Ltd. (United Kingdom); Fernando Allona Alberich, Alfa Imaging S.A. (Spain); Peter M. Frijlink, OMMIC (France); Ramon Gonzalo, Univ. Pública de Navarra (Spain); Manfred Hägelen, Fraunhofer FHR (Germany); Asier Ibáñez, Anteral S.L. (Spain); Viktor Krozer, Johann Wolfgang Goethe-Univ. Frankfurt am Main (Germany); Marian L. Langford, ICTS (UK) Ltd. (United Kingdom); Ernesto Limiti, Univ. degli Studi di Roma Tor Vergata (Italy); Duncan Platt, Acreo AB (Sweden); Marek Schikora, Fraunhofer FKIE (Germany); Hui Wang, Rutherford Appleton Lab. (United Kingdom); Marc Andree Weber, Albert-Ludwigs-Univ. Freiburg (Germany). . . . . [9078-1]

8:20 am: **Determination of truckload by microwave and millimeter-wave imaging**, Markus Peichl, Stephan Dill, Timo M. Kempf, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [9078-2]

8:40 am: **Standoff passive video imaging at 350 GHz with 251 superconducting detectors**, Daniel T. Becker, National Institute of Standards and Technology (USA); Cale Gentry, Univ. of Colorado (USA); Ilya Smirnov, Univ. of Maryland (USA); James A. Beall, Hsiao-Mei Cho, William D. Duncan, Dale Li, Gene C. Hilton, National Institute of Standards and Technology (USA); Kent D. Irwin, Stanford Univ. (USA); Nicholas G. Paulter Jr., Carl D. Reintsema, Robert E. Schwall, National Institute of Standards and Technology (USA); Peter A. Ade, Carole E. Tucker, Cardiff Univ. (United Kingdom); Simon R. Dicker, Univ. of Pennsylvania (USA); Mark Halpern, The Univ. of British Columbia (Canada) . . . . . [9078-3]

9:00 am: **Concealed threat detection with the IRAD submillimeter-wave 3D imaging radar**, Duncan A. Robertson, Scott L. Cassidy, Univ. of St. Andrews (United Kingdom); Ben Jones, Anthony S. Clark, Home Office Ctr. for Applied Science and Technology (United Kingdom) . . . . . [9078-4]

9:20 am: **Improvements to the design process for a real-time passive millimetre-wave imager to be used for base security and helicopter navigation in degraded visual environments**, Rupert N. Anderton, Colin D. Cameron, James G. Burnett, QinetiQ Ltd. (United Kingdom); Jeff J. Guell, The Boeing Co. (USA); Jack Sanders-Reed, Boeing-SVS, Inc. (USA) . . . . . [9078-5]

9:40 am: **Reflectarray design and its element characterization at millimeter wavelengths**, Aleksi A. Tamminen, Juha Ala-Laurinaho, Tom F. Gallacher, Antti V. Räisänen, Aalto Univ. School of Science and Technology (Finland). . . . . [9078-6]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

SESSION 2

LOCATION: CONV. CTR. ROOM 316 . . THU 10:30 AM TO 12:10 PM

Systems and Phenomenology II

Session Chair: **Duncan A. Robertson,**
Univ. of St. Andrews (United Kingdom)

10:30 am: **Progress in passive submillimeter-wave video imaging**, Erik Heinz, Supracon AG (Germany) and Institut für Photonische Technologien e.V. (Germany); Torsten May, Detlef Born, Gabriel Zieger, Katja Peiselt, Institut für Photonische Technologien e.V. (Germany); Vyacheslav Zakosarenko, Supracon AG (Germany) and Institut für Photonische Technologien e.V. (Germany); Torsten Krause, André Krüger, Marco Schulz, Frank Bauer, Hans-Georg Meyer, Institut für Photonische Technologien e.V. (Germany) . . . . . [9078-7]

10:50 am: **Passive 670 GHz imaging with uncooled low-noise HEMT amplifiers coupled to zero-bias diodes**, Erich N. Grossman, National Institute of Standards and Technology (USA); Xiaobing Mei, Kevin M. Leong, Northrop Grumman Corp. (USA); William R. Deal, Northrop Grumman Aerospace Systems (USA) . . . . . [9078-8]

11:10 am: **Surface and volumetric backscattering at millimeter-wave and terahertz frequencies**, David A. DiGiovanni, Andrew J. Gatesman, Robert H. Giles, Univ. of Massachusetts Lowell (USA); William E. Nixon, National Ground Intelligence Ctr. (USA); Thomas M. Goyette, Univ. of Massachusetts Lowell (USA) . . . . . [9078-9]

11:30 am: **650 GHz bistatic scattering measurements on human skin**, Richard A. Chamberlin, Erich N. Grossman, Natalie Mujica-Schwahn, National Institute of Standards and Technology (USA). . . . . [9078-10]

11:50 am: **Large distance 3D imaging of hidden objects**, Daniel Rozban, Ariel Univ. (Israel); Natan S. Kopeika, Ben-Gurion Univ. of the Negev (Israel); Amir Abramovich III, Ariel Univ. (Israel); Avihai Aharon Akram, Assaf Levanon, Ben-Gurion Univ. of the Negev (Israel) . . . . . [9078-11]

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

SESSION 3

LOCATION: CONV. CTR. ROOM 316 . . . . .THU 1:30 PM TO 3:10 PM

Device Technology

Session Chair: **Roger Appleby,** Queen's Univ. Belfast (United Kingdom)

1:30 pm: **Spatially selective mirror for compressive sensing imaging system**, Steven T. Griffin, The Univ. of Memphis (USA). . . . . [9078-12]

1:50 pm: **A millimeter-wave lithographic imaging spectrometer**, Justus A. Brevik, National Institute of Standards and Technology (USA). . . . . [9078-14]

2:10 pm: **Polarization effects on heterodyne detection and imaging using glow discharge detector at millimeter wavelengths**, Avihai Aharon Akram, Ben-Gurion Univ. of the Negev (Israel) and Ariel Univ. (Israel); Daniel Rozban, Assaf Levanon, Ben-Gurion Univ. of the Negev (Israel); Amir Abramovich III, Ariel Univ. (Israel); Natan S. Kopeika, Ben-Gurion Univ. of the Negev (Israel) . . . . . [9078-15]

2:30 pm: **Sensor for the microwave imaging system based on Josephson Junction**, Lijia Chen, Jiaran Qi, Nannan Wan, Jinghui Qiu, Alexander Denisov, Harbin Institute of Technology (China) . . . . . [9078-16]

2:50 pm: **Design and operation of ACTPol: a millimeter wavelength polarization sensitive receiver for the Atacama Cosmology Telescope**, Benjamin L. Schmitt, Univ. of Pennsylvania (USA) and for the ACTPol Collaboration (USA). . . . . [9078-17]

Coffee Break . . . . . Thu 3:10 pm to 3:40 pm

CONFERENCE 9078

LOCATION: CONV. CTR. ROOM 316 & ROOM 336

SESSION 4

LOCATION: CONV. CTR. ROOM 316 . . . .THU 3:40 PM TO 5:00 PM

Signal Processing

Session Chair: **David A. Wikner,** U.S. Army Research Lab. (USA)

3:40 pm: **Reconstruction techniques for sparse multistatic linear array microwave imaging**, David M. Sheen, Thomas E. Hall, Pacific Northwest National Lab. (USA) . . . . . [9078-18]

4:00 pm: **Investigation of radio astronomy image processing techniques for use in the passive millimetre-wave security screening environment**, Christopher T. Taylor, The Univ. of Manchester (United Kingdom); Simon J. Hutchinson, Neil A. Salmon, Manchester Metropolitan Univ. (United Kingdom); Peter N. Wilkinson, The Univ. of Manchester (United Kingdom); Colin D. Cameron, QinetiQ Ltd. (United Kingdom) . . . . . [9078-19]

4:20 pm: **DFT calculated THz absorption spectra of water clusters**, Lulu Huang, Samuel G. Lambrakos, U.S. Naval Research Lab. (USA); Andrew Shabaev, George Mason Univ. (USA); Noam Bernstein, U.S. Naval Research Lab. (USA); Lou Massa, Hunter College (USA) . . . . . [9078-21]

4:40 pm: **Temperature resolution enhancing of commercially available THz passive cameras due to computer processing of images**, Vyacheslav A. Trofimov, Vladislav V. Trofimov, Igor E. Kuchik, Lomonosov Moscow State Univ. (Russian Federation) . . . . . [9078-22]

POSTERS-THURSDAY

LOCATION: CONV. CTR. HALL C . . . . . .THU 6:00 PM 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 session. 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 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.

Gaussian mixture and clustering of hidden objects with multichannel passive millimeter wave imaging, Seokwon Yeom, Dong-Su Lee, Daegu Univ. (Korea, Republic of) . . . . . [9078-25]

FRIDAY 9 MAY

SESSION 5

LOCATION: CONV. CTR. ROOM 336 . . FRI 10:50 AM TO 12:00 PM

NOTE ROOM CHANGE

Nanotechnology for Millimeter-Wave Sensing I

Joint Session with Conferences 9083 and 9078

Session Chair: **Michael K. Rafailov,** Univ. of Alberta (Canada)

10:50 am: **Terahertz electronics for sensing applications** *(Keynote Presentation)*, Michael S. Shur, Rensselaer Polytechnic Institute (USA). [9083-86]

11:20 am: **Analysis of sub-THz atmospheric data from transmissometer and radar sensors** *(Invited Paper)*, Lawrence Scally, Jason Fritz, Colorado Engineering, Inc. (USA); Albin J. Gasiewski, Univ. of Colorado at Boulder (USA) . . . . . [9083-87]

11:40 am: **mmW staring focal plane arrays for security applications** *(Invited Paper)*, Michael A. Gritz, Leonard P. Chen, Borys Kolasa, Robert Burkholder, Sean F. Harris, Raytheon Co. (USA); Brian A. Lail, Florida Institute of Technology (USA) . . . . . [9083-88]

SESSION 6

LOCATION: CONV. CTR. ROOM 336 . . . . .FRI 1:00 PM TO 2:00 PM

NOTE ROOM CHANGE

Nanotechnology for Millimeter-Wave Sensing II

Joint Session with Conferences 9083 and 9078

Session Chair: **Michael K. Rafailov,** Univ. of Alberta (Canada)

1:00 pm: **Plasmonic terahertz optoelectronics for higher performance terahertz imaging systems** *(Invited Paper)*, Christopher W. Berry, Ning Wang, Mohammad R. Hashemi, Mona Jarrahi, Univ. of Michigan (USA) . . . . . [9078-23]

1:20 pm: **Case study of concealed weapons detection at stand-off distances using a compact, large field-of-view THz camera** *(Invited Paper)*, Linda Marchese, Marc Terroux, Denis G. Dufour, Martin Bolduc, Claude Chevalier, Francis Genereux, Hubert Jerominek, Alain Bergeron, INO (Canada) . . . . . [9083-89]

1:40 pm: **Resonant-tunneling-enhanced plasmonic terahertz devices** *(Invited Paper)*, Berardi Sensale Rodriguez, Univ. of Utah (USA); Huili G. Xing, Univ. of Notre Dame (USA) . . . . . [9078-24]

CONFERENCE 9079

LOCATION: CONV. CTR. ROOM 326

Monday - Tuesday 5 - 6 May 2014 • Proceedings of SPIE Vol. 9079

Ground/Air Multisensor Interoperability, Integration, and Networking for Persistent ISR V

Conference Chair: **Michael A. Kolodny,** U.S. Army Research Lab. (USA)

Conference Co-Chairs: **Tien Pham,** U.S. Army Research Lab. (USA); **Kevin L. Priddy,** Air Force Research Lab. (USA)

Program Committee: **Flavio Bergamaschi,** IBM United Kingdom Ltd. (United Kingdom); **Robert Heathcock,** U.S. Defense Intelligence Agency (USA); **Olga Mendoza-Schrock,** Air Force Research Lab. (USA); **Gavin Pearson,** Defence Science and Technology Lab. (United Kingdom); **King K. Siu,** U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Raja Suresh,** General Dynamics Advanced Information Systems (USA); **Robert Williams,** Air Force Research Lab. (USA)

MONDAY 5 MAY

INTRODUCTION AND WELCOME REMARKS

LOCATION: CONV. CTR. ROOM 326. . . . MON 9:00 AM TO 9:10 AM

Session Chair: **Michael A. Kolodny,** U.S. Army Research Lab.

SESSION 1

LOCATION: CONV. CTR. ROOM 326 . . MON 9:10 AM TO 12:00 PM

Data-to-Decision (D2D)

Session Chairs: **Michael A. Kolodny,** U.S. Army Research Lab. (USA); **Tien Pham,** U.S. Army Research Lab. (USA)

9:10 am: **The Warfighter Associate: decision-support software agent for the management of intelligence, surveillance, and reconnaissance (ISR) assets**, Norbou Buchler, Laura R. Marusich, U.S. Army Research Lab. (USA); Stacey Sokoloff, VELOXITI (USA) . . . . . [9079-1]

9:30 am: **Summary of level 5 metrics for multi-intelligence fusion**, Erik P. Blasch, Air Force Research Lab. (USA) . . . . . [9079-2]

9:50 am: **Application of distributed virtual cluster management to emulated tactical network experimentation**, Kelvin M. Marcus, U.S. Army Research Lab. (USA) . . . . . [9079-3]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

10:40 am: **Agile sensor tasking for COIST using natural language knowledge representation and reasoning**, David Braines, IBM United Kingdom Ltd. (United Kingdom); Geeth de Mel, IBM Thomas J. Watson Research Ctr. (USA); Christopher Gwilliams, Christos Parizas, Diego Pizzocaro, Alun D. Preece, Cardiff Univ. (United Kingdom) . . . . . [9079-4]

11:00 am: **Evaluation and prioritization of scientific data based on its level of support or refutation of an experimental thesis**, Jeremy Straub, The Univ. of North Dakota (USA). . . . . [9079-5]

11:20 am: **Secure complex event processing in a heterogeneous and dynamic network**, Thilina M. Buddhika, Indrakshi Ray, Colorado State Univ. (USA); Mark H. Linderman, Air Force Research Lab. (USA); Anura Jayasumana, Colorado State Univ. (USA). . . . . [9079-6]

11:40 am: **Practical use of a framework for network science experimentation**, Andrew Toth, U.S. Army Research Lab. (USA); Flavio Bergamaschi, IBM United Kingdom Ltd. (United Kingdom). . . . . [9079-7]

Lunch Break . . . . . Mon 12:00 pm to 1:20 pm

SESSION 2

LOCATION: CONV. CTR. ROOM 326 . . . MON 1:20 PM TO 3:00 PM

Persistent Surveillance

Session Chairs: **Gavin Pearson,** Defence Science and Technology Lab. (United Kingdom); **Flavio Bergamaschi,** IBM United Kingdom Ltd. (United Kingdom)

1:20 pm: **Multisensor data fusion for the northern border low-flying aircraft detection and surveillance**, David L. Masters, U.S. Dept. of Homeland Security (USA); Weiqun Shi, The MITRE Corp. (USA) . . . . . [9079-8]

1:40 pm: **Architecture for persistent surveillance using mast and UAS-based autonomous sensing with bio-inspired technologies**, Jerry A. Burman, Intelligent Recognition Systems (USA) . . . . . [9079-9]

2:00 pm: **Real-time movement detection and analysis for video surveillance applications**, Nicolas Hueber, Christophe Hennequin, Pierre Raymond, Jean-Pierre Moeglin, Institut Franco-Allemand de Recherches de Saint-Louis (France) . . . . . [9079-10]

2:20 pm: **Robust human detection, tracking, and recognition in crowded urban areas**, Hai-Wen Chen, Mike McGurr, Booz Allen Hamilton Inc. (USA) . . . . . [9079-11]

2:40 pm: **Advanced MicroObserver® UGS integration with and cueing of the BattleHawk™ squad level loitering munition and UAV**, Robert L. Steadman, John Finklea, Dean Frost, Sean Deller, James Kershaw, Textron Systems Corp. (USA) . . . . . [9079-12]

Coffee Break . . . . . Mon 3:00 pm to 3:30 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 326 . . . MON 3:30 PM TO 4:30 PM

Anomaly Determination

Session Chairs: **King K. Siu,** U. S. Army ARDEC (USA); **Olga Mendoza-Schrock,** Air Force Research Lab. (USA)

3:30 pm: **Anomaly determination system architecure**, Michael A. Kolodny, U.S. Army Research Lab. (USA) . . . . . [9079-13]

3:50 pm: **An algorithm for monitoring the traffic on a less-travelled road using multi-modal sensor suite**, Thyagaraju Damarla, Hao Vu, Gary Chatters, U.S. Army Research Lab. (USA); James M. Sabatier, Univ. of Mississippi (USA) . . . . . [9079-14]

4:10 pm: **Actively learning to distinguish suspicious from innocuous anomalies in a batch of vehicle tracks**, Zhicong Qiu, David J. Miller, The Pennsylvania State Univ. (USA); Brian Stieber, Tim Fair, Toyon Research Corp. (USA) . . . . . [9079-15]

Defense + Security Plenary Presentation

MON 5:00 TO 6:00 PM
LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

CONFERENCE 9079
LOCATION: CONV. CTR. ROOM 326

TUESDAY 6 MAY

SESSION 4
LOCATION: CONV. CTR. ROOM 326 . . . TUE 9:00 AM TO 11:40 AM

Interoperability

Session Chairs: **Tien Pham,** U.S. Army Research Lab. (USA); **Gavin Pearson,** Defence Science and Technology Lab. (United Kingdom)

9:00 am: **Interoperability and coalition operations: coalition C2 and its implications for ISR** *(Invited Paper)*, Matthew J. Martin, U.S. Air Force (USA) . . . . . [9079-16]

9:40 am: **U.S. Unified Vision 2014 contributions** *(Invited Paper)*, Lebert Powell, Secretary of the Air Force/Acquisition (USA) . . . . . [9079-17]

Coffee/Exhibition Break. . . . . Tue 10:00 am to 10:40 am

10:40 am: **Interoperability as a design construct during the development of quick-reaction capability systems**, Kevin L. Priddy, Air Force Research Lab. (USA) . . . . . [9079-18]

11:00 am: **ITA Scenario 2.0: technology impact in future coalition operations**, Paul Sullivan, Intelpoint Inc. (USA); Geeth de Mel, IBM Thomas J. Watson Research Ctr. (USA); Tien Pham, U.S. Army Research Lab. (USA); Seraphin Calo, IBM Thomas J. Watson Research Ctr. (USA); David Braines, IBM United Kingdom Ltd. (USA); Thomas La Porta, The Pennsylvania State Univ. (USA); Alun D. Preece, Cardiff Univ. (United Kingdom); Alice Toniolo, Univ. of Aberdeen (United Kingdom); Ting He, IBM Thomas J. Watson Research Ctr. (USA); Timothy J. Norman, Univ. of Aberdeen (United Kingdom). . . . . [9079-19]

11:20 am: **Power-managed Terra Harvest controller for long life missions**, Matthew J. Rohrer, Richard D. Porter, Robert Fish, McQ, Inc. (USA). . . [9079-21]

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

SESSION 5
LOCATION: CONV. CTR. ROOM 326 . . . . TUE 1:20 PM TO 4:40 PM

Target Classification and Identification

Session Chairs: **Olga Mendoza-Schrock,** Air Force Research Lab. (USA); **Kevin L. Priddy,** Air Force Research Lab. (USA)

1:20 pm: **Distributed fusion and automated sensor tasking in ISR systems**, Jurgo Preden, Raido Pahtma, Sergei Astapov, Andri Riid, Leo Motus, Johannes Ehala, Erki Suurjaak, Tallinn Univ. of Technology (Estonia) . . . . . [9079-22]

1:40 pm: **Exploiting vibration-based signatures for aided target recognition**, Scott J. Kangas, Air Force Research Lab. (USA); Lauren Crider, Arizona State Univ. (USA) . . . . . [9079-23]

2:00 pm: **Stability analyis of laser vibrometry for vechicle classification**, Ashley Smith, Wright State Univ. (USA); Scott J. Kangas, Air Force Research Lab. (USA); Arnab Shaw, Wright State Univ. (USA); Matthew P. Dierking, Olga Mendoza-Schrock, Air Force Research Lab. (USA) . . . . . [9079-24]

2:20 pm: **Long-range dismount activity classification: LODAC**, Denis Garagic, Bradley J. Rhodes, Fang Liu, Robert Haslinger, Manuel Cuevas, BAE Systems (USA); Andrew Freeman, Olga Mendoza-Schrock, Air Force Research Lab. (USA) . . . . . [9079-25]

2:40 pm: **Laser vibrometry exploitation for vehicle identification**, Adam R. Nolan, Andrew J. Lingg, George S. Goley, Etegent Technologies, Ltd. (USA); Scott J. Kangas, Olga Mendoza-Schrock, Andrew Freeman, Air Force Research Lab. (USA) . . . . . [9079-29]

Coffee/Exhibition Break. . . . . Tue 3:00 pm to 3:40 pm

3:40 pm: **Gender classification under extended operation conditions**, Howard N. Rude, Ryan R. McCoppin, Nathan Koester, Louis A. Tamburino, Mateen M. Rizki, Wright State Univ. (USA); Andrew Freeman, Olga Mendoza-Schrock, Todd V. Rovito, Air Force Research Lab. (USA) . . . . . [9079-26]

4:00 pm: **Exploiting the SWAG database for gender classification using data mining techniques**, Olga Mendoza-Schrock, Air Force Research Lab. (USA); Guozhu Dong, Wright State Univ. (USA) . . . . . [9079-27]

4:20 pm: **Deep learning applied to SWAG**, Ryan R. McCoppin, Howard N. Rude, Mateen M. Rizki, Louis A. Tamburino, Wright State Univ. (USA); Olga Mendoza-Schrock, Air Force Research Lab. (USA) . . . . . [9079-28]

CONFERENCE 9080A

LOCATION: CONV. CTR. ROOM 331

Tuesday - Wednesday 6 - 7 May 2014 • Part of Proceedings of SPIE Vol. 9080

Laser Radar Technology and Applications XIX

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); **Dominique Hamoir,** ONERA (France); **Richard M. Heinrichs,** Defense Advanced Research Projects Agency (USA); **Robert T. Hintz,** Naval Air Warfare Ctr. Weapons Div. (USA); **Norman A. 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 K Steinvall,** Swedish Defence Research Agency (Sweden); **Douglas G. Youmans,** SPARTA Inc./Parsons Corp. (USA)

TUESDAY 6 MAY

OPENING REMARKS

LOCATION: CONV. CTR. ROOM 331 . . . . TUE 8:55 AM TO 9:00 AM

Session Chairs: **Monte D. Turner,** Air Force Research Lab. (USA); **Gary Kamerman,** FastMetrix, Inc. (USA)

SESSION 1

LOCATION: CONV. CTR. ROOM 331 . . . . TUE 9:00 AM TO 11:50 AM

Advanced Systems and Components I

Session Chair: **Monte D. Turner,** Air Force Research Lab. (USA)

9:00 am: **Multi-dimensional laser radars** *(Invited Paper)*, Vasyl Molebny, Academy of Technological Sciences of Ukraine (Ukraine); Ove Steinvall, Swedish Defence Research Agency (Sweden) . . . . . [9080-1]

9:30 am: **Development of three-dimensional wind lidar for space** *(Invited Paper)*, Upendra N. Singh, NASA Langley Research Ctr. (USA) . . . . . [9080-2]

10:00 am: **A polarimetric scanning ladar: system development, performance analysis, and field tests**, Renu Tripathi, Yury Markushin, Nicholas P. Calvano, Gour S. Pati, Delaware State Univ. (USA) . . . . . [9080-3]

Coffee Break . . . . . Tue 10:20 am to 10:50 am

10:50 am: **A long-distance laser altimeter for terrain relative navigation and spacecraft landing**, Diego F. Pierrottet, Coherent Applications, Inc. (USA); Farzin Amzajerdian, Bruce W. Barnes, NASA Langley Research Ctr. (USA) . . . . . [9080-4]

11:10 am: **1541nm GmAPD ladar system**, Mary R. Kutteruf, Paul Lebow, U.S. Naval Research Lab. (USA) . . . . . [9080-5]

11:30 am: **Mosaïc active imaging: Direct physical modelling, image reconstruction, and experimental assessment**, Emmanuelle Thouin, Marie-Thérèse Velluet, Laurent Hespel, Xavier Briottet, Dominique Hamoir, ONERA (France); François Malgouyres, Univ. de Toulouse (France) . . . . . [9080-6]

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

SESSION 2

LOCATION: CONV. CTR. ROOM 331 . . . . . TUE 2:00 PM TO 5:50 PM

Advanced Systems and Components II

Session Chair: **Gary Kamerman,** FastMetrix, Inc. (USA)

This presentation will be made at 5:30 PM in this session
Laser vibrometry exploitation for vehicle identification, Adam R. Nolan, Andrew J. Lingg, George S. Goley, Etegent Technologies, Ltd. (United States; Scott J. Kangas, Olga Mendoza-Schrock, Andrew Freeman, Air Force Research Lab. (USA)

2:00 pm: **Design and performance of a fiber array coupled multi-channel photon counting, 3D imaging, airborne lidar system**, Genghua Huang, Rong Shu, Libing Hou, Yuxing Ding, Shanghai Institute of Technical Physics (China) . . . . . [9080-8]

2:20 pm: **16W average power 2μm Thulium fiber laser with one stage MOPA**, Wendi Wu, Ting Yu, Qijie Huang, Xiaojin Cheng, Weibiao Chen, Shanghai Institute of Optics and Fine Mechanics (China) . . . . . [9080-9]

2:40 pm: **Laser bathymetry in highly-turbid coastal water using multiply scattered returns**, Anthony B. Davis, Jet Propulsion Lab. (USA) . . . . . [9080-10]

3:00 pm: **Development of scanning laser sensor for underwater 3D measurement**, Hideaki Ochimizu, Masaharu Imaki, Shumpei Kameyama, Takashi Saitou, Mitsubishi Electric Corp. (Japan); Shoujirou Ishibashi, Hiroshi Yoshida, Japan Agency for Marine-Earth Science and Technology (Japan) . . . . . [9080-11]

Coffee/Exhibition Break. . . . . Tue 3:20 pm to 4:00 pm

4:00 pm: **Coherent Doppler lidar backscattered signal power validation against direct detection**, Sameh Abdelazim, Fairleigh Dickinson Univ. (USA); David Santoro, Mark Arend, Fred Moshary, Samir Ahmed, The City College of New York (USA). . . . . [9080-12]

4:20 pm: **Outward atmospheric scintillation effects and inward atmospheric scintillation effects comparisons for direct detection ladar applications**, Douglas G. Youmans, SPARTA, Inc. (USA). . . . . [9080-13]

4:40 pm: **High-fidelity flash lidar model development**, Glenn D. Hines, NASA Langley Research Ctr. (USA); Diego F. Pierrottet, Coherent Applications, Inc. (USA); Farzin Amzajerdian, NASA Langley Research Ctr. (USA). . . . . [9080-14]

5:00 pm: **Doppler lidar system design via interdisciplinary design concept at NASA Langley Research Center**, Charles M. Boyer, NASA Langley Research Ctr. (USA); Trevor P. Jackson, Old Dominion Univ. (USA); Jeffrey Y. Beyon, Larry B. Petway, NASA Langley Research Ctr. (USA) . . . . . [9080-16]

WEDNESDAY 7 MAY

SESSION 3

LOCATION: CONV. CTR. ROOM 331 . . . WED 8:00 AM TO 9:40 AM

Signal Processing

Session Chair: **Vasyl Molebny,** National Taras Shevchenko Univ. of Kyiv (Ukraine)

8:00 am: **Improving waveform lidar processing: Toward robust deconvolution of signals for improved structural assessments**, Kerry Cawse-Nicholson, Jan van Aardt, Shea Hagstrom, Paul Romanczyk, Rochester Institute of Technology (USA); Crystal Schaaf, Univ. of Massachusetts Boston (USA); Alan Strahler, Zhan Li, Boston Univ. (USA); Keith Krause, NEON, Inc. (USA) . . . . . [9080-17]

8:20 am: **Online waveform processing versus full waveform analysis for demanding target situations**, Martin Pfennigbauer, Andreas Ullrich, RIEGL Laser Measurement Systems GmbH (Austria) . . . . . [9080-18]

8:40 am: **Range resolution improvement of eyesafe ladar testbed (ELT) measurements using sparse signal deconvolution**, Scott E. Budge, Jacob H. Gunther, Utah State Univ. (USA) . . . . . [9080-19]

9:00 am: **High-speed on-board data processing for science instruments**, Jeffrey Y. Beyon, Tak-Kwong Ng, Bing Lin, Yongxiang Hu, Wallace Harrison, NASA Langley Research Ctr. (USA) . . . . . [9080-21]

9:20 am: **Incoherent pulse compression in laser range finder**, Daniel Grodensky, Daniel Kravitz, Bar-Ilan Univ. (Israel); Nadav Levanon, Tel Aviv Univ. (Israel); Avinoam Zadok, Bar-Ilan Univ. (Israel) . . . . . [9080-22]

Coffee Break . . . . . Wed 9:40 am to 10:30 am

CONFERENCE 9080A

LOCATION: CONV. CTR. ROOM 331

SESSION 4

LOCATION: CONV. CTR. ROOM 331 . . WED 10:30 AM TO 12:10 PM

Data Processing and Analysis I

Session Chair: **C. Russell Philbrick,** North Carolina State Univ. (USA)

10:30 am: **Algorithm for detecting important changes in LIDAR point clouds**, Dmitriy Korchev, Yuri Owechko, HRL Labs., LLC (USA) . . . . . [9080-23]

10:50 am: **Improved registration for 3D image creation using multiple texel images and incorporating low-cost GPS/INS measurements**, Scott E. Budge, Xuan Xie, Utah State Univ. (USA) . . . . . [9080-24]

11:10 am: **Estimating sampling completeness of lidar datasets using voxel-based geometry**, Shea Hagstrom, David Messinger, Katie N. Salvaggio, Rochester Institute of Technology (USA) . . . . . [9080-25]

11:30 am: **Graph segmentation and point-based features for SVM bare earth alassification in lidar data**, Nicholas S. Shorter, Anthony O. Smith, Philip Smith, Kristian Damkjer, Mark D. Rahmes, Harris Corp. (USA) . . . . . [9080-26]

11:50 am: **Comparison of lidar and stereo photogrammetric point clouds for change detection,** Paul L. Basgall, National Geospatial-Intelligence Agency (USA); Fred A. Kruse, Richard C. Olsen, Naval Postgraduate School (USA) . . . . . [9080-27]

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

SESSION 5

LOCATION: CONV. CTR. ROOM 331 . . . . WED 1:30 PM TO 2:50 PM

Data Processing and Analysis II

Session Chair: **Ove Steinvall,**
Swedish Defence Research Agency (Sweden)

1:30 pm: **Uncertainty assessment and probabilistic change detection using terrestrial and airborne lidar**, Andre Jalobeanu, Angela M. Kim, Scott C. Runyon, Richard C. Olsen, Fred A. Kruse, Naval Postgraduate School (USA) . . . . . [9080-28]

1:50 pm: **Lidar change detection using small-scale building models**, Angela M. Kim, Scott C. Runyon, Andre Jalobeanu, Chelsea H. Esterline, Fred A. Kruse, Naval Postgraduate School (USA). . . . . [9080-29]

2:10 pm: **Correlation between lidar-derived intensity and passive optical imagery**, Jeremy P. Metcalf, Angela M. Kim, Fred A. Kruse, Naval Postgraduate School (USA) . . . . . [9080-30]

2:30 pm: **A calibration method of the multi-channel imaging lidar**, Weiming Xu, Shanghai Institute of Technical Physics (China); Jun Liu, Information Engineering Univ. (China); Rong Shu, Shanghai Institute of Technical Physics (China) . . . . . [9080-31]

Coffee Break . . . . . .Wed 2:50 pm to 3:20 pm

SESSION 6

LOCATION: CONV. CTR. ROOM 331 . . . . WED 3:20 PM TO 5:40 PM

Atmospheric Sensing

Session Chair: **Douglas G. Youmans,** SPARTA, Inc. (USA)

3:20 pm: **Using an eyesafe military laser range finder for atmospheric sensing**, Ove Steinvall, Rolf Persson, Folke Berglund, Ove K. S. Gustafsson, Swedish Defence Research Agency (Sweden) . . . . . [9080-32]

3:40 pm: **Development of a fluorescence lidar for measurement of atmospheric formaldehyde**, Anand Radhakrishnan Mylapore, MassTech Inc. (USA); Mikhail Yakshin, Alexander Achey, In Heon Hwang, Sangwoo Lee, Nikhil Mehta, Geary K. Schwemmer, Coorg R. Prasad, Science and Engineering Services, Inc. (USA); Thomas F. Hanisco, NASA Goddard Space Flight Ctr. (USA) . . . . . [9080-33]

4:00 pm: **A three-beam aerosol backscatter correlation lidar for 3-component wind profiling**, Anand Radhakrishnan Mylapore, Konstantin Novoselov, MassTech Inc. (USA); Sangwoo Lee, Mikhail Yakshin, Alexander Achey, In Heon Hwang, Nikhil Mehta, Geary K. Schwemmer, Coorg R. Prasad, Science and Engineering Services, Inc. (USA); Narasimha S. Prasad, NASA Langley Research Ctr. (USA). . . . . [9080-34]

4:20 pm: **Laser remote sensing of species concentrations and dynamical processes**, C. Russell Philbrick, Hans D. Hallen, North Carolina State Univ. (USA) . . . . . [9080-35]

4:40 pm: **Tunable laser remote sensing for aerosol species identification**, Shupeng Niu, C. Russell Philbrick, Hans D. Hallen, North Carolina State Univ. (USA) . . . . . [9080-36]

5:00 pm: **Offshore wind measurements using Doppler aerosol wind lidar (DAWN) at NASA Langley Research Center**, Jeffrey Y. Beyon, Grady J. Koch, Michael J. Kavaya, NASA Langley Research Ctr. (USA). . . . . [9080-37]

5:20 pm: **Tail clipping of TE-CO_2 laser pulse using gas breakdown technique for high-resolution chemical plume detection**, Taieb Gasmi, Saint Louis Univ.-Madrid Campus (Spain) . . . . . [9080-38]

CONFERENCE 9080B

LOCATION: CONV. CTR. ROOM 330

Tuesday - Wednesday 6 - 7 May 2014 • Part of Proceedings of SPIE Vol. 9080

Atmospheric Propagation XI

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 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 J. Grant,** Defence Science and Technology Organisation (Australia); **Juan C. Juarez,** Johns Hopkins Univ. Applied Physics Lab. (USA); **Christopher I. Moore,** U.S. Naval Research Lab. (USA); **William S. Rabinovich,** 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)

TUESDAY 6 MAY

POSTERS-TUESDAY

LOCATION: CONV. CTR. HALL C. . . . . TUE 6:00 PM 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 session. 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 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.

Detecting binary non-return-to-zero data in free-space optical communication systems using FPGAs, Vy Bui, Lan Tran, Esam El-Araby, Nader M. Namazi, The Catholic Univ. of America (USA). . . . . [9080-53]

WEDNESDAY 7 MAY

SESSION 7

LOCATION: CONV. CTR. ROOM 330 . WED 9:00 AM TO 10:20 AM

Propagation Theory and Validation

Session Chair: **Ammar Al-Habash,**
Raytheon Space & Airborne Systems (USA)

9:00 am: **Scintillation fluctuations of laser beam propagation in strong atmospheric turbulence**, Joseph T. Coffaro, Michael G. Panich, Larry Andrews, Univ. of Central Florida (USA); Ronald Phillips, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [9080-39]

9:20 am: **Internal anisotropy of the turbulent scintillations**, Mikhail I. Charnotskii, National Oceanic and Atmospheric Administration (USA) . [9080-40]

9:40 am: **Simulation of partially spatially coherent laser beam and comparison with field test for both terrestrial and maritime environments**, Nelofar Mosavi, Johns Hopkins Univ. Applied Physics Lab. (USA); Curtis R. Menyuk, Univ. of Maryland, Baltimore County (USA); Brian S. Marks, Bradley G. Boone, Johns Hopkins Univ. Applied Physics Lab. (USA); Charles Nelson, U.S. Naval Academy (USA) . . . . . [9080-41]

10:00 am: **Adaptive laser beam focusing through turbulence in conditions of reciprocity violation**, Anatoliy Khizhnyak, Vladimir B. Markov, Advanced Systems & Technologies, Inc. (USA) . . . . . [9080-42]

Coffee Break . . . . . Wed 10:20 am to 10:50 am

SESSION 8

LOCATION: CONV. CTR. ROOM 330 . WED 10:50 AM TO 12:10 PM

Mitigation Techniques I

Session Chair: **Linda M. Thomas,** U.S. Naval Research Lab. (USA)

10:50 am: **Atmospheric turbulence effects on a monostatic and bistatic retroreflecting link**, Rita Mahon, Mike S. Ferraro, Peter G. Goetz, Christopher I. Moore, James L. Murphy, William S. Rabinovich, U.S. Naval Research Lab. (USA) . . . . . [9080-43]

11:10 am: **Demonstrating capacity-approaching FSO communications**, Thomas R. Halford, Michael P. Fitz, Cenk Kose, Jonathan Cromwell, Steven Gordon, TrellisWare Technologies, Inc. (USA) . . . . . [9080-44]

11:30 am: **Implementation and performance of stochastic parallel gradient descent algorithm for atmospheric turbulence compensation**, Greg A. Finney, Christopher M. Persons, Stephan Henning, IERUS Technologies, Inc. (USA); Jessie Hazen, Daniel Whitley, The Univ. of Alabama in Huntsville (USA) . . . . . [9080-45]

11:50 am: **Analysis of scintillation fluctuations of laser propagation through video data processing**, Sara Belichki, Landon Splitter, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Larry Andrews, Univ. of Central Florida (USA); Ronald Phillips, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [9080-46]

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

SESSION 9

LOCATION: CONV. CTR. ROOM 330 . . . WED 1:40 PM TO 2:40 PM

Mitigation Techniques II

Session Chairs: **Harris R. Burris,** U.S. Naval Research Lab. (USA);
Christopher I. Moore, U.S. Naval Research Lab. (USA)

1:40 pm: **Diversity effects in modulating retroreflector links**, William S. Rabinovich, Rita Mahon, Mike S. Ferraro, Peter G. Goetz, James L. Murphy, U.S. Naval Research Lab. (USA) . . . . . [9080-47]

2:00 pm: **Experimental performance comparison of receiver architectures for airborne FSO systems**, David W. Young, Juan C. Juarez, Johns Hopkins Univ. Applied Physics Lab. (USA); Brian Stadler, David F. Orth, Air Force Research Lab. (USA) . . . . . [9080-48]

2:20 pm: **Integration of a concentric five element InAlAs/InGaAs avalanche photodiode array in a stabilizing bi-static optical assembly**, Mike S. Ferraro, Rita Mahon, William S. Rabinovich, James L. Murphy, U.S. Naval Research Lab. (USA); Wade T. Freeman, Smart Logic, Inc. (USA); Steve Frawley, Smart Logic, Inc. (USA) and U.S. Naval Research Lab. (USA); Peter G. Goetz, Harris R. Burris, Linda M. Thomas, U.S. Naval Research Lab. (USA); William R. Clark, William D. Waters, OptoGration Inc. (USA); Barry M. Mathieu, Barry Design, LLC (USA); Kenneth Vaccaro, Brian Krejca, OptoGration Inc. (USA) . . . . . [9080-49]

Coffee/Exhibition Break. . . . . .Wed 2:40 pm to 3:30 pm

SESSION 10

LOCATION: CONV. CTR. ROOM 330 . . . WED 3:30 PM TO 4:10 PM

Characterization Systems and Applications

Session Chair: **Juan C. Juarez,**
Johns Hopkins Univ. Applied Physics Lab. (USA)

3:30 pm: **The integrated atmospheric characterization system (IACS)**, David W. Roberts, Gary G. Gimmestad, John M. Stewart, Georgia Tech Research Institute (USA) . . . . . [9080-50]

3:50 pm: **Control of a small robot using a hybrid optical modulating retro-reflector/RF link**, James L. Murphy, Mike S. Ferraro, William S. Rabinovich, Peter G. Goetz, Michele R. Suite, U.S. Naval Research Lab. (USA); Stanley H. Uecke, NovaSol (USA). . . . . [9080-52]

CONFERENCE 9081

LOCATION: CONV. CTR. ROOM 314

Tuesday - Wednesday 6 - 7 May 2014 • Proceedings of SPIE Vol. 9081

Laser Technology for Defense and Security X

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); **Iyad Dajani,** Air Force Research Lab. (USA); **Fabio Di Teodoro,** The Aerospace Corp. (USA); **Anthony M. Johnson,** Univ. of Maryland, Baltimore County (USA); **Don D. Seeley,** High Energy Laser Joint Technology Office (USA)

TUESDAY 6 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 314 . . . TUE 8:20 AM TO 10:10 AM

Novel Laser Materials I

Session Chair: **George A. Newburgh,** U.S. Army Research Lab. (USA)

8:20 am: **Comparative analysis of holmium-doped laser materials**, Steve Bowman, Joseph E. Friebele, Woohong R. Kim, U.S. Naval Research Lab. (USA); Christopher G. Brown, Sotera Defense Solutions, Inc. (USA) . . . . [9081-1]

8:40 am: **Processing and characterization of polycrystalline YAG core-clad fibers**, Hyun Jun Kim, Air Force Research Lab. (USA) and UES, Inc. (USA); Geoff E. Fair, Santeri A. Potticary, Matthew O'Malley, Nicholas G. Usechak, Air Force Research Lab. (USA) . . . . . [9081-2]

9:00 am: **Crystal growth, spectroscopy, and laser performance of resonantly pumped eye-safe Er3+:LuVO4 laser**, Nikolay E. Ter-Gabrielyan, Viktor Fromzel, U.S. Army Research Lab. (USA); Z. Yan, Shandong Univ. (China); X. Yan, Lasence Inc. (China); Huaijin Zhang, Jiyang Wang, Shandong Univ. (China); Mark Dubinskii, U.S. Army Research Lab. (USA) . . . . . [9081-3]

9:20 am: **Holmium-doped laser materials for eye-safe solid state laser application**, Woohong R. Kim, Steve Bowman, Colin C. Baker, U.S. Naval Research Lab. (USA); Catalin Florea, Sotera Defense Solutions, Inc. (USA); Guillermo Villalobos, Brandon Shaw, U.S. Naval Research Lab. (USA); Bryan Sadowski, Sotera Defense Solutions, Inc. (USA); Michael Hunt, Univ. Research Foundation (USA); Ishwar D. Aggarwal, Sotera Defense Solutions, Inc. (USA); Jas S. Sanghera, U.S. Naval Research Lab. (USA) . . . . . [9081-4]

9:40 am: **Growth, spectroscopy, and laser performance of rare-earth doped vanadate family crystals** *(Invited Paper)*, Jiyang Wang, Haohai Yu, Huaijin Zhang, Shandong Univ. (China). . . . . [9081-5]

Coffee Break . . . . . Tue 10:10 am to 10:40 am

SESSION 2

LOCATION: CONV. CTR. ROOM 314 . . TUE 10:40 AM TO 11:40 AM

Novel Laser Materials II

Session Chair: **Steven Bowman,** U.S. Naval Research Lab. (USA)

10:40 am: **Calibrated measurements of Er and Yb co-doped glasses for laser properties**, Simi A. George, Joseph S. Hayden, SCHOTT North America, Inc. (USA). . . . . [9081-6]

11:00 am: **Nanoparticle doping for improved power scaling of resonantly-pumped, Yb-free Er-doped fiber lasers**, Joseph E. Friebele, Charles G. Askins, U.S. Naval Research Lab. (USA); John R. Peele, Soltera Defense Systems (USA); Barbara M. Wright, Colin C. Baker, Woohong R. Kim, U.S. Naval Research Lab. (USA); Jun Zhang, Radha K. Pattnaik, Mark Dubinskii, U.S. Army Research Lab. (USA) . . . . . [9081-7]

11:20 am: **Compositional tuning of glass for the suppression of nonlinear and parasitic fiber laser phenomena**, Peter D. Dragic, Univ. of Illinois at Urbana-Champaign (USA); John Ballato, Thomas W. Hawkins, Clemson Univ. (USA) . . . . . [9081-8]

Lunch/Exhibition Break . . . . . Tue 11:40 am to 1:30 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 314 . . . . . TUE 1:30 PM TO 3:10 PM

Laser Sensor and Eye Protection; Other Applications

Session Chair: **Don D. Seeley,**
High Energy Laser Joint Technology Office (USA)

1:30 pm: **Smart filters: protect from laser threats**, Ariela Donval, Tali Fisher, Ofir Lipman, Moshe Oron, KiloLambda Technologies, Ltd. (Israel) . . . . . [9081-9]

1:50 pm: **Characterization of the nonlinear optical properties of a photodegradation-resistant dye/solvent system**, Timothy M. Pritchett, Michael J. Ferry, William M. Shensky III, Andrew G. Mott, U.S. Army Research Lab. (USA); Joy E Haley, Air Force Research Lab (USA) . . . . . [9081-10]

2:10 pm: **HVPE of bulk In1-xGaxAs for sensor protection**, Peter G. Schunemann, BAE Systems (USA) . . . . . [9081-11]

2:30 pm: **Quantitative laser safety analysis for application of high-energy lasers in a field test**, Dietmar Böker, Christine Schwarz-Hemmert, Dirk Netzler, IABG mbH (Germany) . . . . . [9081-12]

2:50 pm: **A laser-based FAIMS detector for detection of ultra-low concentrations of explosives**, Alexander A. Chistyakov, Artem E. Akmalov, National Research Nuclear Univ. MEPhI (Russian Federation); Artem S. Bogdanov, Moscow State Institute of Radiotechnics, Electronics and Automation (Russian Federation); Gennadiy E. Kotkovskiy, National Research Nuclear Univ. MEPhI (Russian Federation); Eugene M. Spitsyn, POLYUS Research and Development Institute (Russian Federation); Alexey V. Sychev, National Research Nuclear Univ. MEPhI (Russian Federation); Anatoly N. Perederii, Moscow State Institute of Radiotechnics, Electronics and Automation (Russian Federation); Anton V. Tugaenko, Inkram (Russian Federation) [9081-13]

Coffee Break . . . . . Tue 3:10 pm to 3:40 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 314 . . . . TUE 3:40 PM TO 5:40 PM

Single-Aperture Power Scaling of Fiber Laser (CW and Pulsed)

Session Chair: **Iyad Dajani,** Air Force Research Lab. (USA)

3:40 pm: **50µm-core Yb-doped leakage channel fiber with flattened mode**, Fanting Kong, Guanchen Gu, Thomas W. Hawkins, Joshua Parsons, Maxwell Jones, Clemson Univ. Research Foundation (USA); Christopher D. Dunn, Clemson Univ. (USA); Monica T. Kalichevsky-Dong, Clemson Univ. Research Foundation (USA); Kanxian Wei, Bryce N. Samson, Nufern (USA); Liang Dong, Clemson Univ. Research Foundation (USA) . . . . . [9081-14]

4:00 pm: **Highly reliable and efficient 1.5µm-fiber-MOPA-based, high-power laser transmitter for space communication**, Doruk Engin, Frank Kimpel, Kent Puffenberger, Slava Litvinovitch, Xung Dang, He Cao, Bruce McIntosh, Mark Storm, Rich Utano, Shantanu Gupta, Fibertek, Inc. (USA) . . . . . [9081-15]

4:20 pm: **Thulium fiber laser and application development**, Lawrence Shah, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Christian Gaida, Martin Gebhardt, Friedrich-Schiller-Univ. Jena (Germany); Alex M. Sincore, Joshua D. Bradford, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Nils Gehlich, Fraunhofer-Institut für Lasertechnik (Germany); Ilya Mingareev, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) and Fraunhofer-Institut für Lasertechnik (Germany); Martin C. Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [9081-16]

4:40 pm: **Resonant tandem pumping of Tm-doped fiber lasers and amplifiers**, Daniel Creeden, Benjamin R. Johnson, Glen A. Rines, Scott D. Setzler, BAE Systems (USA) . . . . . [9081-17]

5:00 pm: **Comparative study of resonant and non-resonant clad-pumping of fiber lasers based on Yb-free, Er-doped fibers**, Jun Zhang, Radha K. Pattnaik, Viktor Fromzel, Mark Dubinskii, U.S. Army Research Lab. (USA) . . . . . [9081-18]

5:20 pm: **Diode clad-pumped, CW Raman fiber laser for a single-aperture power scaling** *(Invited Paper)*, Mark Dubinskii, U.S. Army Research Lab. (USA); Benjamin G Ward, U.S. Air Force Academy (USA); Jay W. Dawson, Michael J. Messerly, Paul H. Pax, John E. Heebner, Derrek R. Drachenberg, Lawrence Livermore National Lab. (USA); Jun Zhang, Viktor Fromzel, Nikolay E. Ter-Gabrielyan, Radha K. Pattnaik, U.S. Army Research Lab. (USA) . . . . . [9081-19]

POSTERS-TUESDAY
LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM TO 7:30 PM

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Highly-efficient, high-energy pulse-burst Yb-doped fiber laser with transform limited linewidth, Doruk Engin, Frank Kimpel, John Burton, Ibraheem Darab, Brian Mathason, Shantanu Gupta, Mark Storm, Fibertek, Inc. (USA) . . . . . [9081-36]

A three wavelength erbium-doped fiber laser source based on fiber Bragg grating reflectors, Siyanda Qhumayo, Univ. of Johannesburg (South Africa) . . . . . [9081-37]

WEDNESDAY 7 MAY

SESSION 5
LOCATION: CONV. CTR. ROOM 314 . WED 8:20 AM TO 10:00 AM

Mid-IR Laser Materials and Laser Development

Session Chair: **Anthony M. Johnson,** Univ. of Maryland, Baltimore County (USA)

8:20 am: **Widely tunable infrared source for molecular fingerprint spectroscopy based on OP-GaAs difference-frequency generation with a synchronized programmable fiber laser**, Mathieu Giguère, Alain Villeneuve, Joseph Salhany, Youngjae Kim, Alexandre Dupuis, Bryan Burgoyne, Genia Photonics Inc. (Canada); Douglas Bamford, Physical Sciences Inc. (USA) . . . . . [9081-20]

8:40 am: **Growth of bulk orientation-patterned gallium phosphide (OP-GaP) for mid-IR laser applications**, Peter G. Schunemann, Alice Vera, Lee Mohnkern, Xiaoping S. Yang, BAE Systems (USA). . . . . [9081-21]

9:00 am: **Cascaded mid-IR Er:Y_2O_3 ceramic laser**, Tigran Sanamyan, Mark Dubinskii, U.S. Army Research Lab. (USA) . . . . . [9081-22]

9:20 am: **Demonstration of a quick process to achieve buried heterostructure QCL leading to high power and wall plug efficiency**, Wondwosen T. Metaferia, KTH Royal Institute of Technology (Sweden); Bouzid Simozrag, III-V Lab. (France); Carl Junesand, KTH Royal Institute of Technology (Sweden) and Epiclarus AB (Sweden); Yan-Ting Sun, KTH Royal Institute of Technology (Sweden); Mathieu Carras, III-V Lab. (France); Federico Capasso, Romain Blanchard, Harvard School of Engineering and Applied Sciences (USA); Sebastian Lourdudoss, KTH Royal Institute of Technology (Sweden) . . . . . [9081-23]

9:40 am: **High-performance mid-infrared GaSb laser diodes for defence and sensing applications**, Augustinas Vizbaras, Edgaras Dvinelis, Augustinas Trinkunas, Ieva ?imonyte, Mindaugas Greibus, Ramunas Songaila, Kristijonas Vizbaras, Brolis Semiconductors UAB (Lithuania). . . . . [9081-24]

Coffee/Exhibition Break. . . . . .Wed 10:00 am to 10:40 am

SESSION 6
LOCATION: CONV. CTR. ROOM 314 . WED 10:40 AM TO 12:00 PM

Fiber Lasers: Power Scaling via Beam Combining

Session Chair: **Fabio Di Teodoro,** The Aerospace Corp. (USA)

10:40 am: **Holographic phasing of fiber lasers: simple, scalable, broadband locking**, Geoff P. Andersen, Ken R. MacDonald, Paul Gelsinger-Austin, Hua, Inc. (USA) . . . . . [9081-25]

11:00 am: **Experimental demonstration of phase locking of a 21-subaperture fiber-collimator array over a 7-km atmospheric propagation path**, Thomas Weyrauch, Univ. of Dayton (USA); Mikhail A. Vorontsov, Univ. of Dayton (USA) and Optonicus (USA); Vladimir M. Ovchinnikov, Guimin Wu, Optonicus (USA) . . . . . [9081-26]

11:20 am: **32-channel coherent-beam combination via LOCSET phase locking**, Benjamin Pulford, Angel Flores, Air Force Research Lab. (USA) . . . . . [9081-27]

11:40 am: **Transient stimulated Brillouin scattering in kilowatt class fiber lasers seeded with phase modulated light**, Iyad Dajani, Angel Flores, Benjamin Pulford, Ann Lanari, Timothy Madden, Shadi A. Naderi, Air Force Research Lab. (USA); Brian Anderson, Univ. of Central Florida (USA) . . [9081-28]

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

SESSION 7
LOCATION: CONV. CTR. ROOM 314 . . . . WED 1:30 PM TO 3:10 PM

Diode Lasers and Advanced Laser Components

Session Chair: **Stephen G. Post,** Missile Defense Agency (USA)

1:30 pm: **Experimental verification of longitudinal spatial hole burning in high-power diode lasers**, Ting Hao, Junyeob Song, Richard W Liptak, Paul O. Leisher, Rose-Hulman Institute of Technology (USA) . . . . . [9081-38]

1:50 pm: **High-efficiency narrow linewidth diode laser pump source at 780nm**, Zhigang Chen, Kevin Bruce, Keith Kennedy, Ling Bao, Shuang Li, Mark DeFranza, Mitch Reynolds, Aaron Brown, Manoj Kanskar, nLIGHT Corp. (USA) . . . . . [9081-29]

2:10 pm: **Current pulse length investigation toward optimal pumping of a gain-switched asymmetric waveguide laser diode**, Brigitte Lanz, Juha Kostamovaara, Univ. of Oulu (Finland) . . . . . [9081-30]

2:30 pm: **Antireflective surface structures on windows for high-energy lasers**, Lynda E. Busse, U.S. Naval Research Lab. (USA); Catalin Florea, Sotera Defense Solutions, Inc. (USA); Jesse Frantz, U.S. Naval Research Lab. (USA); Menelaos K. Poutous, Rajendra Joshi, The Univ. of North Carolina at Charlotte (USA); Brandon Shaw, U.S. Naval Research Lab. (USA); Ishwar D. Aggarwal, The Univ. of North Carolina at Charlotte (USA); Jas S. Sanghera, U.S. Naval Research Lab. (USA) . . . . . [9081-31]

2:50 pm: **Transverse mode selection in laser resonators using volume Bragg gratings**, Brian Anderson, George B. Venus, Daniel Ott, Ivan B. Divliansky, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Derrek R. Drachenberg, Lawrence Livermore National Lab. (USA); Leonid B. Glebov, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Jay W. Dawson, Michael J. Messerly, Paul H. Pax, John B. Tassano, Lawrence Livermore National Lab. (USA) . . . . . [9081-32]

Coffee Break . . . . . .Wed 3:10 pm to 4:00 pm

CONFERENCE 9081

LOCATION: CONV. CTR. ROOM 314

SESSION 8

LOCATION: CONV. CTR. ROOM 314 . . . WED 4:00 PM TO 5:00 PM

Bulk Solid State Lasers: Novel Designs

Session Chair: **Nikolay E. Ter-Gabrielyan,**
U.S. Army Research Lab. (USA)

4:00 pm: **High-gain Yb:YAG amplifier for ultrashort pulse laser at high-average power**, John Vetrovec, Drew A. Copeland, Amardeep S. Litt, Aqwest, LLC (USA); Detao Du, General Atomics Aeronautical Systems, Inc. (USA) . . . . . [9081-33]

4:20 pm: **High-gain amplifier based on a hetero-composite Nd:YVO4/SiC gain assembly**, George A. Newburgh, Mark Dubinskii, U.S. Army Research Lab. (USA) . . . . . [9081-34]

4:40 pm: **Research on water-cooled lamp-pumped 8-radial slab solid state laser**, Zhaoshuo Tian, Ping Xu, Ting Qu, Jieguang Miao, Shiyou Fu, Harbin Institute of Technology in Weihai (China) . . . . . [9081-35]

CONFERENCE 9082

LOCATION: CONV. CTR. ROOM 322 & ROOM 347

Wednesday - Thursday 7 - 8 May 2014 • Proceedings of SPIE Vol. 9082

Active and Passive Signatures V

Conference Chairs: **G. Charmaine Gilbreath,** U.S. Naval Research Lab. (USA); **Chadwick Todd Hawley,** Senior Expert for Signatures (USA)

Program Committee: **David W. Allen,** National Institute of Standards and Technology (USA); **Kelly W. Bennett,** U.S. Army Research Lab. (USA); **Carlos Omar Font,** U.S. Naval Research Lab. (USA); **Marco O. Lanzagorta,** U.S. Naval Research Lab. (USA); **Ram M. Narayanan,** The Pennsylvania State Univ. (USA); **Frank Pipitone,** U.S. Naval Research Lab. (USA); **Carl Salvaggio,** Rochester Institute of Technology (USA); **Fred Schnarre,** National Geospatial-Intelligence Agency (USA); **David N. Strafford,** Soter Technology (USA)

WEDNESDAY 7 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 322 . WED 8:00 AM TO 10:00 AM

Radar Micro-Doppler Signatures I

Joint Session with Conferences 9077 and 9082

Session Chair: **Ram M. Narayanan,** The Pennsylvania State Univ. (USA)

8:00 am: **Performance bounds on micro-Doppler estimation and adaptive waveform design using OFDM signals**, Satyabrata Sen, Jacob Barhen, Charles W. Glover, Oak Ridge National Lab. (USA) . . . . . [9077-40]

8:20 am: **Characterization of micro-Doppler radar signature of commercial wind turbines**, Fanxing Kong, Yan Zhang, Robert Palmer, The Univ. of Oklahoma (USA) . . . . . [9077-41]

8:40 am: **Micro-Doppler classification of rider and riderless horses**, David Tahmoush, U.S. Army Research Lab. (USA). . . . . [9077-42]

9:00 am: **Effect of wind turbine micro-Doppler on SAR and GMTI signatures**, Rajan Bhalla, Leidos (USA); Hao Ling, The Univ. of Texas at Austin (USA) . . . . . [9077-43]

9:20 am: **Detection of small UAV helicopters using micro-Doppler**, David Tahmoush, U.S. Army Research Lab. (USA). . . . . [9077-44]

9:40 am: **Extracting radar micro-Doppler signatures of helicopter rotating rotor blades using K-band radars**, Rachel Chen, Baokun Liu, Ancortek Inc. (USA) . . . . . [9082-1]

Coffee Break . . . . . Wed 10:00 am to 10:30 am

SESSION 2

LOCATION: CONV. CTR. ROOM 322 . WED 10:30 AM TO 12:30 PM

Radar Micro-Doppler Signatures II

Joint Session with Conferences 9077 and 9082

Session Chair: **David Tahmoush,** U.S. Army Research Lab. (USA)

10:30 am: **Software-defined radar and waveforms for studying micro-Doppler signatures**, Baokun Liu, Rachel Chen, Ancortek Inc. (USA) . . [9077-45]

10:50 am: **Very low-phase noise, coherent 94 GHz radar for micro-Doppler and vibrometry studies**, Duncan A. Robertson, Univ. of St. Andrews (United Kingdom); Graham M. Brooker, The Univ. of Sydney (Australia); Patrick D. L. Beasley, QinetiQ Ltd. (United Kingdom) . . . . . [9077-46]

11:10 am: **Comparative of signal processing techniques for micro-Doppler signature extraction with automotive radar systems**, Berta Rodriguez Hervas, The Univ. of Texas at El Paso (USA) and Mercedes-Benz Research & Development North America, Inc. (USA); Michael Maile, Mercedes-Benz Research & Development North America, Inc. (USA); Benjamin C. Flores, The Univ. of Texas at El Paso (USA) . . . . . [9077-47]

11:30 am: **Stationary and moving target shadow characteristics in synthetic aperture radar**, Ann M. Raynal, Douglas L. Bickel, Armin W. Doerry, Sandia National Labs. (USA) . . . . . [9077-48]

11:50 am: **Extremely high-frequency micro-Doppler measurements of humans**, Charles R. Dietlein, Abigail S. Hedden, U.S. Army Research Lab. (USA); Jeremy A. Green, Univ. of Maryland, College Park (USA); Jerry L. Silvious, David A. Wikner, U.S. Army Research Lab. (USA) . . . . . [9077-49]

12:10 pm: **Determining human target orientation and classifying human motion using bistatic radar micro-Doppler signals**, Dustin P. Fairchild, Ram M. Narayanan, The Pennsylvania State Univ. (USA). . . . . [9082-2]

THURSDAY 8 MAY

SESSION 3

LOCATION: CONV. CTR. ROOM 347 . . . THU 8:30 AM TO 11:40 AM

NOTE ROOM CHANGE

Active and Passive Signatures I

8:30 am: **IR polarimetric signatures**, David B. Chenault, Joseph L. Pezzaniti, Polaris Sensor Technologies, Inc. (USA). . . . . [9082-3]

8:50 am: **Electric-field sensors for bullet detection systems**, Stephen J. Vinci, David M. Hull, U.S. Army Research Lab. (USA). . . . . [9082-4]

9:10 am: **A collection and statistical analysis of skin reflectance signatures for inherent variability over the 250nm to 2500 nm spectral range**, Catherine C. Cooksey, Benjamin K. Tsai, David W. Allen, National Institute of Standards and Technology (USA). . . . . [9082-6]

9:30 am: **Possibility of passive THz camera using for a temperature difference observing of objects placed inside the human body**, Vyacheslav A. Trofimov, Vladislav V. Trofimov, Igor E. Kuchik, Lomonosov Moscow State Univ. (Russian Federation). . . . . [9082-7]

9:50 am: **NIST spectrophotometry support available for infrared signature measurements**, Leonard M. Hanssen, Simon G. Kaplan, National Institute of Standards and Technology (USA); Jinan Zeng, Space Dynamics Lab. (USA); Sergey N. Mekhontsev, National Institute of Standards and Technology (USA) . . . . . [9082-8]

Coffee Break . . . . . Thu 10:10 am to 10:40 am

10:40 am: **Investigation of atmospheric blasts by fast radiometry**, Yossi Bushlin, Ronen Ben-Dov, Adam D. Devir, Alexander B. Lessin, Ilan Mendelewicz, Maria Shvebelman, IARD Sensing Solutions Ltd. (Israel). . [9082-9]

11:00 am: **Passive signatures concealed objects recorded by multispectral and hyperspectral systems in visible, infrared, and terahertz range**, Mariusz Kastek, Marcin Kowalski, Henryk Polakowski, Norbert Palka, Military Univ. of Technology (Poland); Philippe Lagueux, Vincent Farley, Marc-André Gagnon, Telops (Canada) . . . . . [9082-10]

11:20 am: **Effective criteria developing for the identification of substance using the reflected THz signal**, Vyacheslav A. Trofimov, Lomonosov Moscow State Univ. (Russian Federation) . . . . . [9082-11]

CONFERENCE 9083

LOCATION: CONV. CTR. ROOM 336

Monday - Friday 5 - 9 May 2014 • Proceedings of SPIE Vol. 9083

Micro- and Nanotechnology Sensors, Systems, and Applications VI

Conference Chairs: **Thomas George,** Zyomed Corp. (USA); **M. Saif Islam,** Univ. of California, Davis (USA); **Achyut K. Dutta,** Banpil Photonics, Inc. (USA)

Program Committee: **Roger Appleby,** Queen's Univ. Belfast (United Kingdom); **Debjyoti Banerjee,** Texas A&M Univ. (USA); **Scott D. Collins,** Univ. of Maine (USA); **Richard Conroy,** National Institutes of Health (USA); **Nibir K. Dhar,** Defense Advanced Research Projects Agency (USA); **Muhammad M. Hussain,** King Abdullah Univ. of Science and Technology (Saudi Arabia); **Matthew E. L. Jungwirth,** Honeywell Defense and Space Electronic Systems (USA); **Christopher M. Kroninger,** U.S. Army Research Lab. (USA); **Susan M. Maley,** U.S. Dept. of Energy (USA); **Michael C. McAlpine,** Princeton Univ. (USA); **Parvaneh Mokarian-Tabari,** Univ. College Coek (Ireland); **William D. Nothwang,** U.S. Army Research Lab. (USA); **Stergios J. Papadakis,** Johns Hopkins Univ. Applied Physics Lab. (USA); **Michael K. Rafailov,** The Reger Group (USA); **Bilge Saruhan-Brings,** Deutsches Zentrum für Luft- und Raumfahrt (Germany); **Antonio Sastre,** National Institutes of Health (USA); **Noriko Satake,** UC Davis Medical Ctr. (USA); **Sivalingam Sivananthan,** Univ. of Illinois at Chicago (USA); **Andre U. Sokolnikov,** Visual Solutions and Applications (USA); **Kyung-Ah Son,** HRL Labs., LLC (USA); **Thomas G. Thundat,** Univ. of Alberta (Canada); **Christopher C. Wilcox,** U.S. Naval Research Lab. (USA)

MONDAY 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 336 . . MON 8:30 AM TO 10:40 AM

Two-dimensional Nano-layered Systems: Graphene and Beyond

Session Chair: **Thomas George,** Zyomed Corp. (USA)

8:30 am: **Two-dimensional atomic-layer research and engineering (2-DARE) beyond graphene** *(Keynote Presentation)*, Anupama B. Kaul, National Science Foundation (USA) . . . . . [9083-1]

9:00 am: **Recent progress on two-dimensional materials for RF communications and sensing** *(Invited Paper)*, Tomas Palacios, Massachusetts Institute of Technology (USA) . . . . . [9083-2]

9:20 am: **Novel layered 2D semiconductors as the building blocks for nano-electronic/photonic systems** *(Invited Paper)*, Haibing Peng, Guoxiong Su, Debtanu De, Viktor G. Hadjiev, Univ. of Houston (USA) . . . . . [9083-3]

9:40 am: **Graphene and beyond-graphene 2D crystals for next-generation green electronics** *(Invited Paper)*, Kaustav Banerjee, Univ. of California, Santa Barbara (USA) . . . . . [9083-4]

10:00 am: **2D materials: From catalysis to optoelectronics** *(Invited Paper)*, Linyou Cao, North Carolina State Univ. (USA) . . . . . [9083-5]

10:20 am: **High-field and thermal transport in 2D atomic devices** *(Invited Paper)*, Eric Pop, Stanford Univ. (USA); Vincent Dorgan, Ashkan Behnam, Univ. of Illinois at Urbana-Champaign (USA); Christopher D. English, Zuanyi Li, Stanford Univ. (USA); Sharnali Islam, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [9083-6]

Coffee Break . . . . . Mon 10:40 am to 11:10 am

SESSION 2

LOCATION: CONV. CTR. ROOM 336 . . MON 11:10 AM TO 12:20 PM

Emerging Electronic Devices/Systems Based on Adaptive and Metamaterials I

Session Chair: **Andre U. Sokolnikov,** Visual Solutions and Applications (USA)

11:10 am: **Where art and technology meet: Origami for three-dimensional adaptive devices** *(Keynote Presentation)*, Richard Vaia, Michael F. Durstock, Timothy J. White, Loon-Seng Tan, James J. Joo, Gregory W. Reich, Air Force Research Lab. (USA) . . . . . [9083-7]

11:40 am: **Coherent phonons in carbon-based nanostructures** *(Invited Paper)*, Christopher J. Stanton, Univ. of Florida (USA) . . . . . [9083-8]

12:00 pm: **Double graphene-layer structures for adaptive devices** *(Invited Paper)*, Vladimir Mitin, Univ. at Buffalo (USA); Victor Ryzhii, Taiichi Otsuji, Tohoku Univ. (Japan); Maxim Ryzhii, Univ. of Aizu (Japan); Michael S. Shur, Rensselaer Polytechnic Institute (USA) . . . . . [9083-9]

Lunch Break . . . . . Mon 12:20 pm to 1:20 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 336 . . . MON 1:20 PM TO 2:00 PM

Emerging Electronic Devices/Systems Based on Adaptive and Metamaterials II

Session Chair: **Andre U. Sokolnikov,** Visual Solutions and Applications (USA)

1:20 pm: **Terahertz devices and device modeling** *(Invited Paper)*, Stephen M. Goodnick, Marco Saraniti, Arizona State Univ. (USA) . . . . . [9083-10]

1:40 pm: **Investigation of MEMS bi-material sensors with metamaterial absorbers for THz imaging** *(Invited Paper)*, Fabio Alves, Dragoslav Grbovic, Gamani Karunasiri, Naval Postgraduate School (USA) . . . . . [9083-11]

SESSION 4

LOCATION: CONV. CTR. ROOM 336 . . . MON 2:00 PM TO 4:30 PM

Graphene and 2D Electronics

Session Chair: **Kyung-Ah Son,** HRL Labs., LLC (USA)

2:00 pm: **Growth of 2D heterostructures of graphene/bn** *(Invited Paper)*, Michael G. Spencer, Cornell Univ. (USA) . . . . . [9083-12]

2:20 pm: **Recent advancements toward achieving graphene-based heterostructures** *(Invited Paper)*, Virginia Wheeler, Nelson Y. Garces, Luke O. Nyakiti, Rachael L. Myers-Ward, Zachary R. Robinson, Neeraj Nepal, Sandra Hernandez, Scott Walton, D. Kurt Gaskill, Charles R. Eddy Jr., U.S. Naval Research Lab. (USA) . . . . . [9083-13]

2:40 pm: **Interface engineered dry-transfer process for high-performance graphene transistor on flexible substrates** *(Invited Paper)*, Sang Y. Yang, Joong Gun Oh, Dae Yool Jung, Chan Hak Yu, Byung-Jin Cho, Sung-Yool Choi, KAIST (Korea, Republic of) . . . . . [9083-14]

Coffee Breeak . . . . . Mon 3:00 pm to 3:30 pm

3:30 pm: **Piezoresitive graphene NEMS sensors** *(Invited Paper)*, Max C. Lemme, Univ. Siegen (Germany); Anderson D. Smith, Sam Vaziri, KTH Royal Institute of Technology (Sweden); Stefan Wagner, Univ. Siegen (Germany); Frank Niklaus, Mikael Östling, KTH Royal Institute of Technology (Sweden) . . . . . [9083-15]

3:50 pm: **Graphene micro- and nanoplasmonics: physics and applications** *(Invited Paper)*, Farhan Rana, Cornell Univ. (USA) . . . . . [9083-16]

4:10 pm: **Graphene-based active and passive component development on transparent substrates** *(Invited Paper)*, James H. Schaffner, Kyung-Ah Son, Hyok J. Song, Jeong S. Moon, Andrey A. Kiselev, Hwa-Chang Seo, Baohua Yang, Danny Wong, HRL Labs., LLC (USA) . . . . . [9083-17]

GREEN PHOTONICS

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

Watch for this icon next to conferences discussing innovative ways to help our planet.

Defense + Security Plenary Presentation

MON 5:00 TO 6:00 PM
LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

TUESDAY 6 MAY

SESSION 5

LOCATION: CONV. CTR. ROOM 336 . . . TUE 8:00 AM TO 9:40 AM

1D Nanoelectronics: Nanowire and Nanotube Architecture Transistors

Session Chair: **Muhammad M. Hussain,** King Abdullah Univ. of Science and Technology (Saudi Arabia)

8:00 am: **Nanowires: Building blocks for nanocomputing to nanobioelectronics** *(Keynote Presentation)*, Charles M. Lieber, Harvard Univ. (USA) . . . . . [9083-18]

8:30 am: **Group IV nanotube transistors for next-generation ubiquitous computing** *(Invited Paper)*, Hossain M. Fahad, Aftab M. Hussain, Galo A. Torres Sevilla, King Abdullah Univ. of Science and Technology (Saudi Arabia); Sanjay K. Banerjee, The Univ. of Texas at Austin (USA); Muhammad M. Hussain, King Abdullah Univ. of Science and Technology (Saudi Arabia) . . . . . [9083-19]

8:50 am: **Piezotronics and piezo-phototronics** *(Keynote Presentation)*, Zhong Lin Wang, Georgia Institute of Technology (USA) . . . . . [9083-20]

9:20 am: **En route toward high-performance electronics based on carbon nanotubes** *(Invited Paper)*, Qing Cao, IBM Thomas J. Watson Research Ctr. (USA) . . . . . [9083-21]

Coffee Break . . . . . Tue 9:40 am to 10:20 am

SESSION 6

LOCATION: CONV. CTR. ROOM 336 . . TUE 10:20 AM TO 12:10 PM

MicroNano Technologies for Adaptive Optics and Beam Control

Session Chairs: **Christopher C. Wilcox,** U.S. Naval Research Lab. (USA); **Matthew E. Jungwirth,** Honeywell Defense and Space Electronic Systems (USA)

10:20 am: **Adaptive Optics Center of Excellence for National Security** *(Keynote Presentation)*, Brij N. Agrawal, Naval Postgraduate School (USA) . . . . . [9083-22]

10:50 am: **Advanced deformable mirrors for high-power lasers** *(Invited Paper)*, Justin D. Mansell, Jesse Jameson, Brian G. Henderson, MZA Associates Corp. (USA) . . . . . [9083-23]

11:10 am: **Exploration of self-phasing in coherently-combined fiber lasers** *(Invited Paper)*, James R. Leger, Univ. of Minnesota, Twin Cities (USA) [9083-24]

11:30 am: **Beam control in multiphoton microscopy using a MEMS spatial light modulator** *(Invited Paper)*, Thomas G. Bifano, Hari P. Paudel, Boston Univ. (USA) . . . . . [9083-25]

11:50 am: **Adaptive optics correction of a laser beam propagating underwater** *(Invited Paper)*, Sergio R. Restaino, Weilin Hou, Andrey Kanaev, Silvia C. Matt, Carlos Omar Font, U.S. Naval Research Lab. (USA) . . . [9083-117]

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

SESSION 7

LOCATION: CONV. CTR. ROOM 336 . . . . TUE 1:30 PM TO 5:20 PM

MicroNano Sensor Systems for Power and Chemical Production Applications

Session Chairs: **Susan M. Maley,** U.S. Dept. of Energy (USA); **Bilge Saruhan-Brings,** Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany)

1:30 pm: **Development and application of fiber optic sensors for power and energy systems** *(Keynote Presentation)*, Susan M. Maley, U.S. Dept. of Energy (USA); Robie Lewis, National Energy Technology Lab. (USA) . . . . . [9083-27]

2:00 pm: **Laser-absorption sensing of gas composition of products of coal gasification** *(Invited Paper)*, Jay B. Jeffries, Ritobrata Sur, Kai Sun, Ronald K. Hanson, Stanford Univ. (USA) . . . . . [9083-28]

2:20 pm: **Industrial Raman gas sensing for real-time system control** *|(Invited Paper)*, Michael P. Buric, Jessica C. Mullen, Steven D. Woodruff, Benjamin T. Chorpening, National Energy Technology Lab. (USA) . . . . [9083-29]

2:40 pm: **Optical fiber Fabry-Perot interferometry for harsh environment sensing** *(Invited Paper)*, Anbo Wang, Virginia Polytechnic Institute and State Univ. (USA) . . . . . [9083-30]

Coffee/Exhibition Break. . . . . Tue 3:00 pm to 3:40 pm

3:40 pm: **Effective design and fabrication of harsh environment gas sensors** *(Invited Paper)*, Prabir K. Dutta, The Ohio State Univ. (USA) . . . . . [9083-31]

4:00 pm: **Trace chemical detection in air using electronic noses and nano-structured sensing materials,** Kurt D. Benkstein, Christopher B. Montgomery, Stephen Semancik, National Institute of Standards and Technology (USA) . . . . . [9083-119]

4:20 pm: **Metal oxide gas sensors on nanoscale** *(Invited Paper)*, Andrej Plecenik, Ali A. Haidry, Tomas Plecenik, Pavol Durina, Martin Truchly, Comenius Univ. in Bratislava (Slovakia); Martin Mosko, Institute of Electrical Engineering (Slovakia); Branislav Grancic, Maros Gregor, Tomas Roch, Leonid Satrapinskyy, Comenius Univ. in Bratislava (Slovakia); Antonia Moskova, Institute of Electrical Engineering (Slovakia); Marian Mikula, Peter Kus, Comenius Univ. in Bratislava (Slovakia) . . . . . [9083-33]

4:40 pm: **Use of nanostructured oxides for selective gas sensing** *(Invited Paper)*, Bilge Saruhan-Brings, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Yakup Goenuellue, Univ. zu Köln (Germany) . . . . . [9083-34]

5:00 pm: **Novel sensors to enable closed-loop active clearance control in power generating gas turbine engines** *(Invited Paper)*, Jonathan L. Geisheimer, Meggitt Sensing Systems (USA); Tom Holst, Meggitt Defense Systems, Inc. (USA). . . . . [9083-35]

POSTERS-TUESDAY

LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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.

Digital level microfabrication for advanced optical structures, Drew J. Boudreau, Marc Christophersen, Michael K. Yetzbacher, U.S. Naval Research Lab. (USA) . . . . . [9083-100]

Wavelength-selective visible-light detector based on integrated graphene transistor and surface plasmon coupler, Christian W. Smith, Douglas Maukonen, Robert E. Peale, Masahiro Ishigami, Univ. of Central Florida (USA); Justin W. Cleary, Air Force Research Lab. (USA) . . . . . [9083-102]

Analysis of flapping mechanism for acoustically actuated microrobotics, Christopher B. House, Samara L. Firebaugh, Jenelle Piepmeier, John Burkhardt, U.S. Naval Academy (USA) . . . . . [9083-103]

Nanoimprint-assisted directed self-assembly of low-molecular weight block copolymers: a route for 3D and multilevel nanostructures, Claudia Delgado Simão, Nikolaos Kehagias, Institut Català de Nanotecnologia (Spain); Michael A. Morris, Univ. College Cork (Ireland); Clivia Sotomayor Torres, Institut Català de Nanotecnologia (Spain). . . . . [9083-104]

CONFERENCE 9083
LOCATION: CONV. CTR. ROOM 336

Modeling and simulation of multilayered thin films for terahertz detection, Fabio Alves, Naval Postgraduate School (USA); Michael F. Martin, U.S. Naval Academy (USA); Ricardo Augusto T. Santos, Instituto Tecnológico de Aeronáutica (Brazil); Dragoslav Grbovic, Naval Postgraduate School (USA) . . . . . [9083-107]

Novel remote sensor systems: design, prototyping, and characterization, Stephen E. Gibbons, James E. Lamb III, Brewer Science, Inc. (USA); Ryan E. Giedd, Missouri State Univ. (USA) . . . . . [9083-108]

Bi-alkali photocathodes based on molecular beam epitaxy for next-generation sensors, Junqi Xie, Marcel Demarteau, Robert G. Wagner, Argonne National Lab. (USA); Xing Wang, Xi'an Institute of Optics and Precision Mechanics (China). . . . . [9083-109]

Novel graphene FETs with field-controlling electrodes to improve RF performance, Chowdhury G. Al-Amin, Raju Sinha, Nezih Pala, Florida International Univ. (USA); Wonbong Choi, Univ. of North Texas (USA) [9083-110]

An optically resonant position read-out system for microcantilever gas sensors, Gino Putrino, Adrian Keating, Mariusz Martyniuk, Lorenzo Faraone, John M. Dell, The Univ. of Western Australia (Australia) . . . . . [9083-112]

Bi-material cantilever sensing technique for measurement of thermal properties of single nanostructures, Carlo Canetta, Arvind Narayanaswamy, Columbia Univ. (USA) . . . . . [9083-114]

Multiplexed optical operation of nanoelectromechanical systems (NEMS) arrays for sensing and signal processing applications, Ashwin Sampathkumar, Riverside Research Institute (USA). . . . . [9083-115]

Spin-on organic polymer dopants for silicon, Bhooshan C. Popere, Megan L. Hoarfrost, Univ. of California, Berkeley (USA); Andrew T. Heitsch, Dow Corning Corp. (USA); Peter Trefonas III, Dow Electronic Materials (USA); Rachel A. Segalman, Univ. of California, Berkeley (USA) . . . . . [9083-118]

WEDNESDAY 7 MAY

SESSION 8
LOCATION: CONV. CTR. ROOM 336 . WED 8:30 AM TO 10:00 AM

Advanced Micro/Nanotechnologies for Solar Energy Generation

Joint session with Conferences 9083 and 9115

Session Chair: **Siva Sivananthan,** EPIR Technologies, Inc. (USA)

8:30 am: **Novel solar cells using II-VI semiconductors** *(Keynote Presentation)*, Sivalingam Sivananthan, James W. Garland, Christoph H. Grein, Robert F. Klie, Univ. of Illinois at Chicago (USA); Ramesh G. Dhere, Episolar Inc. (USA) . . . . . [9083-36]

9:00 am: **Fundamentals and recent results of super-high-efficiency solar cells** *(Invited Paper)*, Masafumi Yamaguchi, Kazuma Ikeda, Yoshio Ohshita, Toyota Technological Institute (Japan) . . . . . [9083-38]

9:20 am: **Nanoscale optimization of quantum dot media for effective photovoltaic conversion** *(Invited Paper)*, Kimberly A. Sablon, U.S. Army Research Lab. (USA) . . . . . [9083-39]

9:40 am: **Using soft x-rays to look into (buried) interfaces of energy conversion devices** *(Invited Paper)*, Clemens Heske, Univ. of Nevada, Las Vegas (USA) and Karlsruher Institut für Technologie (Germany). . . . . [9083-40]

Coffee/Exhibition Break. . . . . .Wed 10:00 am to 10:30 am

SESSION 9
LOCATION: CONV. CTR. ROOM 336 . WED 10:30 AM TO 11:50 AM

Mesodynamic Architectures

Session Chair: **Ryan P. Lu,**
Federal Lab. Consortium for Technology Transfer (USA)

10:30 am: **Coherent feedback and photonic engineering** *(Invited Paper)*, Hideo Mabuchi, Stanford Univ. (USA). . . . . [9083-41]

10:50 am: **Low-power nonlinear nanophotonic circuits for classical information processing** *(Invited Paper)*, Raymond G. Beausoleil, Hewlett-Packard Labs. (USA) . . . . . [9083-42]

11:10 am: **Traveling-wave photon-phonon coupling as the basis for new signal processing technologies** *(Invited Paper)*, Peter T. Rakich, Yale Univ. (USA); Jonathan A. Cox, Sandia National Labs. (USA); Heedeuk Shin, Yale Univ. (USA); Zheng Wang, S. Hossein Mousavi, Hui Dong, The Univ. of Texas at Austin (USA); Rob Jarecki, Aleem Siddiqui, Sandia National Labs. (USA); Robert C. Potter, Rockwell Collins, Inc. (USA) . . . . . [9083-43]

11:30 am: **Coherent signal transduction between photons, microwaves, and spin waves** *(Invited Paper)*, Xufeng Zhang, Hong Tang, Yale Univ. (USA) . . . . . [9083-44]

Lunch/Exhibition Break . . . . . .Wed 11:50 am to 12:50 pm

SESSION 10
LOCATION: CONV. CTR. ROOM 336 . . WED 12:50 PM TO 2:30 PM

3D Printing: An Emerging Technology for Micro/Nano Device Fabrication

Session Chair: **Michael C. McAlpine,** Princeton Univ. (USA)

12:50 pm: **Self-assembly and programmable materials** *(Invited Paper)*, Skylar Tibbits, Massachusetts Institute of Technology (USA). . . . . [9083-45]

1:10 pm: **Programmable synthesis and integrated chemical discovery enabled by 3D-printed reactionware** *(Invited Paper)*, Lee Cronin, Univ. of Glasgow (United Kingdom) . . . . . [9083-46]

1:30 pm: **3D printed bionic ears** *(Invited Paper)*, Manu Sebastian Mannoor, Ziwen Jiang, Princeton Univ. (USA); Teena James, Johns Hopkins Univ. (USA); Yong Lin Kong, Karen Malatesta, Winston W. O. Soboyejo, Naveen Verma, Princeton Univ. (USA); David H. Gracias, Johns Hopkins Univ. (USA); Michael C. McAlpine, Princeton Univ. (USA). . . . . [9083-47]

1:50 pm: **Moving toward multifunctional additive manufacturing** *(Invited Paper)*, Christopher J. Tuck, The Univ. of Nottingham (United Kingdom) . . . . . [9083-48]

2:10 pm: **3D printing of liquid metals for stretchable and flexible conductors** *(Invited Paper)*, Michael Dickey, Collin Ladd, John F. Muth, Ju-Hee So, North Carolina State Univ. (USA) . . . . . [9083-49]

SESSION 11
LOCATION: CONV. CTR. ROOM 336 . . . WED 2:30 PM TO 6:20 PM

Flexible Electronics: Multifaceted Evolutions and Applications

Session Chair: **Muhammad M. Hussain,** King Abdullah Univ. of Science and Technology (Saudi Arabia)

2:30 pm: **Some recent developments in stretchable and flexible electronics** *(Keynote Presentation)*, John A. Rogers, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [9083-50]

2:50 pm: **Adapting MEMS technology to soft, bioelectronics interfaces** *(Invited Paper)*, Stephanie P. Lacour, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [9083-51]

Coffee Break . . . . . .Wed 3:10 pm to 3:40 pm

3:40 pm: **Advanced flexible electronics: challenges and opportunities** *(Invited Paper)*, Stephen W. Bedell, IBM Thomas J. Watson Research Ctr. (USA) . . . . . [9083-52]

4:00 pm: **High performance Bio-integrated Devices** *(Invited Paper)*, Dae-Hyeong Kim, Jongha Lee, Minjoon Park, Seoul National Univ. (Korea, Republic of) . . . . . [9083-53]

4:20 pm: **High-performance flexible microwave passives on plastic** *(Invited Paper)*, Zhenqiang Ma, Univ. of Wisconsin-Madison (USA); Weidong Zhou, The Univ. of Texas at Arlington (USA). . . . . [9083-57]

4:40 pm: **Mechanics of flexible electronics and photonics based on inorganic micro- and nanomaterials** *(Invited Paper)*, Nanshu Lu, The Univ. of Texas at Austin (USA) . . . . . [9083-55]

5:00 pm: **Transformational electronics: A powerful way to revolutionize our information world** *(Invited Paper)*, Muhammad M. Hussain, Jhonathan P. Rojas, Galo A. Torres Sevilla, Mohamed T. Ghoneim, Aftab M. Hussain, Sally M. Ahmed, Joanna M. Nassar, Rabab R. Bahabry, Maha Nour, Arwa T. Kutbee, Amal M. AlAmri, King Abdullah Univ. of Science and Technology (Saudi Arabia); John A. Rogers, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [9083-54]

5:20 pm: **Arthropod eye-inspired digital camera with unique imaging characteristics** *(Invited Paper)*, Jianliang Xiao, Univ. of Colorado at Boulder (USA); Young Min Song, Yizhu Xie, Viktor Malyarchuk, Univ. of Illinois at Urbana-Champaign (USA); Inhwa Jung, Kyung Hee Univ. (Korea, Republic of); Zhuangjian Liu, A*STAR Institute of High Performance Computing (Singapore); Chaofeng Lu, Zhejiang Univ. (China); Rak Hwan Kim, Univ. of Illinois at Urbana-Champaign (USA); Rui Li, Dalian Univ. of Technology (China); Kenneth B. Crozier, Harvard Univ. (USA); Yonggang Huang, Northwestern Univ. (USA); John A. Rogers, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [9083-58]

5:40 pm: **Soft, stretchable bio-integrated systems for continuous health monitoring** *(Invited Paper)*, Roozbeh Ghaffari, Yung-Yu Hsu, Xianyan Wang, Pinghung H. Wei, Milan Raj, Mitul Dalal, Briana Morey, Bryan Keen, MC10, Inc. (USA) . . . . . [9083-59]

6:00 pm: **Two-dimensional atomic sheets for heterogeneous flexible high-frequency and low-power nanoelectronics** *(Invited Paper)*, Deji Akinwande, The Univ. of Texas at Austin (USA) . . . . . [9083-56]

THURSDAY 8 MAY

SESSION 12
LOCATION: CONV. CTR. ROOM 336 . . . THU 8:30 AM TO 10:10 AM

Micro Autonomous Systems Technology (MAST): Performance Bounds and Trade Space Studies

Joint Session with Conferences 9083/9084/9096

Session Chair: **William D. Nothwang,** U.S. Army Research Lab. (USA)

8:30 am: **From wakes to wings: Using a multi-fidelity approach to design flapping wings** *(Invited Paper)*, David J. Willis, Univ. of Massachusetts Lowell (USA) . . . . . [9083-60]

8:50 am: **Characterization and enhancement of micro brushless DC motor response** *(Invited Paper)*, Joseph K. Conroy, U.S. Army Research Lab. (USA); Andrew Kehlenbeck, Univ. of Maryland, College Park (USA); James S. Humbert, Univ. of Maryland, College Park (USA). . . . . [9083-61]

9:10 am: **Power and weight considerations in small, agile quadrotors** *(Invited Paper)*, Yash Mulgaonkar, Michael Whitzer, Univ. of Pennsylvania (USA); Brian Morgan, Christopher M. Kroninger, Aaron M. Harrington, U.S. Army Research Lab. (USA); Vijay Kumar, Univ. of Pennsylvania (USA) . . . . . [9083-62]

9:30 am: **Endurance bounds of aerial systems** *(Invited Paper)*, Aaron M. Harrington, U.S. Army Research Lab. (USA). . . . . [9083-63]

9:50 am: **Autonomous charging to enable long-endurance missions for small aerial robots** *(Invited Paper)*, Yash Mulgaonkar, Vijay Kumar, Univ. of Pennsylvania (USA) . . . . . [9083-64]

Coffee Break . . . . . Thu 10:10 am to 10:40 am

SESSION 13
LOCATION: CONV. CTR. ROOM 336 . THU 10:40 AM TO 12:00 PM

Micro Autonomous Systems Technology (MAST): Power Solutions

Joint Session with Conferences 9083/9084/9096

Session Chairs: **William D. Nothwang,** U.S. Army Research Lab. (USA); **Christopher M. Kroninger,** U.S. Army Research Lab. (USA)

10:40 am: **MEMS-based approaches for miniature power supply applications** *(Invited Paper)*, Sarah S. Bedair, Christopher D. Meyer, Jeffrey S. Pulskamp, Brian Morgan, Ronald G. Polcawich, U.S. Army Research Lab. (USA); Christopher Dougherty, Xue Lin, David Arnold, Rizwan Bashirullah, Univ. of Florida (USA); Iain Kierzewski, Nathan Lazarus, Joel Martin, Brian Power, U.S. Army Research Lab. (USA) . . . . . [9083-65]

11:00 am: **Power management for small scale systems** *(Invited Paper)*, Christopher D. Meyer, Sarah S. Bedair, Brian Morgan, U.S. Army Research Lab. (USA); David Arnold, Univ. of Florida (USA); Nathan Lazarus, Iain Kierzewski, U.S. Army Research Lab. (USA) . . . . . [9083-66]

11:20 am: **High-specific energy and specific power aluminum/air primary battery for micro-air-vehicles** *(Invited Paper)*, Andrew Kindler, Lawrence Matthies, Jet Propulsion Lab. (USA) . . . . . [9083-67]

11:40 am: **Thermophotovoltaic and thermoelectric portable power generators** *(Invited Paper)*, Walker Chan, Massachusetts Institute of Technology (USA); Christopher M. Waits, U.S. Army Research Lab. (USA); Marin Soljacic, Massachusetts Institute of Technology (USA); John D. Joannopoulos, MIT Institute for Soldier Nanotechnologies (USA); Ivan Celanovic, Massachusetts Institute of Technology (USA) . . . . . [9083-68]

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

SESSION 14
LOCATION: CONV. CTR. ROOM 336 . . . . THU 1:00 PM TO 2:50 PM

Self-assembled, Block-copolymer, Nano-structures for Energy and Sensor Applications

Session Chairs: **Parvaneh Mokarian-Tabari,** Univ. College Cork (Ireland); **Michael A. Morris,** Univ. College Cork (Ireland)

1:00 pm: **Self-assembled nanostructures as templates for patterned surfaces with non-microelectronic applications** *(Keynote Presentation)*, Michael A. Morris, Univ. College Cork (Ireland) . . . . . [9083-69]

1:30 pm: **Engineering material properties using block copolymer self-assembly** *(Invited Paper)*, Atikur Rahman, Antonio Checco, Matthew Eisaman, Charles T. Black, Brookhaven National Lab. (USA) . . . . . [9083-70]

1:50 pm: **Patterning of magnetic nanostructures using Si-containing block copolymers** *(Invited Paper)*, Caroline A. Ross, Massachusetts Institute of Technology (USA) . . . . . [9083-71]

2:10 pm: **Soft matter design principles for inorganic photonic nanoarchitectures in photovoltaics, colorimetric sensing, and self-cleaning antireflective coatings** *(Invited Paper)*, Stefan Guldin, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [9083-72]

2:30 pm: **Directed self-assembly for extending patterning capability** *(Invited Paper)*, Joy Y. Cheng, IBM Research - Almaden (USA) . . . . . [9083-73]

Coffee Break . . . . . Thu 2:50 pm to 3:20 pm

SESSION 15
LOCATION: CONV. CTR. ROOM 336 . . . . THU 3:20 PM TO 5:50 PM

Innovations in Multimodal Molecular Probes

Joint Session with Conferences 9083 and 9107

Session Chairs: **Antonio Sastre,** National Institutes of Health (USA); **Richard Conroy,** National Institutes of Health (USA)

3:20 pm: **The era of nanomedicine: perspectives and potential applications in oncology** *(Keynote Presentation)*, Samuel Achilefu, Washington Univ. School of Medicine in St. Louis (USA). . . . . [9083-74]

3:50 pm: **Clinically-translated ultra-small silica nanoparticles for cancer-targeted imaging** *(Invited Paper)*, Michelle S. Bradbury, Pat B. Zanzonico, Snehal Patel, Richard Carvajal, Steven M. Larson, Memorial Sloan-Kettering Cancer Ctr. (USA); Ulrich B. Wiesner, Cornell Univ. (USA) . . . . . [9083-75]

4:10 pm: **Bimodal imaging probes: design and applications** *(Invited Paper)*, Peter Caravan, Massachusetts General Hospital (USA) . . . . . [9083-76]

4:30 pm: **Quantitative simultaneous PET-MR imaging** *(Invited Paper)*, Georges El Fakhri, Massachusetts General Hospital (USA) . . . . . [9083-77]

4:50 pm: **Translational molecular imaging in oncology** *(Invited Paper)*, Sridhar Nimmagadda, Johns Hopkins Univ. (USA) . . . . . [9083-78]

5:10 pm: **18F-PET/fluorescent multimodality imaging and an 18F-analogue to the 99mTc generator for solid-phase 18F-PET/fluorescent antibody generation** *(Invited Paper)*, Richard Ting, Univ. of California, San Diego (USA) . . . . . [9083-79]

5:30 pm: **Ultrasound-switchable fluorescence at near-infrared wavelength for deep-tissue high-resolution imaging** *(Invited Paper)*, Baohong Yuan, Mingyuan Wei, Yanbo Pei, Yuan Liu, Zhiwei Xie, Bingbing Cheng, Kytai T. Nguyen, The Univ. of Texas at Arlington (USA). . . . . [9083-80]

CONFERENCE 9083
LOCATION: CONV. CTR. ROOM 336

POSTERS-THURSDAY
LOCATION: CONV. CTR. HALL C . . . . . .THU 6:00 PM 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.

Imaging quality comparison of two typical methods for imaging through turbid media, Xiaopeng Shao, Tengfei Wu, Changmei Gong, Xidian Univ. (China) . . . . . [9083-105]

Sensing systems using chip-based spectrometers, Arthur Nitkowski, Kyle J. Preston, Nicolás Sherwood-Droz, Tornado Spectral Systems (USA); Jeffrey T. Meade, Yusuf Bismilla, Brandon DesRoches, Andrew T. Cenko, Elizabeth A. Munro, Jared Slaa, Tornado Spectral Systems (Canada); Bradford B. Behr, Tornado Spectral Systems (USA); Arsen R. Hajian, Tornado Spectral Systems (Canada) . . . . . [9083-106]

Graphene shield-enhancement of photosensitive surfaces and devices, Nathan A. Moody, Los Alamos National Lab. (USA) . . . . . [9083-111]

A low-power CMOS flash ADC converter for temperature sensor, Md. Mamum, Md Mamun Bin Ibne Reaz, Mohammad T. Islam, Univ. Kebangsaan Malaysia (Malaysia) . . . . . [9083-116]

FRIDAY 9 MAY

SESSION 16
LOCATION: CONV. CTR. ROOM 336 . . . FRI 8:30 AM TO 10:20 AM

High-accuracy Space-based Radiometry

Session Chair: **Stergios J. Papadakis,**
Johns Hopkins Univ. Applied Physics Lab. (USA)

8:30 am: **NASA ESTO's strategic investments in space-based radiometer technology and flight validation** *(Keynote Presentation)*, Charles D. Norton, Jet Propulsion Lab. (USA) . . . . . [9083-81]

9:00 am: **The power of inexpensive satellite constellations** *(Invited Paper)*, Lars P. Dyrud, Draper Lab. (USA) . . . . . [9083-82]

9:20 am: **RAVAN: A pathfinder for accurate Earth radiation budget measurements** *(Invited Paper)*, Dong L. Wu, Warren J. Wiscombe, NASA Goddard Space Flight Ctr. (USA); William H. Swartz, Johns Hopkins Univ. Applied Physics Lab. (USA); Lars P. Dyrud, Draper Lab. (USA); Steven R. Lorentz, L-1 Standards and Technology, Inc. (USA); Stergios J. Papadakis, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9083-83]

9:40 am: **High-accuracy radiometer and calibrator design for an ESTO CubeSat Mission: RAVAN** *(Invited Paper)*, Steven R. Lorentz, Allan W. Smith, L-1 Standards and Technology, Inc. (USA); William H. Swartz, Johns Hopkins Univ. Applied Physics Lab. (USA); Lars P. Dyrud, Draper Lab. (USA); Warren J. Wiscombe, Dong L. Wu, NASA Goddard Space Flight Ctr. (USA); Stergios J. Papadakis, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9083-84]

10:00 am: **Carbon nanotubes as a photon filter for energetic particle detectors** *(Invited Paper)*, David M. Deglau, Donald G. Mitchell, Andrew H. Monica, G. Bruce Andrews, John E. Mattson, Stergios J. Papadakis, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9083-85]

Coffee Break . . . . . Fri 10:20 am to 10:50 am

SESSION 17
LOCATION: CONV. CTR. ROOM 336 . . .FRI 10:50 AM TO 11:40 AM

Nanotechnology for Millimeter-Wave Sensing I

Joint Session with Conferences 9083 and 9078

Session Chair: **Michael K. Rafailov,** Univ. of Alberta (Canada)

10:50 am: **Terahertz electronics for sensing applications** *(Keynote Presentation)*, Michael S. Shur, Rensselaer Polytechnic Institute (USA) . . . . . [9083-86]

11:20 am: **mmW staring focal plane arrays for security applications** *(Invited Paper)*, Michael A. Gritz, Leonard P. Chen, Borys Kolasa, Robert Burkholder, Sean F. Harris, Raytheon Co. (USA); Brian A. Lail, Florida Institute of Technology (USA) . . . . . [9083-88]

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

SESSION 18
LOCATION: CONV. CTR. ROOM 336 . . . .FRI 1:00 PM TO 2:00 PM

Nanotechnology for Millimeter-Wave Sensing II

Joint Session with Conferences 9083 and 9078

Session Chair: **Michael K. Rafailov,** Univ. of Alberta (Canada)

1:00 pm: **Plasmonic terahertz optoelectronics for higher performance terahertz imaging systems** *(Invited Paper)*, Christopher W. Berry, Ning Wang, Mohammad R. Hashemi, Mona Jarrahi, Univ. of Michigan (USA) . . . . . [9078-23]

1:20 pm: **Case study of concealed weapons detection at stand-off distances using a compact, large field-of-view THz camera** *(Invited Paper)*, Linda Marchese, Marc Terroux, Denis G. Dufour, Martin Bolduc, Claude Chevalier, Francis Genereux, Hubert Jerominek, Alain Bergeron, INO (Canada) . . . . . [9083-89]

1:40 pm: **Resonant-tunneling-enhanced plasmonic terahertz devices** *(Invited Paper)*, Berardi Sensale Rodriguez, Univ. of Utah (USA); Huili G. Xing, Univ. of Notre Dame (USA) . . . . . [9078-24]

SESSION 19
LOCATION: CONV. CTR. ROOM 336 . . . . FRI 2:00 PM TO 3:00 PM

Micro/Nanotechnologies for Lasers and Standoff Detection I

Joint Session with Conferences 9083/9073/9106

Session Chair: **Michael K. Rafailov,** Univ. of Alberta (Canada)

2:00 pm: **Re-engineering defense and homeland security applications using MWIR and LWIR QCLs** *(Keynote Presentation)*, C. Kumar N. Patel, Pranalytica, Inc. (USA) . . . . . [9083-90]

2:20 pm: **Ultrafast laser bleaching technique for stand-off characterization and augmentation** *(Invited Paper)*, Inna Zakharova, Univ. of Alberta (Canada) and Volyn State Univ. (Ukraine) . . . . . [9083-91]

2:40 pm: **Approaches to generation of tunable mid-IR ultrafast pulses with fiber sources** *(Invited Paper)*, Igor Pastirk, TOPTICA Photonics Inc. (USA); Andreas Brodschelm, Alexander Sell, TOPTICA Photonics AG (Germany) . . . . . [9083-92]

Coffee Break . . . . . Fri 3:00 pm to 3:30 pm

SESSION 20
LOCATION: CONV. CTR. ROOM 336 . . . . . FRI 3:30 PM TO 5:10 PM

Micro/Nanotechnologies for Lasers and Standoff Detection II

Joint Session with Conferences 9083/9073/9106

Session Chair: **Michael K. Rafailov,** Univ. of Alberta (Canada)

3:30 pm: **Ultrafast fiber lasers: practical applications** *(Invited Paper)*, Igor Pastirk, TOPTICA Photonics Inc. (USA) . . . . . [9083-93]

3:50 pm: **Standoff laser photoacoustic spectroscopic-based sensor for remote sensing** *(Invited Paper)*, Ramesh C. Sharma, Anil K. Maini, Laser Science and Technology Ctr. (India) . . . . . [9083-94]

4:10 pm: **A mobile platform for infrared photothermal imaging of trace explosives** *(Invited Paper)*, Christopher A. Kendziora, Robert Furstenberg, Michael R. Papantonakis, Viet Nguyen, Jeff M. Byers, R. Andrew McGill, U.S. Naval Research Lab. (USA) . . . . . [9083-95]

4:30 pm: **Point and standoff detection of trace explosives using quantum cascade lasers** *(Invited Paper)*, Seonghwan Kim, Univ. of Calgary (Canada); Dongkyu Lee, Xunchen Liu, Charles W. Van Neste, Thomas G. Thundat, Univ. of Alberta (Canada) . . . . . [9083-96]

4:50 pm: **Recent advances in quantum cascade external cavity laser systems for sensing applications** *(Invited Paper)*, Leigh J. Bromley, David B. Arnone, David B. Caffey, William B. Chapman, Sam Crivello, Timothy Day, Allen Priest, Michael Pushkarsky, Daylight Solutions Inc. (USA); Charles C. Harb, The Univ. of New South Wales (Australia) . . . . . [9083-97]

CONFERENCE 9084

LOCATION: CONV. CTR. ROOM 328

Tuesday - Thursday 6 - 8 May 2014 • Proceedings of SPIE Vol. 9084

Unmanned Systems Technology XVI

Conference Chairs: **Robert E. Karlsen,** U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); **Douglas W. Gage,** XPM Technologies (USA); **Charles M. Shoemaker,** U.S. Army Communications-Electronics Research Development and Engineering Command (USA); **Grant R. Gerhart,** U.S. Army Tank-Automotive Research, Development, and Engineering Ctr.-Retired (USA)

Program Committee: **Jonathan A. Bornstein,** U.S. Army Research Lab. (USA); **Jared Giesbrecht,** Defence Research and Development Canada, Suffield (Canada); **Frank L. Lewis,** The Univ. of Texas at Arlington (USA); **Larry H. Matthies,** Jet Propulsion Lab. (USA); **Camille S. Monnier,** Charles River Analytics, Inc. (USA); **Paul L. Muench,** U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); **Hoa G. Nguyen,** Space and Naval Warfare Systems Ctr. Pacific (USA); **James L. Overholt,** Air Force Research Lab. (USA); **Mike Perschbacher,** RovnoTech (USA); **Marc Raibert,** Boston Dynamics (USA); **Klaus-Juergen Schilling,** Julius-Maximilians-Univ. Würzburg (Germany); **Anthony Stentz,** Carnegie Mellon Univ. (USA); **Gary Witus,** Turing Associates, Inc. (USA); **Brian M. Yamauchi,** iRobot Corp. (USA)

TUESDAY 6 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 328 .... TUE 1:00 PM TO 5:10 PM

Special Topics

Session Chairs: **Douglas W. Gage,** XPM Technologies (USA); **Charles M. Shoemaker,** U.S. Army Communications-Electronics Research Development and Engineering Command (USA)

1:00 pm: **Neurobiomimetic constructs for intelligent unmanned systems and robotics**, Jerome J. Braun, Danelle C. Shah, Marianne A. DeAngelus, MIT Lincoln Lab. (USA). . . . . [9084-1]

1:20 pm: **Intermittent communications modeling and simulation for autonomous unmanned maritime vehicles using an integrated APM and FSMC framework**, Ayodeji Coker, Logan Straatemeier, SPAWARSYSCEN Pacific: San Diego (USA); Kelly Griendling, Pierre Valdez, Georgia Institute of Technology (USA); Ted Rogers, SPAWARSYSCEN Pacific: San Diego (USA); Daniel Cooksey, Georgia Institute of Technology (USA). . . . . [9084-2]

1:40 pm: **The impact of autonomy on robotic ground vehicle communications**, Charles M. Shoemaker, U.S. Army Communications-Electronics Research Development and Engineering Command (USA) . . [9084-3]

2:00 pm: **Automating software design and configuration for a small spacecraft**, Jeremy Straub, The Univ. of North Dakota (USA). . . . . [9084-4]

2:20 pm: **Modeling and simulation of an unmanned ground vehicle power system**, John A. Broderick, Univ. of Michigan (USA); Jack Hartner, U.S. Army RDECOM-TARDEC (USA); Dawn M. Tilbury, Ella M. Atkins, Univ. of Michigan (USA) . . . . . [9084-5]

2:40 pm: **Mobility as a game of timing with terrain: a variant of the rocket car control problem**, Paul L. Muench, David Bednarz, Amandeep Singh, Jeremy Mange, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA). . . . . [9084-6]

Coffee Break . . . . . Tue 3:00 pm to 3:30 pm

3:30 pm: **Autonomous self-righting using recursive Bayesian estimation to determine unknown ground angle**, Jason Collins, Engility Corp. (USA); Chad Kessens, U.S. Army Research Lab. (USA). . . . . [9084-8]

3:50 pm: **Multi-arm multilateral haptics-based immersive tele-tobotic system (HITS) for improvised explosive device disposal**, David Erickson, Defence Research and Development Canada, Suffield (Canada); Hervé Lacheray, Gilbert Lai, Amir Haddadi, Quanser Inc. (Canada) . . . . . [9084-9]

4:10 pm: **Investigating operator aids for autonomous unmanned ground vehicles**, Arthur W. Evans III, U.S. Army Research Lab. (USA) . . . . . [9084-10]

4:30 pm: **Speech and gesture interfaces for squad level human robot teaming**, Jonathan T. Harris, Daniel Barber, Univ. of Central Florida (USA) . . . . . [9084-11]

4:50 pm: **New generation of human machine interfaces for controlling UAV through depth-based gesture recognition**, Tomás Mantecón, Carlos Roberto del Blanco, Fernando Jaureguizar, Narciso García, Univ. Politécnica de Madrid (Spain) . . . . . [9084-12]

TUESDAY 6 MAY

POSTERS-TUESDAY . . . . . TUE 6:00 PM 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 session. 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 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.

Detecting binary non-return-to-zero data in free-space optical communication systems using FPGAs, Vy Bui, Lan Tran, Esam El-Araby, Nader M. Namazi, The Catholic Univ. of America (USA). . . . . [9080-53]

A practical approach to considering uncertainties in the creation of autonomous behaviors in unmanned surface vehicles, Zi Jing Bay, Yip Fatt Lee, Kwok Wai Yue, Ai Peng New, Hao Yi Gan, DSO National Laboratories (Singapore) . . . . . [9084-35]

HALOS: fast compact, autonomous adaptive optics for UAVs, Geoff P. Andersen, Paul Gelsinger-Austin, Phani Gaddipati, Ravi Gaddipati, Fassil Ghebremichael, Hua, Inc. (USA) . . . . . [9084-36]

Use of eternal flight unmanned aircraft in operations, Zafer Kok, Turkish Air Force Academy (Turkey) . . . . . [9084-37]

Roll angle measurement using a polarization scanning reference source, Harbans S. Dhadwal, Jahangir Rastegar, Varun Kankipati, Omnitek Partners, LLC (USA) . . . . . [9084-38]

Tiered approach to autonomous radiation search, John S. Clemmensen, Remote Sensing Lab. (USA) . . . . . [9084-39]

Controlling UCAVs by JTACs in CAS missions, Ahmet Emre Kumaş, Turkish Air War College (Turkey) . . . . . [9084-40]

A distributed equipment monitoring and remedial control system based on a collaboration paradigm, Tom Freund, Dig.y.SoL™ (USA). . . . . [9084-41]

Calculation and simulation of hydrodynamic forces for a novel detecting spherical robot, Yansheng Li, Hanxu Sun, Yanheng Zhang, Beijing Univ. of Posts and Telecommunications (China); Ming Chu, Beijing Univ. of Posts and Telecommunications School of Automation (China); Qingxuan Jia, Beijing Univ. of Posts and Telecommunications (China); Xiaojuan Lan, Beijing University of Posts and Telecommunications School of Automation (China) . . . . . [9084-42]

The auxiliary navigation unit and working mechanism for UAVs, Adem Çakir, Turkish Air Force Academy (Turkey) . . . . . [9084-44]

Current and future possibilities of V2V and I2V technologies: an analysis directed toward augmented reality systems, J. Alejandro Betancur, Andrés Yarce, Aida K. Arnedo, Gilberto Osorio, Univ. EAFIT (Colombia) . . . . . [9084-45]

A 10 GHz polarization scanning reference source, Harbans S. Dhadwal, Jahangir Rastegar, Omnitek Partners, LLC (USA). . . . . [9084-46]

CONFERENCE 9084
LOCATION: CONV. CTR. ROOM 328

WEDNESDAY 7 MAY

SESSION 2
LOCATION: CONV. CTR. ROOM 328 . . WED 8:30 AM TO 10:30 AM

Keynote Session

Joint Session with Conferences 9096 and 9084

Session Chairs: **Raja Suresh,** General Dynamics Advanced Information Systems (USA); **Robert E. Karlsen,** U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA)

Open Architecture (OA)/Open Business Model (OBM) Systems

8:30 am: **Navy perspectives on open architecture unmanned systems** *(Keynote Presentation)*, Mathias W. Winter, Rear Admiral, NAVAIR (USA) . . . . . [9096-19]

9:00 am: **Open architecture applied to next-generation weapons** *(Keynote Presentation)*, Leo J. Rose, Air Force Research Lab. (USA) . . . . . [9096-20]

9:30 am: **General Dynamics journey in open architecture systems** *(Keynote Presentation)*, Michael A. Eagan, General Dynamics Advanced Information Systems (USA) . . . . . [9096-21]

10:00 am: **Robotic collaborative technology alliance: an open architecture approach to integrated research** *(Keynote Presentation)*, Robert M. Dean, Charles A. Diberardino, General Dynamics Land Systems (USA) . . . . . [9096-22]

Coffee Break . . . . . .Wed 10:30 am to 11:00 am

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 328 . . . . . WED 11:00 AM TO 12:00 PM

Open Architecture (OA) Open Business Mode (OBM) Systems

Joint Panel Discussion with Conferences 9096 and 9084

Moderator: **Raja Suresh,** General Dynamics Advanced Information Systems (USA)

Panelists:

Rear Admiral Mathias Winter, Program Executive Officer, Unmanned Aviation and Strike Weapons, U.S. Navy (USA)

Leo Rose, Air Force Research Lab. (USA)

Mike Eagan, Vice President, General Dynamics Advanced Information Systems (USA)

Robert Dean, General Dynamics Robotic Systems (USA)

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

SESSION 3
LOCATION: CONV. CTR. ROOM 328 . . . WED 1:30 PM TO 5:00 PM

RCTA

Session Chair: **Jonathan A. Bornstein,** U.S. Army Research Lab. (USA)

1:30 pm: **Supporting task-oriented collaboration in human-robot teams using semantic-based path planning**, Daqing Yi, Michael Goodrich, Brigham Young Univ. (USA). . . . . [9084-13]

1:50 pm: **Determinants of system transparency, and its influence on trust in and reliance on unmanned robotic systems**, Scott Ososky, Tracy Sanders, Florian Jentsch, Peter Hancock, Univ. of Central Florida (USA); Jessie Chen, U.S. Army Research Lab. (USA) . . . . . [9084-14]

2:10 pm: **An interdisciplinary taxonomy of social cues and signals in the service of engineering robotic social intelligence**, Travis J. Wiltshire, Emilio J. Lobato, Jonathan Velez, Florian Jentsch, Stephen M. Fiore, Univ. of Central Florida (USA) . . . . . [9084-15]

2:30 pm: **Validation and verification of a high-fidelity computational model for a bounding robot's parallel actuated elastic spine**, Jason L. Pusey, U.S. Army Research Lab. (USA); Jeffrey M. Duperret, Daniel E. Koditschek, Univ. of Pennsylvania (USA) . . . . . [9084-16]

2:50 pm: **Temporally consistent segmentation of point clouds**, Jason L. Owens, U.S. Army Research Lab. (USA); Philip Osteen, Engility Corp. (USA); Kostas Daniilidis, Univ. of Pennsylvania (USA) . . . . . [9084-18]

Coffee Break . . . . . .Wed 3:10 pm to 3:40 pm

3:40 pm: **Common world model for unmanned systems: phase 2**, Robert M. Dean, General Dynamics Land Systems (USA). . . . . [9084-19]

4:20 pm: **Field demonstration of an autonomous small ground robot using a MEMS-scanned ladar**, Michael A. Powers, General Dynamics Robotic Systems (USA); Barry L. Stann, Mark M. Giza, U.S. Army Research Lab. (USA) . [9084-20]

4:40 pm: **Autonomous whole-body locomotion via three-dimensional visual sensing**, atthew Travers, Howie Choset, Carnegie Mellon Univ. . . . . [9084-21]

5:00 pm: **Tip-over prevention through heuristic reactive behaviors for unmanned ground vehicles**, Kurt A. Talke, SPAWARSYSCEN Pacific: San Diego (USA); Leah Kelley, SPAWARSYSCEN Pacific: San Diego (USA) and Massachusetts Institute of Technology (USA); Patrick Longhini, Garret Catron, SPAWARSYSCEN Pacific: San Diego (USA) . . . . . [9084-7]

THURSDAY 8 MAY

SESSION 4
LOCATION: CONV. CTR. ROOM 336 . . . THU 8:30 AM TO 10:10 AM

NOTE ROOM CHANGE

Micro Autonomous Systems Technology (MAST): Performance Bounds and Trade Space Studies

Joint Session with Conferences 9083/9084/9096

Session Chairs: **Christopher M. Kroninger,** U.S. Army Research Lab. (USA); **William D. Nothwang,** U.S. Army Research Lab. (USA)

8:30 am: **From wakes to wings: Using a multi-fidelity approach to design flapping wings** *(Invited Paper)*, David J. Willis, Univ. of Massachusetts Lowell (USA) . . . . . [9083-60]

8:50 am: **Characterization and enhancement of micro brushless DC motor response** *(Invited Paper)*, Joseph K. Conroy, U.S. Army Research Lab. (USA); Andrew Kehlenbeck, Univ. of Maryland, College Park (USA); James S. Humbert, Univ. of Maryland, College Park (USA). . . . . [9083-61]

9:10 am: **Power and weight considerations in small, agile quadrotors** *(Invited Paper)*, Yash Mulgaonkar, Michael Whitzer, Univ. of Pennsylvania (USA); Brian Morgan, Christopher M. Kroninger, Aaron M. Harrington, U.S. Army Research Lab. (USA); Vijay Kumar, Univ. of Pennsylvania (USA) . . . . . [9083-62]

9:30 am: **Endurance bounds of aerial systems** *(Invited Paper)*, Aaron M. Harrington, U.S. Army Research Lab. (USA). . . . . [9083-63]

9:50 am: **Autonomous charging to enable long-endurance missions for small aerial robots** *(Invited Paper)*, Yash Mulgaonkar, Vijay Kumar, Univ. of Pennsylvania (USA) . . . . . [9083-64]

Coffee Break . . . . . Thu 10:10 am to 10:40 am

SESSION 5
LOCATION: CONV. CTR. ROOM 336 . THU 10:40 AM TO 12:00 PM

NOTE ROOM CHANGE

Micro Autonomous Systems Technology (MAST): Power Solutions

Joint Session with Conferences 9083/9084/9096

Session Chairs: **William D. Nothwang,** U.S. Army Research Lab. (USA); **Christopher M. Kroninger,** U.S. Army Research Lab. (USA)

10:40 am: **MEMS-based approaches for miniature power supply applications** *(Invited Paper)*, Sarah S. Bedair, Christopher D. Meyer, Jeffrey S. Pulskamp, Brian Morgan, Ronald G. Polcawich, U.S. Army Research Lab. (USA); Christopher Dougherty, Xue Lin, David Arnold, Rizwan Bashirullah, Univ. of Florida (USA); Iain Kierzewski, Nathan Lazarus, Joel Martin, Brian Power, U.S. Army Research Lab. (USA) . . . . . [9083-65]

11:00 am: **Power management for small scale systems** *(Invited Paper)*, Christopher D. Meyer, Sarah S. Bedair, Brian Morgan, U.S. Army Research Lab. (USA); David Arnold, Univ. of Florida (USA); Nathan Lazarus, Iain Kierzewski, U.S. Army Research Lab. (USA) . . . . . [9083-66]

11:20 am: **High-specific energy and specific power aluminum/air primary battery for micro-air-vehicles** *(Invited Paper)*, Andrew Kindler, Lawrence Matthies, Jet Propulsion Lab. (USA) . . . . . [9083-67]

11:40 am: **Thermophotovoltaic and thermoelectric portable power generators** *(Invited Paper)*, Walker Chan, Massachusetts Institute of Technology (USA); Christopher M. Waits, U.S. Army Research Lab. (USA); Marin Soljacic, Massachusetts Institute of Technology (USA); John D. Joannopoulos, MIT Institute for Soldier Nanotechnologies (USA); Ivan Celanovic, Massachusetts Institute of Technology (USA) . . . . . [9083-68]

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

SESSION 6
LOCATION: CONV. CTR. ROOM 328 . . . . THU 1:00 PM TO 3:00 PM

Mobility and Navigation

Session Chairs: **Hoa G. Nguyen,** Space and Naval Warfare Systems Ctr. Pacific (USA); **Roland Brockers,** Jet Propulsion Lab. (USA)

1:00 pm: **Object guided autonomous exploration for mobile robots in indoor environments**, Carlos P. Nieto-Granda, Siddarth Choudhary, Henrik I. Christensen, Georgia Institute of Technology (USA) . . . . . [9084-22]

1:20 pm: **Development and evaluation of the Stingray: an amphibious maritime interdiction operations unmanned ground vehicle**, Hoa G. Nguyen, Mendel Baker, Space and Naval Warfare Systems Ctr. Pacific (USA); Robin Castelli, Macro USA Corp. (USA) . . . . . [9084-23]

1:40 pm: **Micro air vehicle autonomous obstacle avoidance from stereo-vision**, Roland Brockers, Jet Propulsion Lab (USA); Stephan Weiss, Lawrence Matthies, Jet Propulsion Lab (USA) . . . . . [9084-24]

2:00 pm: **Assisted autonomy of articulated snake robots**, David S. Rollinson, Howie Choset, Carnegie Mellon Univ. (USA) . . . . . [9084-25]

2:20 pm: **Counter tunnel exploration, mapping, and localization unmanned system**, Jacoby Larson, Space and Naval Warfare Systems Ctr. Pacific (USA) . . . . . [9084-26]

2:40 pm: **On the consistency analysis of A-SLAM for UAV navigation**, Ersan A. Oguz, Turkish Air Force Academy (Turkey); Hakan Temeltas, Istanbul Technical Univ. (Turkey). . . . . [9084-27]

Coffee Break . . . . . Thu 3:00 pm to 3:30 pm

SESSION 7
LOCATION: CONV. CTR. ROOM 328 . . . . THU 3:30 PM TO 5:30 PM

Perception

Session Chairs: **Camille S. Monnier,** Charles River Analytics, Inc. (USA); **Paul L. Muench,** U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA)

3:30 pm: **Infrared stereo calibration for unmanned ground vehicle navigation**, Josh Harguess, Space and Naval Warfare Systems Ctr. Pacific (USA); Shawn J. Strange, SAIC (USA). . . . . [9084-29]

3:50 pm: **A robust method for online stereo camera self-calibration in unmanned vehicle system**, Yu Zhao, Hitachi, Ltd. (Japan) . . . . . [9084-30]

4:10 pm: **Investigating clutter reduction for unmanned systems applications using imaging polarimetry**, Jonathan Hanks, Todd Aycock, David B. Chenault, Polaris Sensor Technologies, Inc. (USA). . . . . [9084-31]

4:30 pm: **Absolute localization of ground robots by matching lidar and image data in dense forested environments**, Marwan Hussein, Massachusetts Institute of Technology (USA); Matthew Renner, U.S. Army Engineer Research and Development Ctr. (USA); Karl Iagnemma, Massachusetts Institute of Technology (USA) . . . . . [9084-32]

4:50 pm: **Occluded human recognition for a following leader using 3D range and image data in forest environment**, Kuk Cho, Univ. of Science & Technology (Korea, Republic of); SeungHo Baeg, Sangdeok Park, Korea Institute of Industrial Technology (Korea, Republic of) . . . . . [9084-33]

5:10 pm: **A fast and robust plane detection method from 3D-lidar data**, Hakan Temeltas, Istanbul Technical Univ. (Turkey); Cihan Ulas, TUBITAK UME (Turkey) . . . . . [9084-34]

POSTERS-THURSDAY . . . . . THU 6:00 PM 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 session. 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 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.

UCAV's: What capabilities must be?, Ramazan Ekici, Harpak (Turkey) . . . . . [9084-47]

CONFERENCE 9085

LOCATION: CONV. CTR. ROOM 337

Monday - Tuesday 5 - 6 May 2014 • Proceedings of SPIE Vol. 9085

Sensors and Systems for Space Applications VII

Conference Chairs: **Khanh D. Pham,** Air Force Research Lab. (USA); **Joseph L. Cox,** Missile Defense Agency (USA)

Program Committee: **Lisa Belodoff,** LightWorks Optics, Inc. (USA); **Thomas George,** Zyomed Corp. (USA); **Richard T. Howard,** NASA Marshall Space Flight Ctr. (USA); **Ou Ma,** New Mexico State Univ. (USA); **Tien M. Nguyen,** Raytheon Co. (USA); **Andre Samberg,** Sec-Control Finland Ltd. (Finland); **Henry Zmuda,** Univ. of Florida (USA)

MONDAY 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 337 . . MON 8:50 AM TO 10:10 AM

Pervasive Technologies Supporting Responsive Space

Session Chairs: **Ou Ma,** New Mexico State Univ. (USA); **Joseph L. Cox,** Missile Defense Agency (USA)

8:50 am: **Effects of star crossings on the detection of dim objects in orbit and mitigation strategies for improving detection**, Stephen C. Cain, Air Force Institute of Technology (USA) . . . . . [9085-1]

9:00 am: **Using ATCOM to enhance long-range imagery collected by NASA's flight test tracking cameras at Dryden Flight Research Center**, Petersen F. Curt, Aaron L. Paolini, EM Photonics, Inc. (USA); David Tow, NASA Dryden Flight Research Ctr. (USA); Eric J. Kelmelis, EM Photonics, Inc. (USA) . . . . . [9085-2]

9:30 am: **FalconSAT-7: a membrane space telescope**, Geoff P. Andersen, Olha V. Asmolova, Thomas Dickinson, U.S. Air Force Academy (USA) . . [9085-3]

9:50 am: **SUCHI: the space ultra-compact hyperspectral imager for a small satellite**, Sarah T. Crites, Paul G. Lucey, Robert Wright, Univ. of Hawai'i (USA); Jason T. Akagi, Spectrum Photonics, Inc. (USA); Jeremy Chan, Harold Garbeil, Keith Horton, Amber Imai, Mark Wood, Lance Yoneshige, Univ. of Hawai'i (USA) . . . . . [9085-5]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

SESSION 2

LOCATION: CONV. CTR. ROOM 337 . MON 10:40 AM TO 11:40 AM

Radiation Hardening and Space Weather Effects Mitigation

Session Chairs: **Joseph L. Cox,** Missile Defense Agency (USA); **Richard T. Howard,** NASA Marshall Space Flight Ctr. (USA)

10:40 am: **Morphological analysis and characterization of directional emission structures for spacecraft thermal control**, Bryan Adomanis, Air Force Research Lab. (USA) . . . . . [9085-6]

11:00 am: **Chalcogenide glass thin-film optics for infrared applications in space**, Janardan Nath, Deep Panjwani, Douglas Maukonen, Robert E. Peale, Univ. of Central Florida (USA); J. David Musgraves, Peter F. Wachtel, Jennifer M. McKinley, IRradiance Glass, Inc. (USA) . . . . . [9085-7]

11:20 am: **AE9/AP9/SPM: new models for radiation belt and space plasma specification**, W. Robert Johnston, Air Force Research Lab. (USA); T. Paul O'Brien, The Aerospace Corp. (USA); Stuart L. Huston, Atmospheric and Environmental Research, Inc. (USA); Gregory P. Ginet, MIT Lincoln Lab. (USA); Timothy B. Guild, The Aerospace Corp. (USA); Judy Fennelly, Air Force Research Lab. (USA) . . . . . [9085-8]

Lunch Break . . . . . Mon 11:40 am to 1:10 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 337 . . . MON 1:00 PM TO 4:40 PM

Dual-Use Civil-Military Sensors and Systems I

Session Chairs: **Richard T. Howard,** NASA Marshall Space Flight Ctr. (USA); **Joseph L. Cox,** Missile Defense Agency (USA)

1:00 pm: **Development of a spherical aerial vehicle for urban search**, Kang Hou, Hanxu Sun, Qingxuan Jia, Yanheng Zhang, Beijing Univ. of Posts and Telecommunications (China) . . . . . [9085-10]

1:20 pm: **Using sky polarization to localize and navigate in GPS-denied environments**, Todd Aycock, Art Lompado, Polaris Sensor Technologies, Inc. (USA) . . . . . [9085-11]

1:40 pm: **Membrane based thermoelectric sensor array for space debris detection**, Frank Hänschke, Ernst Kessler, Andreas Ihring, Hans-Georg Meyer, Institut für Photonische Technologien e.V. (Germany); Karl D. Bunte, Christian Herbst, etamax space GmbH (Germany); Matthias Mohaupt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Torsten Fichna, Technische Univ. Braunschweig (Germany); Daniel Hagedorn, Physikalisch-Technische Bundesanstalt (Germany). . . . . [9085-12]

2:00 pm: **Flight test of a flight-in-flight suborbital payload concept**, Gerardo Martinez, Ravshan Rustamov, Armando Munoz, Ou Ma, New Mexico State Univ. (USA) . . . . . [9085-13]

2:20 pm: **Constrained orbital intercept evasion**, Aleksandar Zatezalo, Scientific Systems Co., Inc. (USA); Dusan M. Stipanovic, Univ. of Illinois at Urbana-Champaign (USA); Raman K. Mehra, Scientific Systems Co., Inc. (USA); Khanh Pham, Air Force Research Lab. (USA). . . . . [9085-14]

Coffee Break . . . . . Mon 2:40 pm to 3:20 pm

3:20 pm: **The art and science of missile defense seeker design**, Brian K. McComas, Raytheon Missile Systems (USA) . . . . . [9085-15]

3:40 pm: **Study of human arm motion strategy for a robotic capture of a fast moving and/or tumbling object**, Lin Zhang, Zheng Wei, Ou Ma, Igor Dolgov, New Mexico State Univ. (USA) . . . . . [9085-16]

4:00 pm: **Validation and comparison of two varying subspace-based trajectory optimization methods in a vision-based ground robot testbed**, Ni Li, Univ. of Central Florida (USA); Robert SiVilli, Air Force Research Lab. (USA); Yunjun Xu, Univ. of Central Florida (USA); Khanh Pham, Air Force Research Lab. (USA) . . . . . [9085-17]

4:20 pm: **A space dual-sensor for Earth flux measurements**, Irbah Abdanour, Mustapha Meftah, LATMOS (France) . . . . . [9085-9]

Defense + Security Plenary Presentation

MON 5:00 TO 6:00 PM
LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

TUESDAY 6 MAY

SESSION 4
LOCATION: CONV. CTR. ROOM 337 . . TUE 8:00 AM TO 10:00 AM

Resilient and Secure Architectures and Processes for Dual Military-Civil Space Operations

Session Chairs: **Khanh Pham,** Air Force Research Lab. (USA); **Joseph L. Cox,** Missile Defense Agency (USA)

8:00 am: **SecureCPS: preventing attacks on a nanosatellite propulsion system**, Lance A. Forbes, Global InfoTek, Inc. (USA); Bogdan Udrea, Embry-Riddle Aeronautical Univ. (USA); Xenofon Koutsoukos, Vanderbilt Univ. (USA); Hamilton Hagar, Embry-Riddle Aeronautical Univ. (USA); Huy Vu, Global InfoTek, Inc. (USA); Mark Yampolskiy, Peter Horvath, Vanderbilt Univ. (USA) . . . . . [9085-18]

8:20 am: **A resilient and secure software platform and architecture for distributed spacecraft**, Abhishek Dubey, Gabor Karsai, William Otte, Vanderbilt Univ. (USA) . . . . . [9085-19]

8:40 am: **Cyber threat impact assessment and analysis for space vehicle architectures**, Robert M. McGraw, RAM Labs. (USA) . . . . . [9085-20]

9:00 am: **Building space operations resiliency with a multi-tier mission architecture**, Jeremy Straub, The Univ. of North Dakota (USA) . . . . . [9085-21]

9:20 am: **An adaptive process-based cloud infrastructure for space situational awareness applications**, Bingwei Liu, Yu Chen, Binghamton Univ. (USA); Dan Shen, Genshe Chen, Intelligent Fusion Technology, Inc. (USA); Khanh Pham, Erik Blasch, Bruce Rubin, Air Force Research Lab. (USA)[9085-22]

9:40 am: **Securing resource constraints embedded devices using elliptic curve cryptography**, Mohammad Mozumdar, Tony Tam, Mohamed Alfasi, California State Univ., Long Beach (USA) . . . . . [9085-23]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

SESSION 5
LOCATION: CONV. CTR. ROOM 337 . . TUE 10:30 AM TO 11:50 AM

Connectivity and Dissemination for Space Applications I

Session Chairs: **Khanh Pham,** Air Force Research Lab. (USA); **Genshe Chen,** Intelligent Fusion Technology, Inc. (USA)

10:30 am: **Toward QoS provisioning for layered network communications**, Wei Yu, Guobin Xu, Sixiao Wei, Towson Univ. (USA); Genshe Chen, Intelligent Fusion Technology, Inc. (USA); Khanh Pham, Erik Blasch, Air Force Research Lab. (USA); Chao Lu, Towson Univ. (USA) . . . . . [9085-24]

10:50 am: **Dynamic autonomous routing technology for IP-based satellite ad hoc networks**, Xiaofei Wang, Foresight Wireless, LLC (USA); Jing Deng, Univ. of North Carolina at Greensboro (USA); Theresa Kostas, Gowri S. Rajappan, Foresight Wireless, LLC (USA) . . . . . [9085-25]

11:10 am: **Toward effectiveness and agility of network security situation awareness**, Wei Yu, Linqiang Ge, Towson Univ. (USA); Dan Shen, Genshe Chen, Intelligent Fusion Technology, Inc. (USA); Khanh Pham, Air Force Research Lab. (USA); Erik Blasch, Intelligent Fusion Technology, Inc. (USA); Chao Lu, Towson Univ. (USA) . . . . . [9085-26]

11:30 am: **Crosstalk-immune fiber optic sensor based on wavelength-division-multiplexing employing the frequency spectral ratio method for disturbance detection and location**, Yuan Wu, Pang Bian, Bo Jia, Qian Xiao, Fudan Univ. (China) . . . . . [9085-27]

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

SESSION 6
LOCATION: CONV. CTR. ROOM 337 . . . . TUE 1:20 PM TO 2:40 PM

Connectivity and Dissemination for Space Applications II

Session Chairs: **Khanh Pham,** Air Force Research Lab. (USA); **Genshe Chen,** Intelligent Fusion Technology, Inc. (USA)

1:20 pm: **Quantum technology in aerospace applications**, Bin Jia, Intelligent Fusion Technology, Inc. (USA); Khanh Pham, Air Force Research Lab. (USA); Genshe Chen, Dan Shen, Zhonghai Wang, Intelligent Fusion Technology, Inc. (USA) . . . . . [9085-28]

1:40 pm: **Polarization tracking for quantum satellite communications**, Gang Wang, Dan Shen, Genshe Chen, Intelligent Fusion Technology, Inc. (USA); Khanh Pham, Erik Blasch, Air Force Research Lab. (USA) . . . . . [9085-29]

2:00 pm: **Quantum-entanglement-based QKD security guarantee over QoS-driven 3D satellite networks**, Ping Wang, Xi Zhang, Texas A&M Univ. (USA); Genshe Chen, Intelligent Fusion Technology, Inc. (USA). . . . . [9085-30]

2:20 pm: **Resident space object tracking using an interacting multiple model mixing scheme**, Quang M. Lam, LexerdTek Corp. (USA) . . . . . [9085-31]

Coffee Break . . . . . Tue 2:40 pm to 3:30 pm

SESSION 7
LOCATION: CONV. CTR. ROOM 337 . . . . TUE 3:30 PM TO 5:30 PM

Dual-Use Civil-Military Sensors and Systems II

Session Chairs: **Quang M. Lam,** LexerdTek Corp. (USA); **Sandip Roy,** Washington State Univ. (USA)

3:30 pm: **Orbit determination accuracy enhancement from image data using random finite set based filters**, Quang M. Lam, LexerdTek Corp. (USA); Ba-Ngu B. Vo, Curtin Univ. (Australia). . . . . [9085-32]

3:50 pm: **Space object surveillance using incidental measurements from vehicle-board sensors**, Sandip Roy, Washington State Univ. (USA) . . [9085-33]

4:10 pm: **A nanosatellite for study the Sun and the Earth**, Mustapha Meftah, LATMOS (France) . . . . . [9085-34]

4:30 pm: **Dexterous and expedient approach strategies considering non-zero eccentricity orbits and J2 perturbations**, Charles Remeikas, Yunjun Xu, Univ. of Central Florida (USA); Khanh Pham, Air Force Research Lab. (USA); Genshe Chen, Bin Jia, Dan Shen, Intelligent Fusion Technology, Inc. (USA) . . . . . [9085-35]

4:50 pm: **Low-complexity image compression with scalable quality control**, Bruce H. Pillman, Michael E. Napoli, Exelis Geospatial Systems (USA) . [9085-36]

5:10 pm: **Integrating modeling, test case generation and analysis tools for critical software testing**, Nandamudi L. Vijaykumar, Érica F. Souza, Valdivino A. Santiago Jr., Instituto Nacional de Pesquisas Espaciais (Brazil) . . . . [9085-37]

CONFERENCE 9086A

LOCATION: CONV. CTR. ROOM 346

Thursday 8 May 2014 • Part of Proceedings of SPIE Vol. 9086

Display Technologies and Applications for Defense, Security, and Avionics VIII

Conference Chairs: **Daniel D. Desjardins,** Consultant (USA); **Kalluri R. Sarma,** Honeywell Technology (USA)

Program Committee: **Masoud Ali,** Barco, Inc. (USA); **Alexander A. Cameron,** BAE Systems (United Kingdom); **Jerome Conway,** L-3 Display Systems (USA); **Timothy J. Edwards,** Kopin Corp. (USA); **Amalkumar Ghosh,** eMagin Corp. (USA); **Paul R. Havig II,** Air Force Research Lab. (USA); **Gary W. Jones,** NanoQuantum Sciences, Inc. (USA); **Charles J. Lloyd,** Visual Performance, LLC (USA); **Gail M. Nicholson,** Naval Surface Warfare Ctr. Crane Div. (USA); **James Niemczyk,** American Panel Corp. (USA); **Joe Tchon,** Rockwell Collins, Inc. (USA); **Michael W. Weisser,** SCHOTT North America, Inc. (USA); **Paul L. Wisely,** Holoeye Systems (USA)

THURSDAY 8 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 346 . . . THU 8:00 AM TO 9:10 AM

Simulation Visual Systems

Session Chair: **Kalluri R. Sarma,** Honeywell Technology (USA)

8:00 am: **Night-vision goggle stimulation using LCoS and DLP projection technology, which is better?**, Masoud H Ali, Paul Lyon, Sondre Fauskanger, Barco, Inc. (USA) . . . . . [9086-1]

8:20 am: **A display system luminance requirement that meets user expectations** *(Invited Paper)*, Charles J. Lloyd, Visual Performance, LLC (USA) . . . . . [9086-2]

8:50 am: **Focusing the research agenda for simulation training visual requirements**,Charles J. Lloyd, Visual Performance, LLC (USA) . . . . . [9086-3]

SESSION 2

LOCATION: CONV. CTR. ROOM 346 . . THU 9:10 AM TO 10:00 AM

3D, Stereoscopic and Holographic Displays

Session Chair: **Daniel D. Desjardins,** Consultant (USA)

9:10 am: **Subjective evaluations of multiple three-dimensional displays by a stereo-deficient viewer: an interesting case study** *(Invited Paper)*, John P. McIntire, Sharon A. Ellis, Air Force Research Lab. (USA); Lawrence K. Harrington, Ball Aerospace & Technologies Corp. (USA); Paul R. Havig II, Air Force Research Lab. (USA) . . . . . [9086-4]

9:40 am: **Recent developments in stereoscopic and holographic 3D display technologies**, Kalluri R. Sarma, Honeywell Technology (USA) . . . . . [9086-5]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

SESSION 3

LOCATION: CONV. CTR. ROOM 346 . . THU 10:30 AM TO 11:50 AM

Ergonomics and the Human Sensory System

Session Chair: **Joe Tchon,** Rockwell Collins, Inc. (USA)

10:30 am: **Light sources for enhanced vision** *(Invited Paper)*, Gary W. Jones, NanoQuantum Sciences, Inc. (USA) . . . . . [9086-6]

11:00 am: **ARINC 818 specification revisions enable new avionics architectures** *(Invited Paper)*, Paul Granwald, Great River Technology, Inc. (USA) . . . . . [9086-7]

11:30 am: **Mean performance of the human eye and its implications for display systems**, Daniel D. Desjardins, Northrop Grumman Corp. (USA) . . . . . [9086-8]

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

SESSION 4

LOCATION: CONV. CTR. ROOM 346 . . . . THU 1:20 PM TO 2:50 PM

Micro-Displays

Session Chair: **Gary W. Jones,** NanoQuantum Sciences, Inc. (USA)

1:20 pm: **Speckle-free diode laser illumination for the display/projector applications in avionics** *(Invited Paper)*, Andrei V Tchernook, NANOLIT GmbH (Germany) . . . . . [9086-9]

1:50 pm: **Adding intelligence to direct view optical (DVO) sights**, Timothy Hogan, Timothy J. Edwards, Kopin Corp. (USA) . . . . . [9086-10]

2:10 pm: **High-brightness displays in integrated weapon sight systems**, Timothy J. Edwards, Timothy Hogan, Kopin Corp (USA) . . . . . [9086-11]

2:30 pm: **AMOLED microdisplay automated life time measurement system**, Amalkumar P. Ghosh, Ilyas I. Khayrullin, Tariq A. Ali, Ihor Wacyk, Olivier Prache, eMagin Corp (USA) . . . . . [9086-16]

Coffee Break . . . . . Thu 2:50 pm to 3:30 pm

SESSION 5

LOCATION: CONV. CTR. ROOM 346 . . . .THU 3:30 PM TO 4:20 PM

Head-Up Displays

Session Chair: **Charles J. Lloyd,** Visual Performance, LLC (USA)

3:30 pm: **Advances and trends of head-up displays systems in land vehicles**, J. Alejandro Betancur, Gilberto Osorio, Univ. EAFIT (Colombia) . . . . . [9086-12]

4:00 pm: **Approaches to the design of a low-cost head-up display system**, Paul L. Wisely, HOLOEYE Systems Inc. (United Kingdom); Willaim P. Bleha Jr., HOLOEYE Systems Inc. (USA) . . . . . [9086-13]

SESSION 6

LOCATION: CONV. CTR. ROOM 346 . . . THU 4:20 PM TO 5:00 PM

Cornucopia

Session Chair: **Paul L. Wisely,**
HOLOEYE Systems Inc. (United Kingdom)

4:20 pm: **Demosaicing combined video and graphics images from legacy sensors**, Ron Christian, Jerome Conway, L-3 Display Systems (USA) . [9086-14]

4:40 pm: **Current state of OLED technology relative to military avionics requirements**, Joe Tchon, T. J. Barnidge, Bruce Hufnagel, Birendra Bahadur, Rockwell Collins, Inc. (USA) . . . . . [9086-15]

CLOSING REMARKS

LOCATION: CONV. CTR. ROOM 346 . . . . . 5:00 PM TO 5:10 PM

Session Chairs: **Daniel D. Desjardins;**
Kalluri R. Sarma, Honeywell Technology (USA)

CONFERENCE 9086B

LOCATION: CONV. CTR. ROOM 340

Wednesday 7 May 2014 • Part of Proceedings of SPIE Vol. 9086

Head- and Helmet-Mounted Displays XIX: Design and Applications

Conference Chairs: **Peter L. Marasco,** Air Force Research Lab. (USA); **Paul R. Havig,** Air Force Research Lab. (USA); **Michael P. Browne,** SA Photonics (USA); **James E. Melzer,** Rockwell Collins Optronics (USA)

Program Committee: **Randall E. Bailey,** NASA Langley Research Ctr. (USA); **Sion Jennings,** National Research Council Canada (Canada)

WEDNESDAY 7 MAY

SESSION 7

LOCATION: CONV. CTR. ROOM 340 . . WED 8:30 AM TO 10:10 AM

Human Factors Applications

Session Chair: **Peter L. Marasco,** Air Force Research Lab. (USA)

8:30 am: **Is augmented reality ready for prime time: A review of current state-of-the-art and what the future holds**, Paul R. Havig II, Air Force Research Lab. (USA); Simon Su, Ball Aerospace & Technologies Corp. (USA); John P. McIntire, Eric E. Geiselman, Air Force Research Lab. (USA) . . . [9086-16]

8:50 am: **A review of the visual systems of the animal kingdom: Potential for new uses of head-mounted displays**, Paul R. Havig II, John P. McIntire, Eric E. Geiselman, Air Force Research Lab. (USA). . . . . [9086-17]

9:10 am: **User evaluations of a dichoptic display system**, Michael P. Browne, SA Photonics (USA). . . . . [9086-18]

9:30 am: **The effect of HMD sensor height on platform height estimation**, Michael P. Browne, SA Photonics (USA) . . . . . [9086-19]

9:50 am: **Effects of optical combiner in optical see-trough head-mounted display on depth perception**, Hong Hua, Jason Kuhn, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [9086-20]

Coffee/Exhibition Break. . . . . .Wed 10:10 am to 10:50 am

SESSION 8

LOCATION: CONV. CTR. ROOM 340 . WED 10:50 AM TO 11:50 AM

Applications and Operations

Session Chair: **James E. Melzer,** Rockwell Collins Optronics (USA)

10:50 am: **Performance comparison between a head-worn display system and a head-up display for low visibility commercial operations**, Jarvis J. Arthur III, Lawerence J. Prinzel III, NASA Langley Research Ctr. (USA); James R. Barnes, Unisys Corp. (USA); Steven P Williams, NASA Langley Research Ctr (USA); Denise R. Jones, NASA Langley Research Ctr. (USA); Stephanie J. Harrison, Old Dominion Univ. (USA); Randall E. Bailey, NASA Langley Research Ctr. (USA). . . . . [9086-21]

11:10 am: **Helmet-mounted display utility for unguided precision airdrop application within non head-up-display equipped aircraft.**, Eric E. Geiselman, Paul R. Havig II, John P. McIntire, Air Force Research Lab. (USA) . . . . . [9086-22]

11:30 am: **Evaluation of helmet-mounted display targeting symbology based on eye tracking technology**, Lijing Wang, Xiaodong Liu, BeiHang Univ. (China) . . . . . [9086-24]

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

SESSION 9

LOCATION: CONV. CTR. ROOM 340 . . . WED 1:20 PM TO 2:20 PM

Systems

Session Chair: **Michael P. Browne,** SA Photonics (USA)

1:20 pm: **Helmet-mounted nighttime camera system**, Tammy Orourke, Dan Marshall, DevCar, LLC (USA). . . . . [9086-25]

1:40 pm: **Virtual reality 3D headset based on DMD light modulators**, Bruce E. Bernacki, Pacific Northwest National Lab. (USA); Allan Evans, Edward Tang, Avegant Corp. (USA) . . . . . [9086-26]

2:00 pm: **Head-up displays and head-down displays integration in automobiles**, J. Alejandro Betancur, Gilberto Osorio, Alejandro Mejía, Univ. EAFIT (Colombia). . . . . [9086-27]

SESSION 10

LOCATION: CONV. CTR. ROOM 340 . . . WED 2:20 PM TO 4:10 PM

Component Technologies

Session Chair: **Paul R. Havig II,** Air Force Research Lab. (USA)

2:20 pm: **Smart filters: Operational HMD even at bright sunlight conditions**, Ariela Donval, Noam Gross, Eran Partouche, Ido E. Dotan, Ofir Lipman, Moshe Oron, KiloLambda Technologies, Ltd. (Israel) . . . . . [9086-28]

2:40 pm: **Scorpion hybrid optical-based inertial tracker (HObIT) test results**, Robert Atac, Eric Foxlin, Tom Calloway, John Popoolapade, Thales Visionix, Inc. (USA) . . . . . [9086-29]

Coffee Break . . . . . .Wed 3:00 pm to 3:30 pm

3:30 pm: **Gradient index eyepiece technology for head-mounted display applications**, Peter L. Marasco, Air Force Research Lab. (USA) . . . . . [9086-30]

3:50 pm: **A versatile photogrammetric camera automatic calibration suite for multispectral fusion and optical helmet tracking**, Jason P. de Villiers, Robert Jermy, Council for Scientific and Industrial Research (South Africa) . . . . . [9086-32]

CONFERENCE 9087

LOCATION: CONV. CTR. ROOM 349

Wednesday - Thursday 7 - 8 May 2014 • Proceedings of SPIE Vol. 9087

Degraded Visual Environments (DVE): Enhanced, Synthetic, and External Vision Solutions (ESXVS) 2014

Conference Chairs: **Jeff J. Güell,** The Boeing Co. (USA); **Jack Sanders-Reed,** The Boeing Co. (USA)

Program Committee: **Jarvis J. Arthur III,** NASA Langley Research Ctr. (USA); **Cory Dixon,** Stratom, Inc. (USA); **Thomas R. Muensterer,** Cassidian (Germany); **Niklas Peinecke,** Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Christian Pschierer,** Jeppesen GmbH (Germany); **Carlo L. Tiana,** Rockwell Collins, Inc. (USA)

WEDNESDAY 7 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 349 . . .WED 8:30 AM TO 9:30 AM

DVE Sensors I

Session Chair: **Thomas R. Muensterer,** Cassidian (Germany)

8:30 am: **3D surface imaging through visual obscurants using a sub-terahertz radar**, Jason Fritz, Colorado Engineering, Inc. (USA); Albin J. Gasiewski, Univ. of Colorado at Boulder (USA); Lawrence Scally, Colorado Engineering, Inc. (USA); Kun Zhang, Univ. of Colorado at Boulder (USA) [9087-1]

8:50 am: **Overview of the commercial OPAL lidar optimized for rotorcraft platforms operating in degraded visual environments**, Philip M. Church, Neptec Technologies Group (Canada); Tim Paul, The Boeing Co. (USA); Kiatchai Borribanbunpotkat, Mike Sekerka, Neptec Technologies Group (Canada) . . . . . [9087-2]

9:10 am: **3D Flash LIDAR Vision Systems for imaging in degraded visual environments,** Thomas Laux, Advanced Scientific Concepts, Inc. (USA) . . . . . [9087-26]

SESSION 2

LOCATION: CONV. CTR. ROOM 349 . . WED 9:30 AM TO 10:15 AM

Army: DVE Overview

Session Chair: **Jeff J. Guell,** The Boeing Co. (USA)

9:30 am: **DVE and the U.S. Army** *(Invited Paper)*, Layne B. Merritt, U.S. Army Aviation & Missile Research, Development & Engineering Ctr. (USA). . . . [9087-4]

Coffee Break . . . . . .Wed 10:15 am to 10:45 am

SESSION 3

LOCATION: CONV. CTR. ROOM 349 . WED 10:45 AM TO 12:05 PM

DVE Sensors II

Session Chair: **Thomas R. Muensterer,** Cassidian (Germany)

10:45 am: **Imaging through obscurants with a heterodyne detection-based ladar system**, Randy R. Reibel, Peter A. Roos, Brant M. Kaylor, Trenton Berg, James Curry, Bridger Photonics, Inc. (USA) . . . . . [9087-5]

11:05 am: **Three-dimensional landing zone (3D-LZ) joint capability technology demonstration**, James C. Savage, Air Force Research Lab. (USA) . . . . . [9087-6]

11:25 am: **RVS™: a radar-enhanced vision system for degraded visual environments**, John Schneider, Jack Cross, Pete Cariani, Sierra Nevada Corp. (USA) . . . . . [9087-7]

11:45 am: **System modelling of a real-time passive millimetre-wave imager to be used for base security and helicopter navigation in degraded visual environments**, Rupert N. Anderton, Colin D. Cameron, QinetiQ Ltd. (United Kingdom); Jeff J. Guell, The Boeing Co. (USA); Jack Sanders-Reed, Dennis J. Yelton, Boeing-SVS, Inc. (USA). . . . . [9087-8]

Lunch/Exhibition Break . . . . . .Wed 12:05 pm to 1:55 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 349 . . . . WED 1:55 PM TO 2:35 PM

DAS/Panoramic Vision Systems

Session Chair: **Carlo L. Tiana,** Rockwell Collins, Inc. (USA)

1:55 pm: **System of reconfigurable image enhancement and multisensor fusion processor**, Fan Wu, RFEL Ltd. (United Kingdom); Duncan L. Hickman, Tektonex Ltd. (United Kingdom); Steve J. Parker, RFEL Ltd. (United Kingdom) . . . . . [9087-11]

2:15 pm: **DVE: ground and airborne visualization functionalities**, Dustin Franklin, GE Intelligent Platforms (USA); Andy Preece, GE Intelligent Platforms (United Kingdom); Larry Schaffer, GE Intelligent Platforms (USA); Nick Barrett, GE Intelligent Platforms (United Kingdom). . . . . [9087-12]

SESSION 5

LOCATION: CONV. CTR. ROOM 349 . . . WED 2:35 PM TO 3:20 PM

USAF: Perspective on Challenges for DVE

Session Chair: **Jack Sanders-Reed,** The Boeing Co. (USA)

2:35 pm: **USAF/AFRL perspective on the challenges for DVE solutions** *(Invited Paper)*, James C. Savage, U.S. Air Force (USA) and AFRL/RWWS (USA) . . . . . [9087-13]

Coffee/Exhibition Break. . . . . .Wed 3:20 pm to 4:00 pm

SESSION 6

LOCATION: CONV. CTR. ROOM 349 . . .WED 4:00 PM TO 5:20 PM

Systems Evaluation and Metrics

Session Chair: **Jarvis J. Arthur III,** NASA Langley Research Ctr. (USA)

4:00 pm: **Degraded visual environment video quality metrics**, Dustin D. Baumgartner, Bruce J. Schachter, Northrop Grumman Electronic Systems (USA); Eddie L. Jacobs, Jeremy B. Brown, Univ. of Memphis (USA) . . . [9087-14]

4:20 pm: **Image quality evaluations for enhanced vision system intended function and display**, Carlo L. Tiana, Rockwell Collins, Inc. (USA); Weston J. Lahr, Rockwell Collins Aerospace & Electronics Inc. (USA); Brendan English, John A. Volpe National Transportation Systems Ctr. (USA) . . . . . [9087-15]

4:40 pm: **External Vision Systems (XVS) Proof-of-Concept Flight Test Evaluation**, Kevin J. Shelton, Steven P. Williams, Lynda J. Kramer, Jarvis J. Arthur III, Randall E. Bailey, NASA Langley Research Ctr. (USA) . . . . . [9087-16]

5:00 pm: **Visual advantage of enhanced flight vision system during NextGen flight test evaluation**, Lynda J. Kramer, NASA Langley Research Ctr. (USA); Stephanie J. Harrison, Old Dominion Univ. (USA); Randall E. Bailey, NASA Langley Research Ctr. (USA); Kevin J. Shelton, NASA Langley Research Ctr (USA); Kyle K. Ellis, NASA Langley Research Ctr. (USA) . . . . . [9087-17]

THURSDAY 8 MAY

SESSION 7
LOCATION: CONV. CTR. ROOM 349 . . . THU 8:30 AM TO 9:50 AM

Synthetic Vision, Symbology, and Cueing

Session Chair: **Christian Pschierer,** Jeppesen GmbH (Germany)

8:30 am: **Honeywell synthetic vision avionics backbone (SVAB) program**, Howard W. Wiebold, Honeywell Automation & Control Solutions (USA); Patrick L. O'Brien, Honeywell, Inc. (USA). . . . . [9087-18]

8:50 am: **Sensor-enhanced 3D conformal cueing for safe and reliable HC operation in DVE in all flight phases**, Thomas R. Muensterer, Tobias Schafhitzel, Michael Strobel, Stephanus Klasen, AIRBUS Defence & Space (Germany). . . . . [9087-19]

9:10 am: **Visual-conformal display format for helicopter guidance**, Hans-Ullrich Doehler, Sven Schmerwitz, Thomas Lueken, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [9087-20]

9:30 am: **Synthetic vision meets ARINC 661: Feasibility study of different integration concepts for terrain visualization in ARINC 661 avionic displays**, Erik Lipinski, Lars Ebrecht, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [9087-21]

SESSION 8
LOCATION: CONV. CTR. ROOM 349 . . THU 9:50 AM TO 10:20 AM

ONR: Long Range ISR in DVE

Session Chair: **Jack Sanders-Reed,** The Boeing Co. (USA)

9:50 am: **Long-range ISR systems in DVE** *(Invited Paper)*, Ravi Athale, Office of Naval Research (USA). . . . . [9087-22]

Coffee Break . . . . . Thu 10:20 am to 10:50 am

SESSION 9
LOCATION: CONV. CTR. ROOM 349 . . THU 10:50 AM TO 11:30 AM

Synthetic Vision, Symbology, and Cueing II

Session Chair: **Cory Dixon,** Stratom, Inc. (USA)

10:50 am: **Identifying opportune landing sites in degraded visual environments with terrain and cultural databases**, Marc D. Moody, Robert Fisher, The Boeing Co. (USA) . . . . . [9087-23]

11:10 am: **Detection of helicopter landing sites in unprepared terrain**, Niklas Peinecke, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . . . [9087-24]

SESSION 10
LOCATION: CONV. CTR. ROOM 349 . . THU 11:30 AM TO 12:00 PM

DARPA: Beyond the Landing Problem

Session Chair: **Jeff J. Guell,** The Boeing Co. (USA)

11:30 am: **DVE: Beyond the landing problem** *(Invited Paper)*, H. Bruce Wallace, Defense Advanced Research Projects Agency (USA) . . . . . [9087-25]

CONFERENCE 9088

LOCATION: CONV. CTR. ROOM 327

Monday - Wednesday 5 - 7 May 2014 • Proceedings of SPIE Vol. 9088

Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XX

Conference Chairs: **Miguel Velez-Reyes,** The Univ. of Texas at El Paso (USA); **Fred A. Kruse,** Naval Postgraduate School (USA)

Program Committee: **Gail P. Anderson,** Air Force Research Lab. (USA); **Chein-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); **Jacqueline J. Le Moigne,** NASA Goddard Space Flight Ctr. (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 Tuell,** Georgia Tech Research Institute (USA)

MONDAY 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 327 . . . MON 1:20 PM TO 3:00 PM

Spectral Data Analysis Methodologies I

Session Chair: **Miguel Velez-Reyes,**
The Univ. of Texas at El Paso (USA)

1:20 pm: **Graph-based hyperspectral image segmentation with improved affinity matrix**, Lei Fan, David Messinger, Rochester Institute of Technology (USA) . . . . . [9088-1]

1:40 pm: **Wavelet packets and nonlinear manifold learning for analysis of hyperspectral data**, John J. Benedetto, Wojciech Czaja, Timothy Doster, Catherine Schwartz, Univ. of Maryland, College Park (USA) . . . . . [9088-2]

2:00 pm: **Schroedinger eigenmaps with nondiagonal potentials for spatial-spectral clustering of hyperspectral imagery**, Nathan D. Cahill, Rochester Institute of Technology (USA); Wojciech Czaja, Univ. of Maryland, College Park (USA); David Messinger, Rochester Institute of Technology (USA) . . . . . [9088-3]

2:20 pm: **Full-spectrum wavelet-based compression of hyperspectral imagery**, Michael E. Winter, Pacific Spectral Technology (USA) . . . . . [9088-4]

2:40 pm: **Effects of preprocessing applied to the compression of ultraspectral images**, Rolando Herrero, Martin Cadirola, Ecotronics Ventures, LLC (USA); Vinay K. Ingle, Northeastern Univ. (USA) . . . . . [9088-5]

Coffee Break . . . . . .Mon 3:00 pm to 3:30 pm

SESSION 2

LOCATION: CONV. CTR. ROOM 327 . . . MON 3:30 PM TO 4:50 PM

Spectral Signature Measurements and Applications

Session Chair: **Fred A. Kruse,** Naval Postgraduate School (USA)

3:30 pm: **Retrieval of sand density from hyperspectral BRDF**, Charles Bachmann, Andrei Abelev, U.S. Naval Research Lab. (USA); William Philpot, Cornell Univ. (USA); Katarina Z. Doctor, U.S. Naval Research Lab. (USA) and George Mason Univ. (USA); Marcos J. Montes, Robert A. Fusina, Rong-Rong Li, U.S. Naval Research Lab. (USA); Elena van Roggen, Marine Information Resources Corp. (USA) . . . . . [9088-6]

3:50 pm: **The relationship of variable moisture levels in coastal sands to hyperspectral BRDF data**, Katarina Z. Doctor, George Mason Univ. (USA) and U.S. Naval Research Lab. (USA); Charles Bachmann, Marcos J. Montes, Andrei Abelev, U.S. Naval Research Lab. (USA); William Philpot, Cornell Univ. (USA); Rong-Rong Li, Robert A. Fusina, U.S. Naval Research Lab. (USA); Roy J. Hughes, Defence Science and Technology Organisation (Australia) . . . . [9088-7]

4:10 pm: **The influence of particle size on infrared reflectance spectra**, Tanya L. Myers, Carolyn S. Brauer, Yin-Fong Su, Thomas A. Blake, Timothy J. Johnson, Pacific Northwest National Lab. (USA) . . . . . [9088-8]

4:30 pm: **Field collection of hyperspectral signatures**, Brian Curtiss, PANalytical (USA) . . . . . [9088-9]

Defense + Security Plenary Presentation

MON 5:00 TO 6:00 PM
LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

TUESDAY 6 MAY

SESSION 3

LOCATION: CONV. CTR. ROOM 327 . . . TUE 8:00 AM TO 9:40 AM

Detection, Identification, and Quantification I

Session Chair: **David Messinger,**
Rochester Institute of Technology (USA)

8:00 am: **Hyperspectral target detection using graph theory models and manifold geometry via an adaptive implementation of locally linear embedding**, Amanda K. Ziemann, David . Messinger, Rochester Institute of Technology (USA) . . . . . [9088-10]

8:20 am: **Enough with the additive target model**, Alan P. Schaum, U.S. Naval Research Lab. (USA) . . . . . [9088-11]

8:40 am: **Vector tunnel algorithm for hyperspectral target detection**, Suleyman Demirci, Turkish Air Force Academy (Turkey); Iþýn Erer, Istanbul Technical Univ. (Turkey); Okan K. Ersoy, Purdue Univ. (USA) . . . . . [9088-12]

9:00 am: **Transductive and matched-pair machine learning for difficult target detection problems**, James Theiler, Los Alamos National Lab. (USA) . . . . . [9088-13]

9:20 am: **Gaussian/non-Gaussian subspace nonparametric target detector in inhomogeneous hyperspectral data**, Gil A. Tidhar, Stanley R. Rotman, Ben-Gurion Univ. of the Negev (Israel) . . . . . [9088-14]

Remembering Dr. Sylvia Shen: A Tribute

LOCATION: CONV. CTR. ROOM 327 . . . 9:40 AM TO 10:10 AM

Session Chairs: **Fred A. Kruse,** Naval Postgraduate School (USA); **Miguel Velez-Reyes,** The Univ. of Texas at El Paso (USA)

We want to take this opportunity to pay tribute and remember **Dr. Sylvia Shen** , the founder of this meeting, who for nearly 20 years chaired the SPIE Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery conference. This conference is one of the most important forums to present and discuss research and applications in the area.

Dr. Shen, Distinguished Scientist at The Aerospace Corporation and an SPIE Fellow, passed away September 13 2013 after a six-year battle with cancer. Her pioneering efforts in the application of mathematics to the field of spectral remote sensing led to many key developments in the field.

Celebrating 20 Years and Counting

LOCATION: CONV. CTR. 327 . . . . . 10:10 AM TO 10:50 AM

We celebrate 20 years of the Algorithms and Technologies for Multispectral. Hypespestral, and Ultraspectral Imagery conference during this extended coffee break.

Cake and coffee will be served in the room.

SESSION 4

LOCATION: CONV. CTR. ROOM 327 . . TUE 10:50 AM TO 12:10 PM

Spectral Data Analysis Methodologies II

Session Chair: **Fred A. Kruse,** Naval Postgraduate School (USA)

10:50 am: **A comparison of real and simulated satellite/airborne multisensor imagery**, Kevin Bloechl, Chris De Angelis, Michael G. Gartley, John Kerekes, Rochester Institute of Technology (USA); C. Eric Nance, Raytheon Intelligence & Information Systems (USA) . . . . . [9088-15]

11:10 am: **MODTRAN®6: A major upgrade of the MODTRAN® radiative transfer code**, Patrick Conforti, Alexander Berk, Rosemary Kennett, Timothy Perkins, Frederick Hawes, Spectral Sciences, Inc. (USA); Jeannette van den Bosch, Air Force Research Lab. (USA) . . . . . [9088-16]

11:30 am: **A spectral climatology for atmospheric compensation**, John H. Powell, Ronald G. Resmini, George Mason Univ. (USA). . . . . [9088-17]

11:50 am: **A smile effect correction method for dispersive imaging spectrometer based on relative radiometric calibration**, Chuanrong Li, Chuncheng Zhou, Lingling Ma, Jian Hu, Lingli Tang, Academy of Opto-Electronics (China); Shi Qiu, NOAA National Environmental Satellite, Data, and Information Service (USA) and Academy of Opto-Electronics (China); Jianjian Li, Academy of Opto-Electronics (China) and NOAA National Environmental Satellite, Data, and Information Service (USA) . . . . . [9088-18]

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

SESSION 5

LOCATION: CONV. CTR. ROOM 327 . . . . TUE 1:40 PM TO 3:00 PM

Spectral Methodologies and Applications

Session Chair: **Michael T. Eismann,** Air Force Research Lab. (USA)

1:40 pm: **Estimating radiological background using imaging spectroscopy**, Bruce E. Bernacki, John E. Schweppe, Sean C. Stave, David V. Jordan, Jonathan Kulisek, Trevor N. Stewart, Carolyn E. Seifert, Pacific Northwest National Lab. (USA) . . . . . [9088-20]

2:00 pm: **Subsurface unmixing for benthic habitat mapping using hyperspectral imagery and lidar-derived bathymetry**, Maria C. Torres-Madronero, Instituto Tecnológico Metropolitano de Medellin (Colombia); Miguel Velez-Reyes, The Univ. of Texas at El Paso (USA); James A. Goodman, Univ. de Puerto Rico Mayagüez (USA) . . . . . [9088-22]

2:20 pm: **Parallax mitigation for hyperspectral change detection**, Karmon M. Vongsy, Michael T. Eismann, Air Force Research Lab. (USA); Michael J. Mendenhall, Air Force Institute of Technology (USA); Vincent J. Velten, Air Force Research Lab. (USA) . . . . . [9088-23]

2:40 pm: **Multispectral, hyperspectral, and lidar remote sensing and geographic information fusion for improved earthquake response**, Fred A. Kruse, Scott C. Runyon, Angela M. Kim, Naval Postgraduate School (USA); Christopher C. Clasen, National Geospatial-Intelligence Agency (USA); Chelsea H. Esterline, Sarah C. Carlisle, Andre Jalobeanu, Jeremy P. Metcalf, Paul L. Basgall, David M. Trask, Richard C. Olsen, Naval Postgraduate School (USA) . . . . . [9088-19]

Coffee/Exhibition Break. . . . . Tue 3:00 pm to 3:40 pm

SESSION 6

LOCATION: CONV. CTR. ROOM 327 . . . . TUE 3:40 PM TO 5:00 PM

Spectral Missions and Data Collections

Session Chair: **Jacqueline J. Le Moigne,** NASA Goddard Space Flight Ctr. (USA)

3:40 pm: **First observations using SPICE hyperspectral dataset**, Dalton S. Rosario, U.S. Army Research Lab. (USA); Joao M. Romano, U.S. Army Armament Research, Development and Engineering Ctr. (USA); Christoph C. Borel, Air Force Institute of Technology (USA) . . . . . [9088-24]

4:00 pm: **Bobcat 2013: a hyperspectral data collection supporting the development of spatial-spectral algorithms**, Jason Kaufman, Mehmet Celenk, Ohio Univ. (USA); Andre K. White, Alan D. Stocker, Space Computer Corp. (USA) . . . . . [9088-25]

4:20 pm: **First results from the hyperspectral imager for climate science (HySICS)**, Greg A. Kopp, Chris Belting, Zach Castleman, Ginger A. Drake, R. Joey Espejo, Karl F. Heuerman, Bret P. Lamprecht, Univ. of Colorado at Boulder (USA); James Lanzi, NASA Goddard Space Flight Ctr. (USA); Paul Smith, Univ. of Colorado at Boulder (USA); David W. Stuchlik, NASA Goddard Space Flight Ctr. (USA); Bill Vermeer, Univ. of Colorado at Boulder (USA) . . . . . [9088-26]

4:40 pm: **Analysis of spaceborne hyperspectral applicative land and ocean mission (SHALOM) with 10m ground resolutuion**, Gil A. Tidhar, Tal Feingersh, Israel Aerospace Industries Ltd. (Israel) . . . . . [9088-27]

POSTERS-TUESDAY

LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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.

Local imaging from global measurements applied to selective-spectral imaging, Johann Veras, Lockheed Martin Corp. (USA); Robert R. Muise, Lockheed Martin Missiles and Fire Control (USA); David Twede, Lockheed Martin Corp. (USA) . . . . . [9088-49]

Proper spectral band adjustment for coloristic feature-based recognition of safety signs, Christian Merfort, Daniel Schneider, Markus Böhm, Univ. Siegen (Germany) . . . . . [9088-50]

Retrieval of atmospheric CO_2 using ground-based hyperspectral observation, Liping Lei, Institute of Remote Sensing and Digital Earth (China); Masahiro Kawasaki, Nagoya Univ. (Japan); Xiuchun Qin, Institute of Remote Sensing and Digital Earth (China) . . . . . [9088-51]

A color calibration method for spectral image based on radiative transfer mechanism, Chuanrong Li, Lingling Ma, Xinfang Yuan, Ning Wang, Lingli Tang, Academy of Opto-Electronics (China); Shi Qiu, NOAA National Environmental Satellite, Data, and Information Service (USA); Jianjian Li, Academy of Opto-Electronics (China) and NOAA National Environmental Satellite, Data, and Information Service (USA) . . . . . [9088-52]

Band selection in hyperspectral imagery using sparse support vector machines, Sofya Chepushtanova, Colorado State Univ. (USA); Christopher M. Gittins, UTC Aerospace Systems (USA); Michael J. Kirby, Colorado State Univ. (USA) . . . . . [9088-53]

CONFERENCE 9088

LOCATION: CONV. CTR. ROOM 327

WEDNESDAY 7 MAY

SESSION 7

LOCATION: CONV. CTR. ROOM 327 . WED 8:00 AM TO 10:00 AM

Spectral Data Analysis Methodologies III

Session Chair: **Miguel Velez-Reyes,** The Univ. of Texas at El Paso (USA)

8:00 am: **Multisensor data fusion across time and space**, Pierre V. Villeneuve, Scott G. Beaven, Space Computer Corp. (USA); Robert A. Reed, Arnold Engineering Development Ctr. (USA) . . . . . [9088-29]

8:20 am: **Simultaneous spectral analysis of multiple video sequence data for LWIR gas plumes**, Justin Sunu, Jen-Mei Chang, California State Univ., Long Beach (USA); Andrea L. Bertozzi, Univ. of California, Los Angeles (USA) . . . . . [9088-30]

8:40 am: **Long-wave infrared surface reflectance spectra retrieved from Telops Hyper-Cam imagery**, Steven M. Adler-Golden, Patrick Conforti, Spectral Sciences, Inc. (USA); Marc-André Gagnon, Pierre Tremblay, Martin Chamberland, Telops (Canada). . . . . [9088-31]

9:00 am: **Hyperspectral chemical plume quantification and temperature estimation**, Sidi Niu, Northeastern Univ. (USA); Steven E. Golowich, MIT Lincoln Lab. (USA); Vinay K. Ingle, Northeastern Univ. (USA); Dimitris G. Manolakis, MIT Lincoln Lab. (USA). . . . . [9088-32]

9:20 am: **Hyperspectral image fusion using band reduction and contourlets**, Yoonsuk Choi, Ershad Sharifahmadian, Shahram Latifi, Univ. of Nevada, Las Vegas (USA). . . . . [9088-33]

9:40 am: **Determining optimum pixel size for classification**, Shawn D. Hunt, Miguel A. Goenaga-Jimenez, Nicole Rodriguez, Univ. de Puerto Rico Mayagüez (USA); Miguel Velez-Reyes, The Univ. of Texas at El Paso (USA). . . . . [9088-34]

Coffee/Exhbition Break . . . . . .Wed 10:00 am to 10:40 am

SESSION 8

LOCATION: CONV. CTR. ROOM 327 . WED 10:40 AM TO 12:00 PM

Unmixing

Session Chair: **David Messinger,** Rochester Institute of Technology (USA)

10:40 am: **Particle filter-based spectral unmixing and signature characterization**, Sumit Chakravarty, New York Institute of Technology . . . . . [9088-35]

11:00 am: **An analysis of the nonlinear spectral mixing of Didymium and soda lime glass beads using hyperspectral imagery (HSI) microscopy**, Ronald G. Resmini, The MITRE Corp. (USA); Robert S. Rand, National Geospatial-Intelligence Agency (USA); David W. Allen, National Institute of Standards and Technology (USA); Christopher J. Deloye, The MITRE Corp. (USA) . . . . . [9088-36]

11:20 am: **Novel metrics to contrast synthetic and real objects in overhead hyperspectral images**, Prakash Duraisamy, Old Dominion Univ. (USA); Amr H. Yousef, Alexandria Univ. (Egypt); Khan M. Iftekharuddin, Old Dominion Univ. (USA) . . . . . [9088-37]

11:40 am: **Integrating spatial information in unmixing using the nonnegative matrix factorization**, Miguel A. Goenaga-Jimenez, Univ. de Puerto Rico Mayagüez (USA); Miguel Velez-Reyes, The Univ. of Texas at El Paso (USA) . . . . . [9088-39]

Lunch/Exhibition Break . . . . . .Wed 12:00 pm to 1:50 pm

SESSION 9

LOCATION: CONV. CTR. ROOM 327 . . . WED 1:50 PM TO 3:30 PM

Detection, Identification, and Quantification II

Session Chair: **James P. Theiler,** Los Alamos National Lab. (USA)

1:50 pm: **Denoising hyperspectral images for standoff target detection**, Steven A. Wilson, Ershad Sharifahmadian, Shahram Latifi, Univ. of Nevada, Las Vegas (USA). . . . . [9088-40]

2:10 pm: **Assessment of Schrodinger eigenmaps for target detection**, Leidy P. Dorado-Munoz, David Messinger, Rochester Institute of Technology (USA); Wojciech Czaja, Univ. of Maryland, College Park (USA). . . . . [9088-41]

2:30 pm: **Hyperspectral band selection using multiple proximity measures and its aggregation for automated target detection**, John Ball, Derek T. Anderson, Mississippi State Univ. (USA). . . . . [9088-42]

2:50 pm: **Effective training set sampling strategy for SVDD anomaly detection in hyperspectral imagery**, Mustafa Ergül, Erman Okman, Nigar Sen, SDT Uzay & Savunma Teknolojileri (Turkey) . . . . . [9088-43]

3:10 pm: **Using mid-infrared reflectance spectra and spatial power spectral density to detect disturbed-earth patches in quartz soils**, Richard Fauconier, Precysix, LLC (USA) . . . . . [9088-44]

Coffee/Exhibition Break. . . . . .Wed 3:30 pm to 4:10 pm

SESSION 10

LOCATION: CONV. CTR. ROOM 327 . . . WED 4:10 PM TO 5:30 PM

Spectral Sensor Development and Characterization

Session Chair: **Shawn D. Hunt,** Univ. de Puerto Rico Mayagüez (USA)

4:10 pm: **Effects of optical aberration on chromotomographic reconstruction**, Ryan Tervo, Michael R. Hawks, Glen Perram, Matthew Fickus, Air Force Institute of Technology (USA) . . . . . [9088-45]

4:30 pm: **Experimental characterization of the quality of image reconstruction from a chromotomographic system**, Kyle Dufaud, Michael R. Hawks, Ryan Tervo, Air Force Institute of Technology (USA). . . . . [9088-46]

4:50 pm: **Characterization and calibration of a compact 6-band multifunctional camera based on patterned spectral filters in the focal plane**, Hans Erling Torkildsen, Thomas-Olsvik Opsahl, Trym V. Haavardsholm, Stephane Nicolas, Torbjorn Skauli, Norwegian Defence Research Establishment (Norway). . . . . [9088-47]

5:10 pm: **Tower testing of a 64W SWIR supercontinuum laser for use as an HSI illuminator**, Joseph Meola, Air Force Research Lab (USA). . . . . [9088-48]

CONFERENCE 9089A

LOCATION: CONV. CTR. ROOM 324

Monday - Tuesday 5 - 6 May 2014 • Part of Proceedings of SPIE Vol. 9089

Geospatial InfoFusion and Video Analytics IV

Conference Chairs: **Matthew F. Pellechia,** Exelis, Inc. (USA); **Kannappan Palaniappan,** Univ. of Missouri-Columbia (USA)

Conference Co-Chairs: **Shiloh L. Dockstader,** Exelis, Inc. (USA); **Peter Doucette,** Integrity Applications, Inc. (USA)

Program Committee: **Selim Aksoy,** Bilkent Univ. (Turkey); **Erik P. Blasch,** Air Force Research Lab. (Canada); **Bernard V. Brower,** Exelis, Inc. (USA); **Filiz Bunyak,** Univ. of Missouri-Columbia (USA); **Brian J. Daniel,** U.S. Naval Research Lab. (USA); **Larry S. Davis,** Univ. of Maryland, College Park (USA); **Emmanuel Duflos,** École Centrale de Lille (France); **Dan L. Edwards,** National Geospatial-Intelligence Agency (USA); **Paul Fieguth,** Univ. of Waterloo (Canada); **Robert D. Fiete,** Exelis, Inc. (USA); **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); **Simon J. Julier,** Univ. College London (United Kingdom); **Boris Kovalerchuk,** Central Washington Univ. (USA); **Dennis Motsko,** National Geospatial-Intelligence Agency (USA); **Raghuveer M. Rao,** U.S. Army Research Lab. (USA); **John A. Richards,** Sandia National Labs. (USA); **Gunasekaran Seetharaman,** Air Force Research Lab. (USA); **Philippe M. Vanheeghe,** École Centrale de Lille (France); **Darrell L. Young,** Raytheon Intelligence & Information Systems (USA); **Karmon M. Vongsy,** Air Force Research Lab. (USA)

MONDAY 5 MAY

WELCOME AND OPENING REMARKS

LOCATION: CONV. CTR. ROOM 324 . . . . . 2:00 PM TO 2:10 PM

Session Chairs: **Matthew F. Pellechia,** Exelis Geospatial Systems (USA); **Peter Doucette,** Integrity Applications, Inc. (USA); **Kannappan Palaniappan,** Univ. of Missouri-Columbia (USA)

SESSION 1

LOCATION: CONV. CTR. ROOM 324 . . . MON 2:10 PM TO 4:20 PM

Video Analytics

Session Chair: **Matthew F. Pellechia,** Exelis, Inc. (USA)

2:10 pm: **Robust background modeling for enhancing object tracking in video**, Richard J. Wood, John M. Irvine, David Reed, Janet Lepanto, Draper Lab. (USA) . . . . . [9089-1]

2:30 pm: **Tracking nautical objects in real-time via layered saliency detection**, Matthew Dawkins, Zhaohui H. Sun, Arslan Basharat, Amitha Perera, Anthony J. Hoogs, Kitware, Inc. (USA) . . . . . [9089-2]

2:50 pm: **Feature fusion for texture object segmentation in videos**, Surya Prasath, Rengarajan V. Pelapur, Kannappan Palaniappan, Univ. of Missouri-Columbia (USA); Gunasekaran Seetharaman, Air Force Research Lab. (USA) . . . . . [9089-3]

Coffee Break . . . . . Mon 3:10 pm to 3:40 pm

3:40 pm: **The effect of state dependent probability of detection in multitarget tracking applications**, Amadou Gning, Univ. College London (United Kingdom); W. T. Luke Teacy, Univ. of Southampton (United Kingdom); Rengarajan V. Pelapur, Univ. of Missouri-Columbia (USA); Hadi Aliakbarpour, Univ. College London (United Kingdom); Kannappan Palaniappan, Univ. of Missouri-Columbia (USA); Gunasekaran Seetharaman, Air Force Research Lab. (USA); Simon J. Julier, Univ. College London (United Kingdom) . . . . . [9089-4]

4:00 pm: **Vehicle change detection from aerial imagery using detection response maps**, Zhaohui H. Sun, Mathew Leotta, Kitware Inc. (USA); Anthony J. Hoogs, Kitware, Inc. (USA); Rusty Blue, Kitware Inc. (USA); Robert Neuroth, Juan Vasquez, Air Force Research Lab. (USA); Amitha Perera, Matthew Turek, Kitware Inc. (USA); Erik P. Blasch, Air Force Research Lab. (USA) . . . . . [9089-5]

Defense + Security Plenary Presentation

MON 5:00 TO 6:00 PM
LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

TUESDAY 6 MAY

SESSION 2

LOCATION: CONV. CTR. ROOM 324 . . . TUE 8:20 AM TO 8:40 AM

Architecture for Multisensing Geospatial Collection

Session Chair: **Matthew F. Pellechia,** Exelis Geospatial Systems (USA)

8:20 am: **Overview of dynamic data driven applications systems**, Erik Blasch, Air Force Research Lab. (USA) . . . . . [9089-7]

SESSION 3

LOCATION: CONV. CTR. ROOM 324 . . . TUE 8:40 AM TO 9:40 AM

Geo-registration and Uncertainty Handling in Geospatial Data

Session Chair: **Peter Doucette,** Integrity Applications, Inc. (USA)

8:40 am: **Particle filter-based vehicle tracking using fused spatial features and a nonlinear motion model**, Raphael Viguier, Kannappan Palaniappan, Univ. of Missouri-Columbia (USA). . . . . [9089-8]

9:00 am: **Optimal full motion video registration with rigorous error propagation**, John T. Dolloff, Peter Doucette, Bryant Hottel, Henry J. Theiss, Glenn Jocher, Integrity Applications, Inc. (USA) and Contractors for The National Geospatial-Intelligence Agency (USA) . . . . . [9089-9]

9:20 am: **Minimum separation vector mapping (MSVM)**, Glenn Jocher, John T. Dolloff, Peter Doucette, Bryant Hottel, Henry J. Theiss, Integrity Applications, Inc. (USA) and Contractors for The National Geospatial-Intelligence Agency (USA) . . . . . [9089-10]

SESSION 4

LOCATION: CONV. CTR. ROOM 324 . . TUE 9:40 AM TO 10:20 AM

Geospatial Information Application Needs, Challenges, and Roadmaps

Session Chair: **Peter Doucette,** Integrity Applications, Inc. (USA)

9:40 am: **Surveillance of ground vehicles for airport security**, Erik Blasch, Air Force Research Lab. (USA); Zhonghai Wang, Dan Shen, Intelligent Fusion Technology, Inc. (USA); Haibin Ling, Temple Univ. (USA); Genshe Chen, Intelligent Fusion Technology, Inc. (USA) . . . . . [9089-11]

10:00 am: **Summary of methods in wide-area motion imagery**, Erik Blasch, Air Force Research Lab. (USA); Kannappan Palaniappan, Univ. of Missouri-Columbia (USA); Gunasekaran Seetharaman, Air Force Research Lab. (USA) . . . . . [9089-12]

Coffee Break . . . . . Tue 10:20 am to 10:50 am

CONFERENCE 9089A

LOCATION: CONV. CTR. ROOM 324

SESSION 5

LOCATION: CONV. CTR. ROOM 324 . . TUE 10:50 AM TO 12:10 PM

Geospatial Data Processing, Exploitation, and Visualization I

Session Chair: **Kannappan Palaniappan,** Univ. of Missouri-Columbia (USA)

10:50 am: **Automatic georeferencing of imagery from high-resolution, low-altitude, low-cost aerial platforms**, Amanda M. Geniviva, Jason Faulring, Carl Salvaggio, Rochester Institute of Technology (USA) . . . . . [9089-13]

11:10 am: **A voxel-based approach for imaging voids in three-dimensional point clouds**, Katie N. Salvaggio, Carl Salvaggio, Rochester Institute of Technology (USA) . . . . . [9089-14]

11:30 am: **An automated data exploitation system for airborne sensors**, Hai-Wen Chen, Mike McGurr, Booz Allen Hamilton Inc. (USA) . . . . . [9089-15]

11:50 am: **Large-scale bundle adjustment for wide-area motion imagery (WAMI)**, Hadi Aliakbarpour, Univ. College London (USA); Surya Prasath, Raphael Viguier, Rengarajan V. Pelapur, Mahdieh Poostchi, Univ. of Missouri-Columbia (USA); Gunasekaran Seetharaman, Air Force Research Lab. (USA); Kanappan Palaniappan, Univ. of Missouri-Columbia (USA) . . . . . [9089-16]

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

PANEL DISCUSSION

LOCATION: CONV. CTR. ROOM 324 . TUE 1:20 PM TO 2:50 PM

Advanced Analysis of Generalized Point-Clouds and Multidimensional Structures

Moderator: **Shiloh L. Dockstader,** Exelis Inc.

Panelists: **Hui Cheng,** SRI International; **Karl Walli,** U.S.Air Force; **Guna Seetharaman,** AFRL/RI; **Suzanne Inscoe,** NGA; **Paul McManamon,** Univ. of Dayton

The last several years have witnessed an explosive growth on the capture and utility of three-dimensional data for improved processing and exploitation. The popularity of commercial navigation and GPS systems, the need for improved wide-area map and foundation data creation, and the demand for higher quality post-disaster assessment have all contributed to this trend. In response to these diverse applications, we have seen an increase in the use of ground and airborne LIDAR collection systems. LIDAR systems, while highly beneficial, can also suffer from numerous challenges ranging from excessive cost, to limited coverage, to limited stand-off. As a result, the community is placing increased emphasis on the creation of point-cloud and multi-dimensional data sets from alternative sources including from full-motion video and wide-area imaging systems. This creation of derived 3D data leverages previous technology efforts in multi-modal registration, data fusion, structure-from-motion, computer vision, photogrammetry, and more.

In this panel we explore the current state-of-the-art in generalized point-cloud and 3D site model creation, visualization, exploitation, and dissemination. The panelists will present various methods for generating point-clouds to include synthesis from video, multi-frame imagery, and other non-traditional sources and discuss the advantages and disadvantages of relative point-cloud and 3D/4D data representations. Among other issues, this will include a discussion on the pros and cons of point-cloud vs. estimated digital elevation and site model representations. The panel will also address the challenges associated with derived point-cloud and multi-dimensional data set processing relative to the use of more direct collection methods involving LIDAR and time-of-flight sensor systems. Finally, the panel will present and discuss a variety of applications of 3D data that can potentially improve upon otherwise traditional exploitation tasks. This discussion will cover the advantages of fusing different 3-D data sets for the purposes of improving the performance of target detection and tracking, superresolution, mensuration, activity recognition, and other advanced processing and analytical functions.

Coffee/Exhibit Break . . . . . Tue 2:50 pm to 3:30 pm

SESSION 6

LOCATION: CONV. CTR. ROOM 324 . . . . TUE 3:30 PM TO 5:50 PM

Geospatial Data Processing Exploitation, and Visualization II

Session Chair: **Kannappan Palaniappan,** Univ. of Missouri-Columbia (USA)

3:30 pm: **Blind restoration of aerial imagery degraded by spatially varying motion blur**, Abhijith Punnappurath, Rajagopalan Ambasamudram, Indian Institute of Technology Madras (India); Gunasekaran Seetharaman, Air Force Research Lab. (USA) . . . . . [9089-17]

3:50 pm: **Reference-free multiscale blur detection tool for content-based image retrieval**, Soundararajan Ezekiel, Kyle Harrity, Russell Stocker, Indiana Univ. of Pennsylvania (USA); Mark Alford, David Ferris, Air Force Research Lab. (USA) . . . . . [9089-18]

4:10 pm: **Efficient feature extraction from wide-area motion imagery by MapReduce in Hadoop**, Liya Ma, Erkang Cheng, Temple Univ. (USA); Erik Blasch, Carolyn Sheaff, Air Force Research Lab. (USA); Genshe Chen, Intelligent Fusion Technology, Inc. (USA); Haibin Ling, Temple Univ. (USA) . . . . . [9089-19]

4:30 pm: **Fast GPU adaptive 3D median filter for motion estimation using background modeling**, Mahdieh Poostchi, Kannappan Palaniappan, Univ. of Missouri-Columbia (USA) . . . . . [9089-20]

4:50 pm: **Comparative analysis of fusion metrics across anomaly detection algorithms**, Soundararajan Ezekiel, Kyle Harrity, Indiana Univ. of Pennsylvania (USA); Erik Blasch, Mark Alford, David Ferris, Air Force Research Lab. (USA) . . . . . [9089-21]

5:10 pm: **Detection of potential breeding gournds for mosquitoes based on community sourced geo-tagged images**, Ankit Agarwal, Usashi Chaudhuri, Subhasis Chaudhuri, Indian Institute of Technology Bombay (India); Gunasekaran Seetharaman, Air Force Research Lab. (USA) . . . . . [9089-22]

5:30 pm: **Wavelet-based polarimetry analysis**, Soundararajan Ezekiel, Kyle Harrity, Waleed Farag, Indiana Univ. of Pennsylvania (USA); Mark Alford, David Ferris, Erik Blasch, Air Force Research Lab. (USA) . . . . . [9089-23]

CONFERENCE 9089B

LOCATION: CONV. CTR. ROOM 324

Monday 5 May 2014 • Part of Proceedings of SPIE Vol. 9089

Motion Imagery for ISR and Situational Awareness II

Conference Chair: **Donnie Self,** National Geospatial-Intelligence Agency (USA)

Program Committee: **Tom Lash,** SAIC (USA); **Jeffrey Malapit,** AMPS Strategies (USA); **Gary Nadler,** Consultant, Commercial Broadcast Industry (USA); **Norman S. Stein,** InTec, LLC (USA); **Bernie H. Street,** WiSC Enterprises (USA)

MONDAY 5 MAY

SESSION 7

LOCATION: CONV. CTR. ROOM 324 . . MON 8:50 AM TO 12:20 PM

Motion Imagery for ISR and Situational Awareness

Session Chair: **Donnie B. Self,**
National Geospatial-Intelligence Agency (USA)

8:50 am: **Computer vision-based technologies and commercial best practices for the advancement of the motion imagery tradecraft**, Marja Phipps, 2d3 Inc. (USA); David Capel, 2D3 Ltd. (USA); James R. Srinivasan, 2d3 Inc. (United Kingdom) . . . . . [9089-24]

9:10 am: **A multimodal, activity-based intelligence experiment using motion imagery sensors**, Christian Lewis, David Messinger, Briana Neuberger, Rochester Institute of Technology (USA) . . . . . [9089-25]

9:30 am: **Full-motion video analysis for improved gender classification using non-pathological gait kinematics**, Jeffrey B. Flora, Khan M. Iftekharuddin, Old Dominion Univ. (USA); Darrell F. Lochtefeld, Air Force Research Lab. (USA) . . . . . [9089-27]

9:50 am: **Standardized rendering from IR surveillance motion imagery**, Francine J. Prokoski, IRID, Inc. (USA) . . . . . [9089-28]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

10:40 am: **Lambda vision**, Michael F. Czajkowski, Lockheed Martin Corp. (USA) . . . . . [9089-29]

11:00 am: **Improved target recognition using dedicated video architecture: meet CHARM**, Gordon A. Cain, Vision4ce Ltd. (United Kingdom). . . . . [9089-30]

11:20 am: **Statistical moments-based methods for detecting sub-pixel target tracks in large-image sequences**, Christoph C. Borel, David J. Bunker, Air Force Institute of Technology (USA); Lori A. Mahoney, National Geospatial-Intelligence Agency (USA) . . . . . [9089-31]

11:40 am: **Aerial video georegistration using terrain models from dense and coherent stereo matching**, Susana Ruano, Guillermo Gallego, Carlos Cuevas, Narciso García, Univ. Politécnica de Madrid (Spain) . . . . . [9089-32]

12:00 pm: **Low-complexity multiplierless DCT/DST approximations for low-power HEVC digital IP cores**, Sunera C. Kulasekera, Arjuna Madanayake, The Univ. of Akron (USA); Renato J. Cintra, Univ. Federal de Pernambuco (Brazil); Fabio M. Bayer, UFSM (Brazil) . . . . . [9089-33]

Defense + Security Plenary Presentation

MON 5:00 TO 6:00 PM
LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

CONFERENCE 9090

LOCATION: CONV. CTR. ROOM 329

Monday - Tuesday 5 - 6 May 2014 • Proceedings of SPIE Vol. 9090

Automatic Target Recognition XXIV

Conference Chairs: **Firooz A. Sadjadi,** Lockheed Martin Advanced Technology Labs. (USA); **Abhijit Mahalanobis,** Lockheed Martin Missiles and Fire Control (USA)

Program Committee: **Mohammad S. Alam,** Univ. of South Alabama (USA); **Farid Amoozegar,** Jet Propulsion Lab. (USA); **Mahmood R. Azimi-Sadjadi,** Colorado State Univ. (USA); **David Casasent,** Carnegie Mellon Univ. (USA); **Leon Cohen,** Hunter College (USA); **Frederick D. Garber,** Wright State Univ. (USA); **Guillermo C. Gaunaurd,** Consultant (USA); **Izidor Gertner,** The City College of New York (USA); **Patti S. Gillespie,** U.S. Army Research Lab. (USA); **Riad I. Hammoud,** BAE Systems (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); **Andre U. Sokolnikov,** Visual Solutions and Applications (USA); **Alan J. Van Nevel,** Naval Air Warfare Ctr. Aircraft Div. (USA); **Bradley C. Wallet,** Automated Decisions LLC (USA); **Edmund Zelnio,** Air Force Research Lab. (USA)

MONDAY 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 329 . . MON 8:30 AM TO 10:10 AM

Advanced Concept I

Session Chair: **Firooz A. Sadjadi,**
Lockheed Martin Advanced Technology Labs. (USA)

8:30 am: **Unification of automatic target tracking and automatic target recognition**, Bruce J. Schachter, Northrop Grumman Electronic Systems (USA) . . . . . [9090-1]

8:50 am: **Optimized sparse presentation-based classification with position-weighted block dictionary**, Jun He, Bo Sun, Xuewen Wu, Beijing Normal Univ. (China); Chao Chen, Naval Academy of Armament (China) . . . . . [9090-2]

9:10 am: **Maritime vessel recognition in degraded satellite imagery**, Katie Rainey, Shibin Parameswaran, Josh Harguess, Space and Naval Warfare Systems Ctr. Pacific (USA) . . . . . [9090-3]

9:30 am: **Application of an image feature network-based object recognition algorithm to aircraft detection and classification**, Jeremy Straub, The Univ. of North Dakota (USA). . . . . [9090-4]

9:50 am: **Fusion-based approach for long-range night-time facial recognition**, Robert B. Martin, Mikhail Sluch, Kristopher M. Kafka, Andrew Dolby, Robert V. Ice, Brian E. Lemoff, West Virginia High Technology Consortium Foundation (USA). . . . . [9090-5]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

SESSION 2

LOCATION: CONV. CTR. ROOM 329 . MON 10:40 AM TO 12:00 PM

Advanced Concept II

Session Chair: **Leon Cohen,** Hunter College (USA)

10:40 am: **Detection of moving targets in homogeneous clutter by MIMO radar systems employing the generalized detector**, Vyacheslav P. Tuzlukov, Kyungpook National Univ. (Korea, Republic of) . . . . . [9090-6]

11:10 am: **Evolution of nonstationary noise in waveguides**, Leon Cohen, Jonatan Ben-Benjaming, Hunter College (USA) . . . . . [9090-7]

11:20 am: **detection, characterization, and localization of multiple LFMCW LPI signals**, Brandon Hamschin, John Clancy, Mike Grabbe, Matthew Fortier, Johns Hopkins Univ. Applied Physics Lab. (USA); Johns Novak, ASD Space and Sensor Systems (USA) . . . . . [9090-8]

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

SESSION 3

LOCATION: CONV. CTR. ROOM 329 . . . MON 1:00 PM TO 2:40 PM

Active Sensor Processing

1:00 pm: **New experiments in inverse synthetic aperture radar image exploitation for maritime surveillance**, Firooz A. Sadjadi, Lockheed Martin Advanced Technology Labs. (USA). . . . . [9090-10]

1:20 pm: **Ladar ATR via probabilistic open set techniques**, Matthew Scherreik, Brian D. Rigling, Wright State Univ. (USA) . . . . . [9090-11]

1:40 pm: **Radar target identification using various nearest neighbor techniques**, Ismail I. Jouny, Lafayette College (USA) . . . . . [9090-12]

2:00 pm: **Automatic detection of pulsed radiofrequency (RF) targets using sparse representations in under-complete learned dictionaries**, Daniela I. Moody, David A. Smith, Steven P. Brumby, Los Alamos National Lab. (USA) . . . . . [9090-13]

2:20 pm: **Autonomous underwater pipeline monitoring navigation system**, Nina Mahmoudian, Byrel Mitchell, Guy Meadows, Michigan Tech (USA) . . . . . [9090-14]

Coffee Break . . . . . Mon 2:40 pm to 3:15 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 329 . . . . MON 3:15 PM TO 4:35 PM

Advanced Sensor Processing II

Session Chair: **Andre U. Sokolnikov,**
Visual Solutions and Applications (USA)

3:15 pm: **Time-frequency filtering for classifying targets in nonstationary clutter** *(Invited Paper)*, Patrick J. Loughlin, Vikram T. Gomatam, Univ. of Pittsburgh (USA) . . . . . [9090-15]

3:45 pm: **The Wigner-Hilbert transform**, Patrick J. Loughlin, Univ. of Pittsburgh (USA) . . . . . [9090-16]

4:05 pm: **Optimal power allocation and limited-feedback strategies for distributed classification in wireless sensor networks** *(Invited Paper)*, Mohammad Fanaei, Natalia A. Schmid, Matthew C. Valenti, Marwan M. Alkhweldi, West Virginia Univ. (USA). . . . . [9090-17]

Defense + Security Plenary Presentation

MON 5:00 TO 6:00 PM
LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

TUESDAY 6 MAY

SESSION 5A
LOCATION: CONV. CTR. ROOM 329 . . . TUE 8:00 AM TO 9:00 AM

Advanced Sensor Processing II

Session Chair: **Andre U. Sokolnikov,**
Visual Solutions and Applications (USA)

8:00 am: **Cross-spectral TDOA and FDOA estimation** *(Invited Paper)*, Douglas J. Nelson, National Security Agency (USA). . . . . [9090-9]

8:30 am: **Matrix superposition structure with tree-based principle** *(Invited Paper)*, Andre U. Sokolnikov, Visual Solutions and Applications (USA) . . . . . [9090-21]

SESSION 5
LOCATION: CONV. CTR. ROOM 329 . . TUE 9:00 AM TO 10:20 AM

Advanced Algorithms

Session Chair: **Izidor Gertner,** The City College of New York (USA)

9:00 am: **Classification-based target tracker using convolutional neural networks with GPU implementation**, Serhat Ozdemir, ASELSAN Inc. (Turkey); Ozgur Yilmaz, Turgut Ozal Univ. (Turkey) . . . . . [9090-18]

9:20 am: **Sparse representation for vehicle recognition**, Nathan D. Monnig, Univ. of Colorado at Boulder (USA); Wesam A. Sakla, Air Force Research Lab. (USA) . . . . . [9090-19]

9:40 am: **Adaptive compressive sensing for target detection**, Abhijit Mahalanobis, Lockheed Martin Missiles and Fire Control (USA) . . . . . [9090-20]

10:00 am: **Automatic target recognition using group-structured sparse representation**, Bo Sun, Xuewen Wu, Jun He, Xiaoming Zhu, Beijing Normal Univ. (China); Chao Chen, Naval Academy of Armament (China). . . . . [9090-22]

Coffee/Exhibit Break . . . . . Tue 10:20 am to 11:00 am

SESSION 6
LOCATION: CONV. CTR. ROOM 329 . . . TUE 11:00 AM TO 12:10 PM

Facial and Activity Recognition

Session Chair: **Abhijit Mahalanobis,**
Lockheed Martin Missiles and Fire Control (USA)

11:00 am: **Automatic recognition of emotions from facial expressions**, Henry Xue, Izidor Gertner, The City College of New York (USA). . . . . [9090-23]

11:20 am: **Robust person and object tracking in LWIR and VIS based on a new template matching method**, Thomas Müller, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [9090-24]

11:40 am: **Military personnel recognition system using texture, colour, and SURF features**, Martins E. Irhebhude, Eran A. Edirisinghe, Loughborough Univ. (United Kingdom). . . . . [9090-26]

2014 ATR Best Paper Awards
LOCATION: CONV. CTR. ROOM 329 . . . 12:00 PM TO 12:30 PM

Session Chair: **Firooz A. Sadjadi,** Lockheed Martin Advanced Technology Labs. (USA)

Lockheed Martin Corporation generously offered to sponsor the Best Paper Awards for the Automatic Target Recognition (ATR) conference. Two awards are planned: the first is the overall Best Paper Award, and the second is a Best Student Paper Award.

Award Sponsored by

LOCKHEED MARTIN

POSTERS-TUESDAY
LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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.

Image feature extraction based multiple ant colonies cooperation, Zhang Zhilong, Jicheng Li, Xinping Lu, National Univ. of Defense Technology (China) . . . . . [9090-27]

Fast algorithm of infrared small target detection in jitter background, Weiping Yang, Xinping Lu, Jicheng Li, National Univ. of Defense Technology (China); Zhongliang Jiang, National Univ. of Defence Technology (China) . . . . . [9090-28]

Polarization diversity sensor for enhanced detection and tracking, David B. Chenault, Art Lompado, Jonathan Hanks, Richard Edmondson, Polaris Sensor Technologies, Inc. (USA) . . . . . [9090-29]

Line fitting-based feature extraction for object recognition, Bing Li, Lockheed Martin Systems Integration-Owego (USA) . . . . . [9090-31]

CONFERENCE 9091

LOCATION: CONV. CTR. ROOM 325

Monday - Thursday 5 - 8 May 2014 • Proceedings of SPIE Vol. 9091

Signal Processing, Sensor/Information Fusion, and Target Recognition XXIII

Conference Chair: **Ivan Kadar,** Interlink Systems Sciences, Inc. (USA)

Conference Co-Chairs: **Erik P. Blasch,** Air Force Research Lab. (USA); **Kenneth Hintz,** George Mason Univ. (USA); **Thia Kirubarajan,** McMaster Univ. (Canada); **Ronald P. S. Mahler,** Lockheed Martin Corp. (USA)

Program Committee: **Mark G. Alford,** Air Force Research Lab. (USA); **William D. Blair,** Georgia Tech Research Institute (USA); **Mark J. Carlotto,** General Dynamics Advanced Information Systems (USA); **Kuo-Chu Chang,** George Mason Univ. (USA); **Chee-Yee Chong,** Consultant (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); **Jon S. Jones,** Air Force Research Lab. (USA); **Martin E. Liggins II,** Consultant (USA); **James Llinas,** Univ. at Buffalo (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 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 325 . . MON 8:30 AM 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: **Determining sensor location from measured state and covariance of tracked objects**, Lynn R. Purser, Georgia Tech Research Institute (USA) . . . . . [9091-1]

8:50 am: **Study of data fusion algorithms applied to unattended ground sensor network**, Benjamin Pannetier, Jean Dezert, Julien Moras, ONERA (France) . . . . . [9091-2]

9:10 am: **Summary of tracking and identification methods**, Erik Blasch, Air Force Research Lab. (USA); Chun Yang, Sigtem Technology, Inc. (USA); Ivan Kadar, Interlink Systems Sciences, Inc. (USA) . . . . . [9091-3]

9:30 am: **Fusing airborne video with RF location estimates to locate moving emitters in dense mover environments**, Robert Cole, Geoffrey Guisewite, Herbert G. Greene, Raytheon Intelligence & Information Systems (USA) . [9091-4]

9:50 am: **Optimal fusion of video and RF data for detection and tracking with object occlusion**, Benjamin Shapo, Christopher Kreucher, Integrity Applications, Inc. (USA). . . . . [9091-5]

Coffee Break . . . . . Mon 10:10 am to 10:30 am

SESSION 2

LOCATION: CONV. CTR. ROOM 325 . MON 10:30 AM TO 11:50 AM

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: **Recognition of ships for long-term tracking**, Sebastiaan P. van den Broek, Henri Bouma, Henny Veerman, Koen W. Benoist, Piet B. W. Schwering, TNO Defence, Security and Safety (Netherlands); Richard J.M. den Hollander, TNO (Netherlands). . . . . [9091-7]

10:50 am: **Real-time target tracking for a 360-degree panoramic IR imager**, Colin C. Olson, U.S. Naval Research Lab. (USA) and Sotera Defense Solutions, Inc. (USA); Jonathan M. Nichols, James R. Waterman, U.S. Naval Research Lab. (USA) . . . . . [9091-8]

11:10 am: **Clutter heterogeneity and ground moving target indication tracking**, Bhashyam Balaji, Christoph Gierull, Defence Research and Development Canada (Canada) . . . . . [9091-9]

11:30 am: **Magnetic dipole tracking and smoothing**, Bhashyam Balaji, J. B. Nelson, Defence Research and Development Canada (Canada) . . [9091-10]

Lunch Break . . . . . Mon 11:50 am to 1:10 pm

INVITED PANEL DISCUSSION

LOCATION: CONV. CTR. ROOM 325 . . MON 1:15 PM TO 4:45 PM

Issues and Challenges of Information Fusion in Contested Environments

Panel Organizers: **Chee-Yee Chong,** Consultant; **Erik Blasch,** Air Force Research Lab.; **Ivan Kadar,** Interlink Systems Sciences, Inc.

Panel Moderators: **Chee-Yee Chong,** Consultant; **Ivan Kadar,** Interlink Systems Sciences, Inc.

Panelists: **Erik Blasch,** Air Force Research Lab.; **Chee-Yee Chong,** Consultant; **Laurie Fenstermacher,** Air Force Research Lab; **John Gorman,** DARPA,; **Hillary Holloway,** Systems & Technology Research Inc.; **Eric Jones,** Systems & Technology Research, Inc.; **Ivan Kadar,** Interlink Systems Sciences, Inc.; **Georgiy Levchuk,** Aptima, Inc.; **Nils F. Sandell,** Systems & Technology Research, Inc.

In contested environments such as those involving peer nations, fusion has to address challenges not present in uncontested environments, e.g., counter insurgencies. The objects of interest may be hard to detect due to the use of stealth technology. Sensing may be at stand-off distances and observations may be sparse. Full motion video that has been very valuable in recent missions will no longer be available. Communication will be unreliable due to possible jamming and bandwidth may be limited. Thus fusion has to deal with more difficult targets using lower quality/quantity data over less capable communication networks.

The panel will address issues and challenges highlighting the problem of acquiring, representing, handling, processing, fusing and using information sources in contested environments. A number of invited experts will discuss current challenges of the fusion process and research to address these challenges.

The panelists shall illustrate parts of the above mentioned area in many applications, and will address applications to all levels of information fusion. The objective of this panel is to bring to the attention of the fusion community the importance of dealing with contested information sources, highlighting issues, and illustrating potential approaches and addressing challenges. Conceptual and real-world related examples associated with the overall complex problem will be used by the panel to highlight issues and challenges. Audience participation is welcomed to provide a forum for exchange of ideas.

Defense + Security Plenary Presentation

MON 5:00 TO 6:00 PM
LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

TUESDAY 6 MAY

SESSION 3
LOCATION: CONV. CTR. ROOM 325 . . TUE 8:00 AM TO 10:20 AM

Information Fusion Methodologies and Applications I

Session Chair: **Ronald P. Mahler,** Lockheed Martin Corp. (USA)

8:00 am: **An improved CPHD filter for unknown clutter backgrounds**, Ronald P. Mahler, Lockheed Martin Corp. (USA); Ba-Tuong Vo, Curtin Univ. (Australia). . . . . [9091-11]

8:20 am: **CPHD filters for unknown clutter and target-birth processes**, Ronald P. Mahler, Lockheed Martin Corp. (USA) . . . . . [9091-12]

8:40 am: **Hybrid multi-Bernoulli CPHD filter for superpositional sensors**, Santosh Nannuru, Mark Coates, McGill Univ. (Canada) . . . . . [9091-13]

9:00 am: **Multisensor dynamic cancellation method for spurious data based on RFS theory**, Xin Chen, Ratnasingham Tharmarasa, McMaster Univ. (Canada); Anne-Laure Jousselme, Defence Research and Development Canada, Valcartier (Canada); Thiagalingam Kirubarajan, McMaster Univ. (Canada) . . . . . [9091-14]

9:20 am: **Simulation-based examination of performance limits for decentralized multi-agent surveillance and tracking of undersea targets**, Cameron K. Peterson, Andrew J. Newman, James C. Spall, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9091-15]

9:40 am: **Fusion of imaging data and auxiliary signal for target classification**, Aleksandar Zatezalo, Ssu-Hsin Yu, Scientific Systems Co., Inc. (USA) . . . . . [9091-16]

10:00 am: **Space collision threat mitigation**, Aleksandar Zatezalo, Scientific Systems Co., Inc. (USA); Dusan M. Stipanovic, Univ. of Illinois at Urbana-Champaign (USA); Raman K. Mehra, Scientific Systems Co., Inc. (USA); Khanh Pham, Air Force Research Lab. (USA) . . . . . [9091-17]

Coffee Break . . . . . Tue 10:20 am to 10:40 am

SESSION 4
LOCATION: CONV. CTR. ROOM 325 . . TUE 10:40 AM TO 12:20 PM

Information Fusion Methodologies and Applications II

Session Chairs: **Chee-Yee Chong,** Consultant (USA); **Michael L. Hinman,** Air Force Research Lab. (USA); **Ivan Kadar,** Interlink Systems Sciences, Inc. (USA)

10:40 am: **Renormalization group flow and other ideas inspired by physics for nonlinear filters, Bayesian decisions, and transport**, Frederick E. Daum, Jim Huang, Raytheon Co. (USA) . . . . . [9091-18]

11:00 am: **Supersymmetry and nonlinear filtering**, Bhashyam Balaji, Defence Research and Development Canada (Canada) . . . . . [9091-19]

11:20 am: **Bayesian inference and string theory**, Bhashyam Balaji, Defence Research and Development Canada (Canada) . . . . . [9091-20]

11:40 am: **User metrics for graphical information fusion**, Erik Blasch, Air Force Research Lab. (USA); Georgiy M. Levchuk, Dustin Burke, Aptima, Inc. (USA) . . . . . [9091-21]

12:00 pm: **An objective multisensor fusion metric for target detection**, Jeffrey D. Clark, Stephen Sweetnich, Shane Fernandes, Air Force Institute of Technology (USA); Wesam A. Sakla, Air Force Research Lab. (USA). . . [9091-22]

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

SESSION 5
LOCATION: CONV. CTR. ROOM 325 . . . . TUE 1:20 PM TO 3:20 PM

Information Fusion Methodologies and Applications III

Session Chairs: **Michael L. Hinman,** Air Force Research Lab. (USA); **Kenneth Hintz,** George Mason Univ. (USA); **Chee-Yee Chong,** Consultant (USA); **Ivan Kadar,** Interlink Systems Sciences, Inc. (USA)

1:20 pm: **Toward the quality evaluation of complex information systems**, Ion-George Todoran, Laurent Lecornu, Télécom Bretagne (France); Ali Khenchaf, ENSTA Bretagne (France); Jean-Marc Le Caillec, Télécom Bretagne (France) . . . . . [9091-23]

1:40 pm: **Activity recognition from multi-INT data**, Hillary Holloway, Eric K. Jones, Systems & Technology Research (USA); Jorge Tierno, Barnstorm Research Corp. (USA) . . . . . [9091-24]

2:00 pm: **Detecting misinformation and knowledge conflicts in relational data**, Georgiy M. Levchuk, Brian Riordan, Matthew Jackobsen, Aptima, Inc. (USA) . . . . . [9091-25]

2:20 pm: **Information fusion: Telling the story (or threat narrative)**, Laurie Fenstermacher, U.S. Air Force (USA) . . . . . [9091-26]

2:40 pm: **Multisource data integration from Rafael Advanced Defense Systems, LTD**, Gideon Weiss, Rafael USA, Inc. (USA); Zvi Yavin, Rafael Advanced Defense Systems Ltd. (Israel). . . . . [9091-27]

3:00 pm: **Survey of virtual environment platforms with multimodality sensors support**, Mohammad Serkhail Habibi, Amir Shirkhodaie, Tennessee State Univ. (USA). . . . . [9091-28]

Coffee/Exhibition Break. . . . . Tue 3:20 pm to 4:00 pm

SESSION 6
LOCATION: CONV. CTR. ROOM 325 . . . .TUE 4:00 PM TO 5:50 PM

Information Fusion Methodologies and Applications IV

Session Chairs: **Erik P. Blasch,** Air Force Research Lab. (USA); **Michael L. Hinman,** Air Force Research Lab. (USA); **Kenneth Hintz,** George Mason Univ. (USA); **Chee-Yee Chong,** Consultant (USA)

4:00 pm: **Group activity discovery and recognition through multilayered hidden Markov model**, Vinayak Elangovan, Amir Shirkhodaie, Tennessee State Univ. (USA) . . . . . [9091-29]

4:20 pm: **Assessing the threat of firearms: New threat formula, resources, and ontological linking algorithms**, Christian F. Hempelmann, Abdullah N. Arslan, Salvatore Attardo, Grady P. Blount, Nikolay M. Sirakov, Texas A&M Univ.-Commerce (USA). . . . . [9091-30]

4:40 pm: **Clustering and visualization of non-classified points from lidar data for helicopter navigation**, Ferdinand Eisenkeil, Univ. Konstanz (Germany); Tobias Schafhitzel, Cassidian - EADS Deutschland GmbH (Germany); Uwe Kühne, EADS Deutschland GmbH (Germany); Oliver Deussen, Univ. Konstanz (Germany) . . . . . [9091-31]

5:00 pm: **Multi-attributed tagged big data exploitation for hidden concepts discovery**, Moath Obeidat, Amir Shirkhodaie, Tennessee State Univ. (USA) . . . . . [9091-32]

5:20 pm: **Dempster-Shafer theory and connections to Choquet's theory of capacities and information theory** *(Invited Paper)*, Joseph S. J. Peri, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9091-33]

CONFERENCE 9091
LOCATION: CONV. CTR. ROOM 325

POSTERS-TUESDAY
LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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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A model-based multisensor data fusion knowledge management approach, Jeremy Straub, The Univ. of North Dakota (USA) . . . . . [9091-61]

A novel algorithm for long pseudo-code acquisition in spread spectrum communication system, Yusheng Fu, Univ. of Electronic Science and Technology of China (China) and Univ. of Delaware (USA); Zhongquan He, Chunhui Ren, Univ. of Electronic Science and Technology of China (China); Kenneth E. Barner, Univ. of Delaware (USA). . . . . [9091-62]

A joint algorithm of hopping period estimation for frequency-hopping signals, Yusheng Fu, Univ. of Electronic Science and Technology of China (China) and Univ. of Delaware (USA); Li Feng, Chunhui Ren, Univ. of Electronic Science and Technology of China (China); Kenneth E. Barner, Univ. of Delaware (USA) . . . . . [9091-64]

Improved method for pulse sorting based on PRI transform, Chunhui Ren, Junqing Cao, Univ. of Electronic Science and Technology of China (China); Yusheng Fu, Univ. of Electronic Science and Technology of China (China) and Univ. of Delaware (USA); Kenneth E. Barner, Univ. of Delaware (USA) . [9091-65]

Bearing and frequency estimation for nonstationary sources using cardiod sensors, Bhashyam Balaji, Defence Research and Development Canada (Canada) . . . . . [9091-66]

THELMA: a mobile app for crowdsourcing environmental data, Kenneth Hintz, Faris Almomen, Christian Adounvo, Michael D' Amato, George Mason Univ. (USA); Christopher Hintz, Savannah State Univ. (USA) . . . . . [9091-67]

WEDNESDAY 7 MAY

SESSION 7
LOCATION: CONV. CTR. ROOM 325 . WED 8:00 AM TO 10:00 AM

Signal and Image Processing, and Information Fusion Applications I

Session Chairs: **Lynne L. Grewe,** California State Univ., East Bay (USA); **Mark J. Carlotto,** General Dynamics Advanced Information Systems (USA); **Mark G. Alford,** Air Force Research Lab. (USA)

8:00 am: **The advantages of stereo vision in a face recognition system**, Yufeng Zheng, Alcorn State Univ. (USA); Erik Blasch, Air Force Research Lab. (USA) . . . . . [9091-34]

8:20 am: **A comparative study of DIGNET, average, complete, single hierarchical and k-means clustering algorithms in 2D face image recognition**, Konstantinos-George Thanos, NCSR "Demokritos" (Greece); Stelios C. A. Thomopoulos, National Ctr. for Scientific Research Demokritos (Greece) . . . . . [9091-35]

8:40 am: **Thermal-to-visible face recognition using multiple-kernel learning**, Shuowen Hu, Prudhvi Gurram, Heesung Kwon, Alex L. Chan, U.S. Army Research Lab. (USA) . . . . . [9091-36]

9:00 am: **Can the usage of human growth hormones affect facial appearance and the accuracy of face recognition systems?**, Jake L. Rose, Thirimachos Bourlai, West Virginia Univ. (USA) . . . . . [9091-37]

9:20 am: **Salient feature extraction from polarimetric SAR data**, Bart Kahler, Frederick G. Harmon, Leidos (USA) . . . . . [9091-38]

9:40 am: **Target recognition performance using limited salient features**, Bart Kahler, Leidos (USA) . . . . . [9091-39]

Coffee Break . . . . . .Wed 10:00 am to 10:30 am

SESSION 8
LOCATION: CONV. CTR. ROOM 325 . WED 10:30 AM TO 12:30 PM

Signal and Image Processing, and Information Fusion Applications II

Session Chairs: **Mark J. Carlotto,** General Dynamics Advanced Information Systems (USA); **Lynne L. Grewe,** California State Univ., East Bay (USA); **Mark G. Alford,** Air Force Research Lab. (USA)

10:30 am: **Dynamic object masking for relevant component scatterers**, Bart Kahler, Leidos (USA) . . . . . [9091-40]

10:50 am: **Fusing maps with photos from mobile devices**, Mark J. Carlotto, General Dynamics Advanced Information Systems (USA) . . . . . [9091-41]

11:10 am: **A numerical study of sensory-guided multiple views for improved object identification**, Brigid A. Blakeslee, Univ. of Pennsylvania (USA); Edmund Zelnio, Air Force Research Lab. (USA); Daniel E. Koditschek, Univ. of Pennsylvania (USA) . . . . . [9091-42]

11:30 am: **Real-time 3D reconstruction of depth sequences using signed distance functions**, Richard L. Tutwiler, John P. Morgan Jr., The Pennsylvania State Univ. (USA). . . . . [9091-43]

11:50 am: **Group activity recognition via fusion of depth map and optical imaging techniques**, Vinayak Elangovan, Amir Shirkhodaie, Tennessee State Univ. (USA) . . . . . [9091-44]

12:10 pm: **Acoustic events semantic detection, classification, and annotation for persistent surveillance applications**, Amjad H. Alkilani, Amir Shirkhodaie, Tennessee State Univ. (USA) . . . . . [9091-45]

Lunch/Exhibition Break . . . . . .Wed 12:30 pm to 1:40 pm

SESSION 9
LOCATION: CONV. CTR. ROOM 325 . . . WED 1:40 PM TO 3:20 PM

Signal and Image Processing, and Information Fusion Applications III

Session Chairs: **Mark G. Alford,** Air Force Research Lab. (USA); **Mark J. Carlotto,** General Dynamics Advanced Information Systems (USA); **Lynne L. Grewe,** California State Univ., East Bay (USA)

1:40 pm: **An RFID-based luggage and passenger tracking system for airport security control applications**, George E. Vastianos, Dimitris M. Kyriazanos, Vassilios I. Kountouriotis, Stelios C. A. Thomopoulos, National Ctr. for Scientific Research Demokritos (Greece) . . . . . [9091-46]

2:00 pm: **Wavelet-based identification of objects from a distance**, Ershad Sharifahmadian, Yoonsuk Choi, Shahram Latifi, Univ. of Nevada, Las Vegas (USA) . . . . . [9091-47]

2:20 pm: **rScene®: A revolutionary low-cost microradar for target classification and tracking**, Thomas Plummer, Richard D. Porter, Robert Raines, McQ, Inc. (USA) . . . . . [9091-48]

2:40 pm: **Optimal fusion of detectors through joint posterior ratio estimation**, Brandon Smock, Joseph Wilson, Taylor Glenn, Univ. of Florida (USA) . . . . . [9091-49]

3:00 pm: **Distributed detection by generalized receiver in macrodiversity cellular communication systems**, Vyacheslav P. Tuzlukov, Kyungpook National Univ. (Korea, Republic of) . . . . . [9091-50]

Coffee Break . . . . . .Wed 3:20 pm to 3:50 pm

SESSION 10
LOCATION: CONV. CTR. ROOM 325 . . . WED 3:50 PM TO 4:50 PM

Signal and Image Processing, and Information Fusion Applications IV

Session Chairs: **Mark G. Alford,** Air Force Research Lab. (USA); **Mark J. Carlotto,** General Dynamics Advanced Information Systems (USA); **Lynne L. Grewe,** California State Univ., East Bay (USA)

3:50 pm: **Invariant-feature-based adaptive automatic target recognition in obscured 3D point clouds**, Timothy S. Khuon, Charles M. Kershner, Arnel Alverio, Enrico Mattei, National Geospatial-Intelligence Agency (USA) . [9091-68]

4:10 pm: **Fast methods for fusing visible/IR images with natural color appearance under different typical scenes**, Lingxue Wang, Wei Zhang, Zhen Jin, Yuan Luo, Yi Cai, Beijing Institute of Technology (China) . . . . . [9091-51]

4:30 pm: **Vision-based target detection in marine search and rescue**, Shining Wang, Xiujuan Yu, China Water Transport Research Institute (China) . . . . . [9091-52]

THURSDAY 8 MAY

SESSION 11
LOCATION: CONV. CTR. ROOM 325 . . .THU 8:00 AM TO 12:30 PM

Signal Processing, Information Fusion, and Understanding Aspects of Cyber Physical Systems

Session Chair: **Lynne L. Grewe,** California State Univ., East Bay (USA)

8:00 am: **An improved ground vehicle tracking algorithm by integrating Bayesian tracking framework with an auxiliary particle filter** *(Invited Paper)*, Miao Yu, Cunjia Liu, Wenhua Chen, Jonathon Chambers, Loughborough Univ. (United Kingdom). . . . . [9091-53]

8:30 am: **Fall risks assessment among community dwelling elderly using wearable wireless sensors** *(Invited Paper)*, Thurmon E. Lockhart, Rahul Soangra, Virginia Polytechnic Institute and State Univ. (USA) . . . . . [9091-54]

9:00 am: **A cyber-physical system for senior collapse detection** *(Invited Paper)*, Lynne L. Grewe, Steven Magana-Zook, California State Univ., East Bay (USA) . . . . . [9091-55]

9:30 am: **Biobotic insect swarm-based sensor networks for search and rescue** *(Invited Paper)*, Alper Bozkurt, Edgar Lobaton, Mihail Sichitiu, North Carolina State Univ. (USA); Tyson Hedrick, The Univ. of North Carolina at Chapel Hill (USA); Tahmid Latif, Ali Dirafzoon, Eric Whitmire, Alexander Verderber, North Carolina State Univ. (USA); Juan Marin, Middle Creek High School (USA) . . . . . [9091-56]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

10:30 am: **A social-based cyber-physical system for distributed message transmission** *(Invited Paper)*, Kang Chen, Haiying Shen, Clemson Univ. (USA) . . . . . [9091-57]

11:00 am: **Trust: A category reputation based Q&A system** *(Invited Paper)*, Yuhua Lin, Haiying Shen, Clemson Univ. (USA) . . . . . [9091-58]

11:30 am: **High-assurance SPIRAL** *(Invited Paper)*, Franz Franchetti, Carnegie Mellon Univ. (USA). . . . . [9091-59]

12:00 pm: **Deceiving entropy-based DoS detection** *(Invited Paper)*, Ilker Ozcelik, Richard R. Brooks, Clemson Univ. (USA) . . . . . [9091-60]

CONFERENCE 9092

LOCATION: CONV. CTR. ROOM 324

Wednesday - Thursday 7 - 8 May 2014 • Proceedings of SPIE Vol. 9092

Signal and Data Processing of Small Targets 2014

Conference Chair: **Oliver E. Drummond,** Consulting Engineer (USA)

Conference Co-Chair: **Richard D. Teichgraeber,** 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); **Karla K. Spriestersbach,** Missile Defense Agency (USA); **Steven W. Waugh,** Defense Threat Reduction Agency (USA)

Conference Location Will Alternate Each Year

In the year 2014, 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 http://odrummond.com

WEDNESDAY 7 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 324 . . WED 8:30 AM TO 12:05 PM

Signal Processing of Small Targets

Session Chairs: **Darren K. Emge,** U.S. Army Edgewood Chemical Biological Ctr. (USA); **Steven W. Waugh,** Defense Threat Reduction Agency (USA)

8:30 am: **Application of rich feature descriptors to small target detection in wide-area persistent ISR systems**, Christopher W. Miller, Jason A. Edelberg, Michael L. Wilson, U.S. Naval Research Lab. (USA) . . . . . [9092-1]

8:55 am: **Detection of small targets and their characterization based on their formation using an image feature network-based object recognition algorithm**, Jeremy Straub, The Univ. of North Dakota (USA). . . . . [9092-2]

9:20 am: **Advancement and results in hostile fire indication using potassium-line missile warning sensors**, Joel B. Montgomery, Marjorie Montgomery, M&M Aviation (USA) . . . . . [9092-3]

9:45 am: **Plot enchaining algorithm: A novel approach for clustering flocks of birds**, Gulay Buyukaksoy Kaplan, Adnan Lana, TUBITAK UME (Turkey) . . . . . [9092-4]

Coffee/Exhibition Break. . . . . .Wed 10:10 am to 10:50 am

10:50 am: **Polar synthetic aperture radar imaging based on Maxwell's equations**, Zhijun G. Qiao, The Univ. of Texas-Pan American (USA); Bing Sun, BeiHang Univ. (China) and The Univ. of Texas-Pan American (USA); Jacob Banda, The Univ. of Texas-Pan American (USA) . . . . . [9092-5]

11:15 am: **Multiset singular-value decomposition for image fusion**, Darren K. Emge, U.S. Army Edgewood Chemical Biological Ctr. (USA). . . . . [9092-6]

11:40 am: **Non-blind beamforming and DOA estimation by generalized receiver in MIMO wireless communication systems**, Vyacheslav P. Tuzlukov, Jin Gui Liu, Modar S. Shbat, Kyungpook National Univ. (Korea, Republic of) . . . . . [9092-7]

Lunch/Exhibition Break . . . . . .Wed 12:05 pm to 1:35 pm

SESSION 2

LOCATION: CONV. CTR. ROOM 324 . . . . WED 1:35 PM TO 4:35 PM

Tracking Small Targets I

Session Chairs: **Richard D. Teichgraeber,** Consulting Engineer (USA); **Darren K. Emge,** U.S. Army Edgewood Chemical Biological Ctr. (USA)

1:35 pm: **Particle filter for very long-range radar with high-range accuracy**, Kevin Romeo, Peter K. Willett, Yaakov Bar-Shalom, Univ. of Connecticut (USA) . . . . . [9092-8]

2:00 pm: **Tracking targets with low signal-to-noise ratio using particle filtering with flow control**, Nima Moshtagh, Paul M. Romberg, Steve G. Spray, Moses W. Chan, Lockheed Martin Space Systems Co. (USA). . . . . [9092-9]

2:25 pm: **how to avoid normalization of particle flow for nonlinear filters, Bayesian decisions and transport**, Frederick E. Daum, Jim Huang, Raytheon Co. (USA). . . . . [9092-10]

2:50 pm: **Seven dubious methods to mitigate stiffness in particle flow with non-zero diffusion for nonlinear filters, Bayesian decisions and transport**, Frederick E. Daum, Jim Huang, Raytheon Co. (USA) . . . . . [9092-11]

Coffee Break . . . . . .Wed 3:15 pm to 3:45 pm

3:45 pm: **A comparison of multiple-IMM estimation approaches using EKF, UKF, and PF for impact point prediction**, Ting Yuan, Yaakov Bar-Shalom, Peter K. Willett, R. Ben-Dov, S. Pollak, Univ. of Connecticut (USA). . . . [9092-12]

4:10 pm: **The CPHD and R-RANSAC trackers applied to the VIVID dataset,** Ramona Georgescu, United Technologies Research Ctr. (USA); Peter Niedfeldt, Brigham Young Univ. (USA); Shou Zhang, Amit Surana, Alberto Speranzon, Ozgur Erdinc, United Technologies Research Ctr. (USA) . . . . . [9082-28]

CONFERENCE OVERVIEW

LOCATION: CONV. CTR. ROOM 324 WED 4:35 PM TO 5:00 PM

The Future Outlook of Small Target Tracking Algorithm Development and Suggestions for Future Conferences in this Series

Moderators: **Oliver E. Drummond,** Consulting Engineer (USA); **Richard D. Teichgraeber,** Consulting Engineer (USA)

THURSDAY 8 MAY

SESSION 3

LOCATION: CONV. CTR. ROOM 324 . . . THU 8:30 AM TO 11:55 AM

Tracking Small Targets II

Session Chairs: **Steven W. Waugh,** Defense Threat Reduction Agency (USA); **Larry B. Stotts,** Stotts Consulting, LLC (USA)

8:30 am: **Beyond covariance consistency: A new metric for uncertainty consistency**, Joshua T. Horwood, Jeffrey M. Aristoff, Navraj Singh, Aubrey B. Poore, Numerica Corp. (USA) . . . . . [9092-15]

8:55 am: **IMM filtering on parametric data for multisensor fusion**, Scott Shafer, Mark W. Owen, Space and Naval Warfare Systems Ctr. Pacific (USA) . . . . . [9092-16]

9:20 am: **A comparative study of new nonlinear uncertainty propagation methods for space surveillance**, Joshua T. Horwood, Jeffrey M. Aristoff, Navraj Singh, Aubrey B. Poore, Numerica Corp. (USA) . . . . . [9092-17]

9:45 am: **A method for reconstructing track error covariance from track quality index (TQI)**, William D. Blair, Yanhua Ruan, Jason Kramer, Georgia Tech Research Institute (USA) . . . . . [9092-18]

Coffee Break . . . . . Thu 10:10 am to 10:40 am

10:40 am: **A new computational method for ambiguity assessment of solutions to assignment problems arising in target tracking**, Alexander D. Mont, Aubrey B. Poore, Numerica Corp. (USA) . . . . . [9092-19]

11:05 am: **The advancement of an algorithm**, Darin T. Dunham, Vectraxx, Inc. (USA); Peter K. Willett, Univ. of Connecticut (USA); Terry L. Ogle, Vectraxx, Inc. (USA); Balakumar Balasingam, Univ. of Connecticut (USA) . . . . . [9092-20]

11:30 am: **Approximate calculation of marginal association probabilities using a hybrid data association model**, Marcus Baum, Peter K. Willett, Yaakov Bar-Shalom, Univ. of Connecticut (USA); Ing Uwe D. Hanebeck, Karlsruher Institut für Technologie (Germany). . . . . [9092-21]

Lunch/Exhibition Break . . . . . Thu 11:55 am to 1:30 pm

SESSION 4
LOCATION: CONV. CTR. ROOM 324 . . . . THU 1:30 PM TO 2:50 PM

Signal and Data Processing

Session Chairs: **Larry B. Stotts,** Stotts Consulting, LLC (USA); **Richard D. Teichgraeber,** Consulting Engineer (USA)

1:30 pm: **ML-PMHT threshold determination and target trackability for K-distributed clutter**, Steven Schoenecker, Naval Undersea Warfare Ctr. (USA); Peter K. Willett, Yaakov Bar-Shalom, Univ. of Connecticut (USA) . . . . . [9092-23]

1:55 pm: **Bias estimation for space-based optical sensors with targets of opportunity**, Djedjiga Belfadel, Richard W. Osborne III, Yaakov Bar-Shalom, Univ. of Connecticut (USA) . . . . . [9092-25]

2:20 pm: **Intialization and tracking with Doppler-biased multistatic time-of-arrival measurements**, Wenbo Dou, Yaakov Bar-Shalom, Peter K. Willett, Univ. of Connecticut (USA). . . . . [9092-26]

Coffee Break . . . . . Thu 2:50 pm to 3:40 pm

WORKSHOP
LOCATION: CONV. CTR. ROOM 324 THU 3:40 PM TO 4:05 PM

Signal and Track Processing

Session Chair: **Richard D. Teichgraeber,** Consulting Engineer (USA)

This Workshop is similar to a typical conference session with the exception that no manuscript is required. A copy of the Workshop presenters' PowerPoint files will be published in the front matter of the conference proceedings and the SPIE Digital Library. The Workshop may also serve as a platform for computer-generated demonstrations. If there is a video for a demonstration presentation, it cannot be included in the proceedings. However, the author may add a link in his PowerPoint that is directed to where his is storing his video file. All Workshop authors retain their copyright.

Workshop abstracts may still be accepted (email Pat Wight, patw@spie.org)

3:40 pm: **Some fundamentals unique to multiple target tracking**, Oliver Drummond, Consulting Engineer (USA). . . . . [9092-27]

OPEN DISCUSSION
LOCATION: CONV. CTR. ROOM 324 . . . . . 4:05 PM TO 4:55 PM

The Future Outlook of Small Target Tracking Algorithm Development and Suggestions for Future Conferences in this Series

Moderator: **Oliver E. Drummond,** Consulting Engineer

CONFERENCE 9093

LOCATION: CONV. CTR. ROOM 329

Wednesday - Thursday 7 - 8 May 2014 • Proceedings of SPIE Vol. 9093

Algorithms for Synthetic Aperture Radar Imagery XXI

Conference Chairs: **Edmund 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,** Systems & Technology Research (USA); **Charles V. Jakowatz Jr.,** Sandia National Labs. (USA); **Eric R. Keydel,** SAIC (USA); **Juan Li,** Univ. of Central 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,** Jacobs 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 7 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 329 . . WED 9:00 AM TO 11:10 AM

Advanced Imaging

Session Chair: **Charles V. Jakowatz Jr.,** Sandia National Labs. (USA)

9:00 am: **Phenomenology of low probability of intercept synthetic aperture radar via frank codes**, David A. Garren, Phillip E. Pace, Ric N. Romero, Naval Postgraduate School (USA). . . . . [9093-1]

9:10 am: **Autofocus and analysis of geometrical errors within the framework of fast factorized back projection**, Jan Torgrimsson, Chalmers Univ. of Technology (Sweden); Patrik Dammert, Hans Hellsten, Saab AB (Sweden); Lars M. H. Ulander, Swedish Defence Research Agency (Sweden) . . . . . [9093-2]

9:20 am: **A three-dimensional fractional Fourier transformation methodology for volumetric linear, circular, and orbital synthetic aperture radar image formation**, Matthew P. Pepin, U.S. Air Force (USA) . . . . . [9093-3]

9:30 am: **Doppler synthetic aperture radar interferometry**, H. Cagri Yanik, Birsen Yazici, Rensselaer Polytechnic Institute (USA) . . . . . [9093-4]

9:40 am: **Polar format algorithm for SAR imaging with Matlab**, Ross W. Deming, Solid State Scientific Corp. (USA). . . . . [9093-5]

9:50 am: **Antenna trajectory error analysis in backprojection-based SAR Images**, Ling Wang, Nanjing Univ. of Aeronautics and Astronautics (China); H. Cagri Yanik, Birsen Yazici, Rensselaer Polytechnic Institute (USA) . . . . . [9093-6]

10:00 am: **Model-based 3D reconstruction**, Chad Knight, Space Dynamics Lab. (USA); Jacob H. Gunther, Utah State Univ. (USA) . . . . . [9093-7]

Coffee Break . . . . . .Wed 10:10 am to 10:40 am

10:40 am: **Bayesian autofocus for interrupted SAR using approximate message passing**, Joshua N. Ash, The Ohio State Univ. (USA) . . . . . [9093-8]

10:50 am: **Applying stereo SAR to remove height-dependent layover effects from video SAR imagery**, John Miller, Edward Bishop, General Atomics Aeronautical Systems, Inc. (USA); Armin W. Doerry, Sandia National Labs. (USA) . . . . . [9093-9]

11:00 am: **The Born approximation, multiple scattering, and the butterfly algorithm**, Alejandro F. Martinez, The Univ. of Texas-Pan American (USA) . . . . . [9093-10]

SESSION 2

LOCATION: CONV. CTR. ROOM 329 . . WED 11:10 AM TO 12:30 PM

Automated Exploitation

11:10 am: **Estimation of information measures on target manifolds**, Emre Ertin, The Ohio State Univ. (USA) . . . . . [9093-11]

11:20 am: **Geometric separability analysis for radar exploitation**, Adam R. Nolan, Andrew J. Lingg, George S. Goley, Etegent Technologies, Ltd. (USA) . . . . . [9093-12]

11:30 am: **Feature selection using sparse Bayesian inference**, James R. Baxter, T. Scott Brandes, Signal Innovations Group, Inc. (USA) . . . . . [9093-13]

11:40 am: **Geometrical prediction of SAR templates**, Christopher Paulson, Edmund Zelnio, Air Force Research Lab. (USA) . . . . . [9093-14]

11:50 am: **Ship detection in SAR images using efficient land masking methods**, Ahmed S. Mashaly, Ezz Farouk, Tarek Mahmoud, Military Technical College (Egypt) . . . . . [9093-15]

12:00 pm: **Novel approach for assessing uncertainty propagation via information-theoretic divergence metrics and multivariate Gaussian Copula modeling**, Brian J. Thelen, Joseph W. Burns, Michigan Tech Research Institute (USA) . . . . . [9093-16]

12:10 pm: **Model-based expoitation, uncertainty, and interpretation**, Eric R. Keydel, Leidos (USA). . . . . [9093-17]

12:20 pm: **Recent Improvements to the Radier Tracer Scattering Prediction Tool**, Brian D. Rigling, Wright State Univ. (USA); Austin Mackey, The Ohio State Univ. (USA) . . . . . [9093-18]

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

POSTER SESSION

LOCATION: CONV. CTR. ROOM 329 . . . . .2:00 PM TO 3:30 PM

Coffee Break . . . . . .Wed 3:30 pm to 4:00 pm

DISCUSSION/WORKSHOP

LOCATION: CONV. CTR. ROOM 329 . . . . 4:00 PM TO 5:00 PM

THURSDAY 8 MAY

SESSION 3
LOCATION: CONV. CTR. ROOM 329 . . . THU 9:00 AM TO 11:30 AM

Moving Targets

Session Chair: **Edmund Zelnio,** Air Force Research Lab. (USA)

9:00 am: **Estimating moving target information using single-channel SAR**, Jacob H. Gunther, Josh Hunsaker, Utah State Univ. (USA); Hyrum Anderson, Sandia National Labs. (USA); Todd Moon, Utah State Univ. (USA) . . . . [9093-19]

9:10 am: **CRB analysis of multichannel SAR with nonstationary noise**, Gregory E. Newstadt, Alfred O. Hero III, Univ. of Michigan (USA); Edmund Zelnio, Air Force Research Lab. (USA) . . . . . [9093-20]

9:20 am: **Detection of moving humans in UHF wideband SAR**, Thomas K. Sjögren, Lars M. H. Ulander, Per-Olov Frölind, Anders Gustavsson, Swedish Defence Research Agency (Sweden) . . . . . [9093-21]

9:30 am: **Ground vehicle ISAR for feature-aided tracking**, Stephen J. Hershkowitz, Brian Lamb, Electromagnetic Systems, Inc. (USA) . . . . . [9093-22]

9:40 am: **Blind phase calibration for along-track interferometry: application to gotcha data set**, Faruk Uysal, Vinay Murthy, C&P Technologies, Inc. (USA); Steven Scarborough, Air Force Research Laboratory, WPAFB (USA) . . [9093-23]

9:50 am: **Circular SAR GMTI**, Douglas Page, BAE Systems (USA). . . . [9093-24]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

10:30 am: **Subband processing for grating lobe disambiguation in sparse arrays**, Ryan K. Hersey, Georgia Institute of Technology (USA) . . . . . [9093-25]

10:40 am: **Extracting target shape invariants from pulsed radar data**, Matthew A. Ferrara, Gregory Arnold, Matrix Research Inc. (USA); Mark Stuff, Michigan Tech Research Institute (USA); Jason T. Parker, Air Force Research Lab. (USA) . . . . . [9093-26]

10:50 am: **ISAR image-aided measurement-level radar/AIS fusion for maritime surveillance**, Bhashyam Balaji, Michael K. McDonald, Anthony Damini, Christopher M. Parry, Defence Research and Development Canada (Canada) . . . . . [9093-27]

11:00 am: **An FFT-based along track interferometry (ATI) approach to SAR-based GMTI**, Daniel Thomas, SRC Inc. (USA) . . . . . [9093-28]

11:10 am: **Simultaneous SAR and GMTI using ATI/DPCA**, Matthew Best, Air Force Lifecycle Management Ctr. (USA); Ross Deming, Solid State Scientific Corp. (USA); Sean Farrell, Air Force Research Lab. (USA) . . . . . [9093-29]

11:20 am: **Multiresolution spatio-temporal modeling of video using Kronecker PCA**, Kristjan Greenewald, Univ. of Michigan (USA); Edmund Zelnio, Air Force Research Lab. (USA); Alfred O. Hero III, Univ. of Michigan (USA) . . . . . [9093-30]

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

POSTER SESSION
LOCATION: CONV. CTR. ROOM 329 . . . . . 1:20 PM TO 3:20 PM

Coffee Break . . . . . Thu 3:20 pm to 3:50 pm

DISCUSSION/WORKSHOP
LOCATION: CONV. CTR. ROOM 329 . . . . . 3:50 PM TO 4:50 PM

CONFERENCE 9094

LOCATION: CONV. CTR. ROOM 337

Tuesday - Wednesday 6 - 7 May 2014 • Proceedings of SPIE Vol. 9094

Optical Pattern Recognition XXV

Conference Chairs: **David Casasent,** Carnegie Mellon Univ. (USA); **Tien-Hsin Chao,** Jet Propulsion Lab. (USA)

Program Committee: **Mohammad S. 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. Stirbl,** Jet Propulsion Lab. (USA); **Ashit Talukder,** National Institute of Standards and Technology (USA); **Rupert C. Young,** Univ. of Sussex (United Kingdom)

TUESDAY 6 MAY

POSTERS-TUESDAY

LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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.

MINACE filter: variants of realization in 4-f correlator, Dmitry V. Shaulskiy, Nikolay Evtikhiev, Rostislav S. Starikov, Sergey N. Starikov, Evgeny Y. Zlokazov, National Research Nuclear Univ. MEPhI (Russian Federation) . . . . . [9094-20]

Invariant correlation filters comparison for multiclass recognition of scaled objects, Petr A. Ivanov, Yaroslavl State Univ. (Russian Federation) . . . [9094-21]

WEDNESDAY 7 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 337 . . WED 8:30 AM TO 11:30 AM

Invited Papers

Session Chair: **David Casasent,** Carnegie Mellon Univ. (USA)

8:30 am: **High-speed optical processing using digital micromirror device** *(Invited Paper)*, Tien-Hsin Chao, Thomas T. Lu, Jet Propulsion Lab. (USA); Brian P. Walker, Georgia Institute of Technology (USA); George F. Reyes, Jet Propulsion Lab. (USA) . . . . . [9094-1]

9:00 am: **A midwave compressive imaging system design for high throughput** *(Invited Paper)*, Richard Shilling, Robert R. Muise, Abhijit Mahalanobis, Lockheed Martin Missiles and Fire Control (USA) . . . . . [9094-2]

9:30 am: **Recent advances in correlation filter theory and application** *(Invited Paper)*, B. V. K. Vijaya Kumar, Joseph A Fernandez, Carnegie Mellon Univ. (USA); Andres Rodriguez, U.S. Air Force Research Laboratory (USA); Vishnu Naresh Boddeti, Carnegie Mellon Univ. (USA) . . . . . [9094-3]

Coffee Break . . . . . .Wed 10:00 am to 10:30 am

10:30 am: **Performance comparison of photorefractive two-bream coupling correlator with optimal fiber-based correlators** *(Invited Paper)*, Jed Khoury, Air Force Research Lab. (USA); Mohammad S. Alam, Univ. of South Alabama (USA); Partha P. Banerjee, Georges T. Nehmetallah, Univ. of Dayton (USA); Daniel M. Martin, William M. Durrant, Univ. of South Alabama (USA) . . . [9094-4]

11:00 am: **Data science and analytics measurement and benchmarking** *(Invited Paper)*, Ashit Talukder, National Institute of Standards and Technology (USA) . . . . . [9094-5]

SESSION 2

LOCATION: CONV. CTR. ROOM 337 . .WED 11:30 AM TO 12:30 PM

Novel Pattern Recognition and Correlator Systems

Session Chairs: **David Casasent,** Carnegie Mellon Univ. (USA); **Tien-Hsin Chao,** Jet Propulsion Lab. (USA)

11:30 am: **GPU processing for parallel image processing and real-time object recognition**, Kevin Vincent, California State Univ. (USA); Damien Nguyen, Saddleback College (USA); Brian P. Walker, Georgia Institute of Technology (USA); Thomas T. Lu, Tien-Hsin Chao, Jet Propulsion Lab. (USA) . . . . . [9094-6]

11:50 am: **Local binary patterns preprocessing for face identification/ verification using the VanderLugt correlator**, Thibault Napoléon, Ayman Alfalou, ISEN Brest (France) . . . . . [9094-7]

12:10 pm: **Performance evaluation of photorefractive two-beam coupling joint transform correlator**, Georges T. Nehmetallah, Partha P. Banerjee, Univ. of Dayton (USA); Mohammad S. Alam, Univ. of South Alabama (USA); Jed Khoury, Air Force Research Lab. (USA) . . . . . [9094-8]

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

SESSION 3

LOCATION: CONV. CTR. ROOM 337 . . . WED 1:30 PM TO 2:50 PM

Optical Tracking Systems

Session Chairs: **Mohammad S. Alam,** Univ. of South Alabama (USA); **Tien-Hsin Chao,** Jet Propulsion Lab. (USA)

1:30 pm: **A novel multitracking system for the evaluation of high-level swimmers performances**, D. Benara, Thibault Napoléon, Ayman Alfalou, ISEN Brest (France); A. Verney, ACTRIS (France); P. Hellar, FFN (France) . . . . [9094-9]

1:50 pm: **Target tracking using log-polar transform-based shifted phase-encoded joint transform correlation**, Mohammed N. Islam, Worku T Bitew, The State Univ. of New York (USA). . . . . [9094-10]

2:10 pm: **Performance evaluation of optimal filters for target detection using SAR imagery**, Mohammad S. Alam, Univ. of South Alabama (USA); Jed Khoury, Air Force Research Lab. (USA); Partha P. Banerjee, Univ. of Dayton (USA); William M. Durant, Daniel M. Martin, Univ. of South Alabama (USA); Georges T. Nehmetallah, Univ. of Dayton (USA). . . . . [9094-11]

2:30 pm: **A proposed optical system for implementing the novel super-fast image processing scheme: the LPED method**, Chialun John Hu, Univ. of Colorado at Boulder (USA) . . . . . [9094-13]

Coffee/Exhibition Break. . . . . .Wed 2:50 pm to 3:30 pm

SESSION 4
LOCATION: CONV. CTR. ROOM 337 . . . WED 3:30 PM TO 5:30 PM

Novel Optical Communications and Image Processing Systems and Applications

Session Chairs: **B. V. K. Vijaya Kumar,** Carnegie Mellon Univ. (USA); **Tien-Hsin Chao,** Jet Propulsion Lab. (USA)

3:30 pm: **Addressing channel noise and bit rate in a multi-channel free space optical communication system**, Brian P. Walker, Georgia Institute of Technology (USA); Thomas T. Lu, Jet Propulsion Lab. (USA); Colin Costello, California State Polytechnic Univ., Pomona (USA); George F. Reyes, Tien-Hsin Chao, Jet Propulsion Lab. (USA). . . . . [9094-14]

3:50 pm: **A rotation-invariant pattern recognition using spectral fringe-adjusted joint transform correlator and histogram representation**, Paheding Sidike, Theus Aspiras, Vijayan K. Asari, Univ. of Dayton (USA); Mohammad S. Alam, Univ. of South Alabama (USA) . . . . . [9094-15]

4:10 pm: **Local directional pattern of phase congruency features for illumination invariant face recognition**, Almabrok Essa, Vijayan K. Asari, Univ. of Dayton (USA). . . . . [9094-16]

4:30 pm: **A novel two-pattern full lateral resolution structured light illumination method**, Minghao Wang, Laurence G. Hassebrook, Univ. of Kentucky (USA) . . . . . [9094-17]

4:50 pm: **Finding weak edges in imagery**, Prakash Duraisamy, Old Dominion Univ. (USA) and Massachusetts Institute of Technology (USA); Stephen Jackson, Xiaohui Yuan, Univ. of North Texas (USA); Mohammad S. Alam, Univ. of South Alabama (USA) . . . . . [9094-18]

5:10 pm: **Wavelet analysis for compressed image sensing using matrices**, Andre U. Sokolnikov, Visual Solutions and Applications (USA) . . . . . [9094-19]

CONFERENCE 9095

LOCATION: CONV. CTR. ROOM 333

Tuesday 6 - 6 May 2014 • Proceedings of SPIE Vol. 9095

Modeling and Simulation for Defense Systems and Applications IX

Conference Chair: **Eric J. Kelmelis,** EM Photonics, Inc. (USA)

Program Committee: **James P. Durbano,** Northrop Grumman (USA); **James N. Elele,** Naval Air Systems Command (USA); **Susan Harkrider,** U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Jonathan D. Rogers,** Georgia Institute of Technology (USA); **Chen Wu,** Defence Research and Development Canada, Ottawa (Canada)

TUESDAY 6 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 333 . . TUE 8:40 AM TO 10:00 AM

Learning and Intelligence

Session Chair: **Robert Wright,** Capella Univ. (USA)

8:40 am: **Using artificial intelligence for automating testing of a resident space object collision avoidance system on an orbital spacecraft**, Jeremy Straub, The Univ. of North Dakota (USA) . . . . . [9095-1]

9:00 am: **Portability scenarios for intelligent robotic control agent software**, Jeremy Straub, The Univ. of North Dakota (USA) . . . . . [9095-2]

9:20 am: **Modeling techniques for remote sensing**, Jeevake Attapattu, Ershad Sharifahmadian, Shahram Latifi, Univ. of Nevada, Las Vegas (USA) . . . . [9095-3]

9:40 am: **Migrating EO/IR sensor simulations to cloud-based infrastructure as a service architectures**, Stephen Berglie, Steven Webster, KINEX (USA); Christopher M. May, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [9095-4]

Coffee/Exhibition Break. . . . . Tue 10:00 am to 10:30 am

SESSION 2

LOCATION: CONV. CTR. ROOM 333 . .TUE 10:40 AM TO 12:00 PM

Sensors and Imaging

Session Chair: **Paul A. Fox,** EM Photonics, Inc. (USA)

10:40 am: **RF/microwave system high-fidelity modeling and simulation: application to airborne multichannel receiver system for angle of arrival estimation**, Chen Wu, Sreeraman Rajan, Anne Young, Christina O'Regan, Defence Research and Development Canada (Canada). . . . . [9095-5]

11:00 am: **MetaTracker: Integration and abstraction of 3D motion tracking data from multiple hardware systems**, Ken Kopecky, Eliot Winer, Iowa State Univ. (USA) . . . . . [9095-6]

11:20 am: **Integrated sensor architecture (ISA) for live virtual constructive (LVC) environments**, Christine L. Moulton, U.S. Army Night Vision & Electronic Sensors Directorate (USA); John Harrell, Jared J. Hepp, Oakwood Controls Corp. (USA) . . . . . [9095-7]

11:40 am: **Mean square error performance evaluation of a commercial speckle imaging system using simulated imagery**, Jeremy P. Bos, Michigan Technological Univ. (USA); Petersen F. Curt, Aryeh Kuller, EM Photonics, Inc. (USA); Michael C. Roggemann, Michigan Technological Univ. (USA) . . . [9095-8]

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

SESSION 3

LOCATION: CONV. CTR. ROOM 333 . . . . .TUE 1:30 PM TO 1:50 PM

Human Interaction

Session Chair: **Dan Mackriders,**
Phase Sensitive Innovations, Inc. (USA)

1:30 pm: **Knowledge fusion and continuity in disaster response service delivery systems: The integrated family assistance center model**, Robert Wright, Capella Univ. (USA). . . . . [9095-9]

SESSION 4

LOCATION: CONV. CTR. ROOM 333 . . . . TUE 1:50 PM TO 2:30 PM

Threats and Countermeasures

Session Chair: **Dan Mackriders,**
Phase Sensitive Innovations, Inc. (USA)

1:50 pm: **Regional value analysis at threat evaluation**, Metin M. İşcan, Aykut Coskun, Harp Akademileri Komutanligi (Turkey). . . . . [9095-12]

2:10 pm: **Optimized design of photonic crystal-based infrared obscurants**, William W. Maslin III, Univ. of Delaware (USA); Mathew J. Zablocki, James Murray, Ahmed S. Sharkawy, Lumilant, Inc. (USA); Brendan G. DeLacy, James D. Shomo, U.S. Army Edgewood Chemical Biological Ctr. (USA); Mark S. Mirotznik, Univ. of Delaware (USA) . . . . . [9095-13]

Coffee/Exhibition Break. . . . . Tue 2:30 pm to 3:30 pm

SESSION 5

LOCATION: CONV. CTR. ROOM 333 . . . . TUE 3:30 PM TO 4:30 PM

Tools and Techniques

Session Chair: **Timothy Creazo,** Lumilant (USA)

3:30 pm: **Optimization techniques for OpenCL-based linear algebra routines**, Stephen T. Kozacik, Univ. of Delaware (USA); Paul A. Fox, John R. Humphrey Jr., Aryeh Kuller, EM Photonics, Inc. (USA); Dennis W. Prather, Univ. of Delaware (USA) . . . . . [9095-14]

3:50 pm: **Targeting multiple-hetergeneous hardware platforms with OpenCL**, Paul A. Fox, EM Photonics, Inc. (USA); Stephen T. Kozacik, Univ. of Delaware (USA); John R. Humphrey Jr., Eric J. Kelmelis, Aryeh Kuller, EM Photonics, Inc. (USA) . . . . . [9095-15]

4:10 pm: **Accelerated openCV with CUDA or openCL using ArrayFire**, John M. Melonakos, AccelerEyes LLC (USA) . . . . . [9095-16]

POSTERS-TUESDAY

LOCATION: CONV. CTR. HALL C . . . . . .TUE 6:00 PM 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 session. 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 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.

IDS algorithm based on reinforcement learning, Jie Su, Harbin Univ. of Science and Technology (China). . . . . [9095-17]

Distributed neural network learning algorithm, Peili Qiao, Harbin Univ. of Science and Technology (China). . . . . [9095-18]

An improved detection model for large-scale distributed network based on P2P, Peili Qiao, Harbin Univ. of Science and Technology (China) . . . . . [9095-19]

CONFERENCE 9096

LOCATION: CONV. CTR. ROOM 334

Monday - Wednesday 5 - 7 May 2014 • Proceedings of SPIE Vol. 9096

Open Architecture/Open Business Model Net-Centric Systems and Defense Transformation 2014

Conference Chair: **Raja Suresh,** General Dynamics Advanced Information Systems (USA)

Program Committee: **Vasu D. Chakravarthy,** Air Force Research Lab. (USA); **Megan Cramer,** U.S. Navy PEO LCS (USA); **John S. Eicke,** U.S. Army Research Lab. (USA); **Bassam S. Farroha,** U.S. Dept. of Defense (USA); **Deborah Farroha,** U.S. Dept. of Defense (USA); **Thomas Green,** SAIC (USA); **Nickolas Guertin,** U.S. Navy (USA); **Michael A. Kolodny,** U.S. Army Research Lab. (USA); **Leo J. Rose,** U.S. Air Force (USA); **Jason R. Stack,** Office of Naval Research (USA)

MONDAY 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 334 . . . .MON 1:20 PM TO 3:20 PM

Net-centric Open Architecture Systems I

Session Chairs: **Raja Suresh,** General Dynamics Advanced Information Systems (USA); **Leo J. Rose,** Air Force Research Lab. (USA)

1:20 pm: **Q-learning and p-persistent CSMA-based rendezvous protocol for cognitive radio networks**, Clifton L. Watson, Air Force Research Lab. (USA) and Michigan State Univ. (USA); Subir Biswas, Michigan State Univ. (USA) . . . . . [9096-1]

1:40 pm: **The UAS control segment ecosystem**, Douglas A. Gregory, Neya Systems LLC (USA); Lisa K. Yarbrough, IBM Corp. (USA) . . . . . [9096-2]

2:00 pm: **Assessment of the integration capability of system architectures from a complex and distributed software systems perspective**, Sandro Leuchter, Hochschule Rhein-Waal (Germany); Frank Reinert, Wilmuth Müller, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [9096-3]

2:20 pm: **Proximity-based access control for context-sensitive information provision in SOA-based systems**, Gowri S. Rajappan, Xiaofei Wang, Foresight Wireless, LLC (USA); Robert C. Grant, Matthew Paulini, Air Force Research Lab. (USA) . . . . . [9096-4]

2:40 pm: **On investigating social dynamics in tactical opportunistic mobile networks**, Wei Gao, Yong Li, The Univ. of Tennessee Knoxville (USA) . . [9096-5]

3:00 pm: **An end-to-end communications architecture for condition-based maintenance applications**, Joseph B. Kroculick, Winifred Associates (USA) . . . . . [9096-6]

Defense + Security Plenary Presentation

MON 5:00 TO 6:00 PM
LOCATION: CONV. CTR. BALLROOM 1-2

Innovation: Hard on Earth, Harder in Space

This presentation will highlight the challenges that have been overcome to achieve today's national security space capabilities, and those that must be faced in the near future to sustain and evolve these capabilities

Dr. Troy E. Meink, Member of the Senior Executive Service, Deputy Under Secretary of the Air Force for Space; Director, Executive Agent for Space Staff, Washington D.C.

TUESDAY 6 MAY

SESSION 2

LOCATION: CONV. CTR. ROOM 334 . . . TUE 8:30 AM TO 11:40 AM

RF-Field Programmable Gate Arrays

Session Chairs: **Raja Suresh,** General Dynamics Advanced Information Systems (USA); **Vasu D. Chakravarthy,** Air Force Research Lab. (USA)

8:30 am: **RF-FPGA program overview** *(Invited Paper)*, William Chappell, Defense Advanced Research Projects Agency (USA). . . . . [9096-7]

9:00 am: **A scalable multi-input multi-output (MIMO) software defined radio platform**, Hossein Hashemi, The Univ. of Southern California (USA). . . . [9096-8]

9:20 am: **High-power sub-1 ohm phase-change RF switching for reconfigurable RF front end**, Jeong S. Moon, HRL Labs., LLC (USA) . . [9096-9]

9:40 am: **Low-loss, non-volatile, phase-change RF switching technology for system reconfigurability and reliability**, Mike Lee, Northrop Grumman Corp. (USA) . . . . . [9096-10]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

10:30 am: **MATRICs: Micrwave array technology for reconfigurable integrated circuits**, Scott Sweetland, BAE Systems (USA). . . . . [9096-11]

10:50 am: **Low-loss millimeter-waves switches based in Vanadium dioxide metal-insulator-transition**, Mark Field, Philip Stupar, Kang-Jin Lee, Teledyne Scientific Co. (USA); Mark J. Rodwell, Univ. of California, Santa Barbara (USA) . . . . . [9096-12]

DEMONSTRATION

LOCATION: CONV. CTR. ROOM 334 . . . . 11:10 AM TO 11:40 AM

Software Defined Radio Platform Demonstration

Hossein Hashemi, Univ. of Southern California (USA)

Lunch/Exhibition Break . . . . . Tue 10:40 am to 1:00 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 334 . . . . TUE 1:00 PM TO 3:30 PM

Net-Centric Open Architecture Systems II

Session Chairs: **Jason R. Stack,** Office of Naval Research (USA); **Nickolas Guertin,** U.S. Navy (USA)

1:00 pm: **Integration of avionics payloads: open architecture approaches and technologies** *(Invited Paper)*, Robert A, Bond, MIT Lincoln Lab. (USA); Vincent Sabio, Defense Advanced Research Projects Agency (USA) . . [9096-14]

1:30 pm: **Cross domaine open RF architecture** *(Invited Paper)*, Betsy DeLong, Office of Naval Research (USA). . . . . [9096-15]

2:00 pm: **Manufacturing of affordable open systems for ISR** *(Invited Paper)*, Dan Turner, Air Force Research Lab. (USA) . . . . . [9096-16]

2:30 pm: **U.S. Navy Working Group Report: unmanned maritime system reference architecture** *(Invited Paper)*, Christiane N. Duarte, Naval Undersea Warfare Ctr. (USA). . . . . [9096-17]

3:00 pm: **Empowering open systems through cross-platform interoperability** *(Invited Paper)*, James C. Lyke, Air Force Research Lab. (USA) . . . . . [9096-18]

CONFERENCE 9096

LOCATION: CONV. CTR. ROOM 328 & ROOM 336

WEDNESDAY 7 MAY

SESSION 4

LOCATION: CONV. CTR. ROOM 328 . . WED 8:30 AM TO 10:30 AM

NOTE ROOM CHANGE

Keynote Session

Joint Session with Conferences 9096 and 9084

Session Chairs: **Raja Suresh,** General Dynamics Advanced Information Systems (USA); **Robert E. Karlsen,** U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA)

Open Architecture (OA)/Open Business Model (OBM) Systems

8:30 am: **Navy perspectives on open architecture unmanned systems** *(Keynote Presentation)*, Mathias W. Winter, Rear Admiral, NAVAIR (USA) . . . . . [9096-19]

9:00 am: **Open architecture applied to next-generation weapons** *(Keynote Presentation)*, Leo J. Rose, Air Force Research Lab. (USA) . . . . . [9096-20]

9:30 am: **General Dynamics journey in open architecture systems** *(Keynote Presentation)*, Michael A. Eagan, General Dynamics Advanced Information Systems (USA) . . . . . [9096-21]

10:00 am: **Robotic collaborative technology alliance: an open architecture approach to integrated research** *(Keynote Presentation)*, Robert M. Dean, Charles A. Diberardino, General Dynamics Land Systems (USA) . . . . . [9096-22]

Coffee Break . . . . . Wed 10:30 am to 11:00 am

PANEL DISCUSSION

LOCATION: CONV. CTR. ROOM 328 . . . . . WED 11:00 AM TO 12:00 PM

NOTE ROOM CHANGE

Open Architecture (OA) Open Business Mode (OBM) Systems

Joint Panel Discussion with Conferences 9096 and 9084

Moderator: **Raja Suresh,** General Dynamics Advanced Information Systems (USA)

Panelists:

Rear Admiral Mathias Winter, Program Executive Officer, Unmanned Aviation and Strike Weapons, U.S. Navy (USA)

Leo Rose, Air Force Research Lab. (USA)

Mike Eagan, Vice President, General Dynamics Advanced Information Systems (USA)

Robert Dean, General Dynamics Robotic Systems (USA)

THURSDAY 8 MAY

SESSION 5

LOCATION: CONV. CTR. ROOM 336 . . . THU 8:30 AM TO 10:10 AM

NOTE ROOM CHANGE

Micro Autonomous Systems Technology (MAST): Performance Bounds and Trade Space Studies

Joint Session with Conferences 9083/9084/9096

Session Chairs: **Christopher M. Kroninger,** U.S. Army Research Lab. (USA); **William D. Nothwang,** U.S. Army Research Lab. (USA)

8:30 am: **From wakes to wings: Using a multi-fidelity approach to design flapping wings** *(Invited Paper)*, David J. Willis, Univ. of Massachusetts Lowell (USA) . . . . . [9083-60]

8:50 am: **Characterization and enhancement of micro brushless DC motor response** *(Invited Paper)*, Joseph K. Conroy, U.S. Army Research Lab. (USA); Andrew Kehlenbeck, Univ. of Maryland, College Park (USA); James S. Humbert, Univ. of Maryland, College Park (USA). . . . . [9083-61]

9:10 am: **Power and weight considerations in small, agile quadrotors** *(Invited Paper)*, Yash Mulgaonkar, Michael Whitzer, Univ. of Pennsylvania (USA); Brian Morgan, Christopher M. Kroninger, Aaron M. Harrington, U.S. Army Research Lab. (USA); Vijay Kumar, Univ. of Pennsylvania (USA) . . . . . [9083-62]

9:30 am: **Endurance bounds of aerial systems** *(Invited Paper)*, Aaron M. Harrington, U.S. Army Research Lab. (USA). . . . . [9083-63]

9:50 am: **Autonomous charging to enable long-endurance missions for small aerial robots** *(Invited Paper)*, Yash Mulgaonkar, Vijay Kumar, Univ. of Pennsylvania (USA) . . . . . [9083-64]

Coffee Break . . . . . Thu 10:10 am to 10:40 am

SESSION 6

LOCATION: CONV. CTR. ROOM 336 . THU 10:40 AM TO 12:00 PM

NOTE ROOM CHANGE

Micro Autonomous Systems Technology (MAST): Power Solutions

Joint Session with Conferences 9083/9084/9096

Session Chairs: **William D. Nothwang,** U.S. Army Research Lab. (USA); **Christopher M. Kroninger,** U.S. Army Research Lab. (USA)

10:40 am: **MEMS-based approaches for miniature power supply applications** *(Invited Paper)*, Sarah S. Bedair, Christopher D. Meyer, Jeffrey S. Pulskamp, Brian Morgan, Ronald G. Polcawich, U.S. Army Research Lab. (USA); Christopher Dougherty, Xue Lin, David Arnold, Rizwan Bashirullah, Univ. of Florida (USA); Iain Kierzewski, Nathan Lazarus, Joel Martin, Brian Power, U.S. Army Research Lab. (USA) . . . . . [9083-65]

11:00 am: **Power management for small scale systems** *(Invited Paper)*, Christopher D. Meyer, Sarah S. Bedair, Brian Morgan, U.S. Army Research Lab. (USA); David Arnold, Univ. of Florida (USA); Nathan Lazarus, Iain Kierzewski, U.S. Army Research Lab. (USA) . . . . . [9083-66]

11:20 am: **High-specific energy and specific power aluminum/air primary battery for micro-air-vehicles** *(Invited Paper)*, Andrew Kindler, Lawrence Matthies, Jet Propulsion Lab. (USA) . . . . . [9083-67]

11:40 am: **Thermophotovoltaic and thermoelectric portable power generators** *(Invited Paper)*, Walker Chan, Massachusetts Institute of Technology (USA); Christopher M. Waits, U.S. Army Research Lab. (USA); Marin Soljacic, Massachusetts Institute of Technology (USA); John D. Joannopoulos, MIT Institute for Soldier Nanotechnologies (USA); Ivan Celanovic, Massachusetts Institute of Technology (USA) . . . . . [9083-68]

CONFERENCE 9097

LOCATION: CONV. CTR. ROOM 347

Tuesday 6 May 2014 • Proceedings of SPIE Vol. 9097

Cyber Sensing 2014

Conference Chairs: **Igor V. Ternovskiy,** Air Force Research Lab. (USA); **Peter Chin,** Draper Lab. (USA), Boston Univ. (USA)

Program Committee: **Chad D. Heitzenrater,** Air Force Research Lab. (USA); **Tony C. Kim,** Air Force Research Lab. (USA)

TUESDAY 6 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 347 .. TUE 8:20 AM TO 10:00 AM

Detection and Prevention Issues at Cyber Sensing

Session Chairs: **Peter Chin,** Draper Lab. (USA), Boston Univ. (USA); **Igor V. Ternovskiy,** Air Force Research Lab. (USA)

8:20 am: **Applying hardware-based machine learning for detecting cyber security virus attacks**, Bruce McCormick, CogniMem Technologies, Inc. (USA); Robinson E. Pino, ICF International (USA) . . . . . [9097-1]

8:40 am: **Generation of an electromagnetic field via the electro-kinetic effect and network effects**, Igor V. Ternovskiy, Air Force Research Lab. (USA); Naum I. Gershenzon, Gust Bambakidis, Wright State Univ. (USA). . . . . [9097-19]

9:00 am: **Proactive malware detection and prevention**, Jonathan A. Gloster, David Dredden, Mark Olsen, The Van Dyke Technology Group, Inc. (USA); Nischit Vaidya, The Van Dyke Technology Group, Inc. (USA) and Capitol College (USA); Michael Diep, The Van Dyke Technology Group, Inc. (USA) and Univ. of Maryland Univ. College (USA) . . . . . [9097-3]

9:20 am: **On effectiveness of cryptographic mechanisms for smart grid communications**, Sriharsha Mallapuram, Paul Moulema, Wei Yu, Towson Univ. (USA) . . . . . [9097-4]

9:40 am: **The impact of the council of EUROPE'S convention on cyber crime on cyber security**, Gökhan Bayraktar, Turkish Air War College (Turkey) [9097-5]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

SESSION 2

LOCATION: CONV. CTR. ROOM 347 .. TUE 10:30 AM TO 11:50 AM

Social and Methodological Aspects of Cyber Sensing

Session Chairs: **Igor V. Ternovskiy,** Air Force Research Lab. (USA); **Peter Chin,** Draper Lab. (USA), Boston Univ. (USA)

10:30 am: **Classification of group behaviors in social media via social behavior grammars**, Georgiy M. Levchuk, Aptima, Inc. (USA); Lise Getoor, Univ. of California, Santa Cruz (USA); Mark Smith, Connected Action (USA) . . . . . [9097-6]

10:50 am: **Challenges to inferring causality from viral information dispersion in dynamic social networks**, John Ternovski, Univ. of Oxford (United Kingdom) . . . . . [9097-7]

11:10 am: **The new requirement for the fifth-dimension of the war: cyber intelligence**, Gökhan Bayraktar, Turkish Air War College (Turkey) . . . . . [9097-8]

11:30 am: **Three tenets for secure cyber-physical system design and assessment**, Jeff Hughes, Tenet 3, LLC (USA); George Cybenko, Thayer School of Engineering at Dartmouth (USA) . . . . . [9097-9]

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

PANEL DISCUSSION

LOCATION: CONV. CTR. ROOM 347 . TUE 1:00 PM TO 1:40 PM

Trusted Systems in Defense

Panel Moderator: **Tony Kim,** Air Force Research Lab.

Panelists: **Peter Chin,** Draper Lab., Boston Univ.; **Igor V. Ternovskiy,** Air Force Research Lab.; **Jeff Hughes,** Tenet 3, LLC

What technology and policy aspects in Trusted Systems, Devices, and Components could make large organizations capable of better protecting their assets and data?

SESSION 3

LOCATION: CONV. CTR. ROOM 347 . . . . TUE 1:40 PM TO 3:00 PM

Vulnerabilities and Risk Assessment in Cyber Sensing

Session Chair: **Tony C. Kim,** Air Force Research Lab. (USA)

1:40 pm: **Radar susceptibility to cyber attack**, David Tahmoush, U.S. Army Research Lab. (USA) . . . . . [9097-10]

2:00 pm: **Designing resiliency**, Anurag Dwivedi, Johns Hopkins Univ. Applied Physics Lab. (USA) . . . . . [9097-11]

2:20 pm: **Modeling vulnerability, risk, and resilience in distributed control systems**, Hasan Cam, U.S. Army Research Lab. (USA). . . . . [9097-12]

2:40 pm: **New generations of war: active defence on cyber space**, Fatih Aksoy, Turkish Air War College (Turkey) . . . . . [9097-13]

Coffee Break . . . . . Tue 3:00 pm to 3:30 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 347 . . . . TUE 3:30 PM TO 6:30 PM

Enabling Technologies for Cyber Sensing

Session Chairs: **Igor V. Ternovskiy,** Air Force Research Lab. (USA); **Peter Chin,** Draper Lab. (USA), Boston Univ. (USA)

3:30 pm: **Main control computer (MCC) security model for intranet protection against cyber attacks**, Bilal Seymen, Münir Gedikli, Oğuz Sayin, Turkish Air War College (Turkey) . . . . . [9097-14]

3:50 pm: **Improvements of cyber space and affects to the battlefield**, Münir Gedikli, Oğuz Sayin, Bilal Seymen, Turkish Air War College (Turkey) . . . [9097-15]

4:10 pm: **Defending against advanced targeted attacks in the healthcare ecosystem**, Stephen Bono, Independent Security Evaluators (USA) . . [9097-16]

4:30 pm: **Efficient non-resonant absorption of electromagnetic radiation in thin cylindrical targets: experimental evidence**, Andrey Akhmeteli, LTASolid Inc. (USA); Nikolay G. Kokodiy, Boris Safronov, Valeriy Balkashin, Ivan Priz, V.N. Karazin Kharkiv National Univ. (Ukraine); Alexander Tarasevitch, Univ. Duisburg-Essen (Germany) . . . . . [9097-17]

4:50 pm: **Micromirror array simulation and far-field diffraction analysis**, Xiaohui Yuan, Siyuan Liu, Univ. of North Texas (USA); Jason D. Schmidt, MZA Associates Corp. (USA); Igor Anisimov, Air Force Research Lab. (USA) [9097-18]

5:10 pm: **Robust volumetric change detection using mutual information with 3D fractals**, Mark D. Rahmes, Morris Akbari, Ronda R. Henning, John Pokorny III, Harris Corp. (USA). . . . . [9097-2]

5:30 pm: **Image reconstruction from sub-apertures of circular spotlight SAR**, Xiaohui Yuan, Univ. of North Texas (USA); Igor V. Ternovskiy, Air Force Research Lab. (USA) . . . . . [9097-20]

5:50 pm: **Classification for wireless covert timing channel communications: a geometric approach**, Dung N. Tran, Johns Hopkins Univ. (USA); Peter Chin, Draper Lab. (USA) . . . . . [9097-21]

6:10 pm: **No-hardware-signature cybersecurity-crypto-module: a resilient cyber defense agent**, Yasser A. Zaghloul, Consultant (USA); Abdel Rahman M. Zaghloul, ITR Technologies, Inc. (USA). . . . . [9097-22]

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Jung-Young Son, Konyang Univ. (Korea, Republic of)
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Adrian Stern, Ben-Gurion Univ. of the Negev (Israel)
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Harold H. Szu, U.S. Army Research Office (USA)
Shu-I Tu, USDA Agricultural Research Service (USA)
Eric Udd, Columbia Gorge Research (USA)
Tuan Vo-Dinh, Fitzpatrick Institute for Photonics, Duke Univ. (USA)
Anbo Wang, Virginia Polytechnic Institute and State Univ. (USA)
Virginia E. Wotring, Universities Space Research Association/NASA JSC (USA)
Toru Yoshizawa, NPO 3D Associates Japan
Michael David Zoltowski, Purdue Univ. (USA)

Sensing Technology + Applications Daily Conference Schedule

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
IMAGING AND SENSING TECHNOLOGIES				
9101 **Next-Generation Spectroscopic Technologies VII** *(Druy/Crocombe)*		**WED. PLENARY PRESENTATIONS** 8:30 to 10:00 am	9098 **Fiber Optic Sensors and Applications XI** *(Du/Pickrell/Udd)*	
9102 **Terahertz Physics, Devices, and Systems VIII: Advanced Applications in Industry and Defense** *(Anwar/Crowe/Manzur)*		9100 **Image Sensing Technologies: Materials, Devices, Systems, and Applications** *(Dhar/Dutta)*		
9099 **Polarization: Measurement, Analysis, and Remote Sensing XI** *(Chenault/Goldstein)*		9103 **Wireless Sensing, Localization, and Processing IX** *(Dianat/Zoltowski)*		
			9104 **Spectral Imaging Sensor Technologies: Innovation Driving Advanced Application Capabilities** *(Bannon)*	
		9109 **Compressive Sensing III** *(Ahmad)*		
SENSING FOR INDUSTRY, ENVIRONMENT, AND HEALTH				
9105 **Thermosense: Thermal Infrared Applications XXXVI** *(Colbert/Hsieh)*				
9106 **Advanced Environmental, Chemical, and Biological Sensing Technologies XI** *(Vo-Dinh/Lieberman/Gauglitz)*		9107 **Smart Biomedical and Physiological Sensor Technology XI** *(Cullum/McLamore)*		
	9108 **Sensing for Agriculture and Food Quality and Safety VI** *(Kim/Chao)*			
9110 **Dimensional Optical Metrology and Inspection for Practical Applications III** *(Harding/Yoshizawa)*				
	9111 **Ocean Sensing and Monitoring VI** *(Hou/Arnone)*			
9112 **Sensing Technologies for Global Health, Military Medicine, and Environmental Monitoring IV** *(Southern)*				
		9113 **Sensors for Extreme Harsh Environments** *(Senesky/Dekate)*		
	9097 **Cyber Sensing 2014** *(Ternovskiy/Chin)*		9075 **Biometric and Surveillance Technology for Human and Activity Identification XI** *(Kakadiaris/Scheirer/Busch)*	
IMAGERY AND PATTERN ANALYSIS				
		9094 **Optical Pattern Recognition XXV** *(Casasent/Chao)*		

Sensing Technology + Applications Daily Conference Schedule

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
EMERGING TECHNOLOGIES				
9115 **Energy Harvesting and Storage: Materials, Devices, and Applications V** *(Dhar/Balaya/Dutta)*		9114 **Advanced Photon Counting Techniques VIII** *(Itzler)*		
			9116 **Sensors for Next-Generation Robotics** *(Popa/Wijesundara)*	
DATA VISUALIZATION				
9117 **Three-Dimensional Imaging, Visualization, and Display 2014** *(Javidi/Son)*				
INFORMATION SYSTEMS AND NETWORKS: PROCESSING, FUSION, AND KNOWLEDGE GENERATION				
	9122 **Next-Generation Analyst II** *(Broome/Hall/Llinas)*	9118 **Independent Component Analyses, Compressive Sampling, Wavelets, Neural Net, Biosystems, and Nanoengineering XII** *(Szu)*		
9120 **Mobile Multimedia/Image Processing, Security, and Applications 2014** *(Agaian/Jassim/Du)*			9119 **Machine Intelligence and Bio-inspired Computation: Theory and Applications VIII** *(Blowers/Williams)*	
	9121 **Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications 2014** *(Braun)*		9123 **Quantum Information and Computation XII** *(Donkor/Pirich/Brandt)*	
			9124 **Satellite Data Compression, Communications, and Processing X** *(Huang/Chang/López)*	
IR SENSORS AND SYSTEMS				
9070 **Infrared Technology and Applications XL** *(Andresen/Fulop/Hanson/Norton)*				
	9071 **Infrared Imaging Systems: Design, Analysis, Modeling, and Testing XXV** *(Holst/Krapels)*			
INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE				
9089B **Motion Imagery for ISR and Situational Awareness II** *(Self)*				
NEXT-GENERATION SENSORS AND SYSTEMS				
9083 **Micro- and Nanotechnology Sensors, Systems, and Applications VI** *(George/Islam/Dutta)*				
	9084 **Unmanned Systems Technology XVI** *(Karlsen/Gage/Shoemaker/Gerhart)*			
SENSOR DATA AND INFORMATION EXPLOITATION				
9088 **Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XX** *(Velez-Reyes/Kruse)*				
9089A **Geospatial InfoFusion and Video Analytics IV** *(Pellechia/Palaniappan/Deignan)*				
9091 **Signal Processing, Sensor/Information Fusion, and Target Recognition XXIII** *(Kadar)*				

CONFERENCE 9098

LOCATION: CONV. CTR. ROOM 330

Thursday - Friday 8 - 9 May 2014 • Proceedings of SPIE Vol. 9098

Fiber Optic Sensors and Applications XI

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: **Christopher S. Baldwin,** Weatherford International Ltd. (USA); **Jerry J. Benterou,** Lawrence Livermore National Lab. (USA); **Anbo Wang,** Virginia Polytechnic Institute and State Univ. (USA)

Program Committee: **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); **Xudong Fan,** Univ. of Michigan (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); **Alexis Mendez,** MCH Engineering LLC (USA); **Stephen J. Mihailov,** Communications Research Ctr. Canada (Canada); **Thomas D. Monte,** KVH Industries, Inc. (USA); **Glen A. Sanders,** Honeywell Technology (USA); **Fei Tian,** Stevens Institute of Technology (USA); **Dennis J. Trevor,** OFS Labs. (USA); **Xingwei Wang,** Univ. of Massachusetts Lowell (USA); **Reinhardt Willsch,** Institut für Photonische Technologien e.V. (Germany); **Hai Xiao,** Missouri Univ. of Science and Technology (USA)

THURSDAY 8 MAY

KEYNOTE SESSION

LOCATION: CONV. CTR. ROOM 330 THU 8:00 AM TO 8:40 AM

Session Chair: **Henry H. Du,** Stevens Institute of Technology (USA)

8:00 am: **Development and application of fiber optic sensors for power and energy systems** *(Keynote Presentation)*, Susan M. Maley, U.S. Dept. of Energy (USA); Robie Lewis, National Energy Technology Lab. (USA) [9098-1]

SESSION 1

LOCATION: CONV. CTR. ROOM 330 .. THU 8:40 AM TO 10:30 AM

Oil and Gas Applications

Session Chair: **Henry H. Du,** Stevens Institute of Technology (USA)

8:40 am: **Brief history of fiber optic sensing in the oil field industry** *(Invited Paper)*, Christopher S. Baldwin, Weatherford International Ltd. (USA) . . . [9098-2]

9:10 am: **Downhole fiber optic sensing: the oilfield service provider's perspective: from the cradle to the grave**, Neal G. Skinner, John L. Maida Jr., Halliburton Energy Services (USA) . . . . . [9098-3]

9:30 am: **Get smart, go optical: example uses of optical fibre sensing technology for production optimisation and subsea asset monitoring**, Chris Staveley, Smart Fibres Ltd. (United Kingdom) . . . . . [9098-4]

9:50 am: **Design and performances of a high temperature/high pressure, Hydrogen tolerant, bend insensitive single-mode fiber for downhole seismic systems and applications**, Andy M. Gillooly, Aurelien Bergonzo, Sudhendu Kashikar, Laurence Cooper, Fibercore Ltd. (United Kingdom) [9098-5]

10:10 am: **Real-time hydraulic fracture monitoring, a distributed acoustic sensing solution**, Peter Hayward, Alan Yau, Fotech Solutions Ltd. (United Kingdom) . . . . . [9098-6]

Coffee Break . . . . . Thu 10:30 am to 11:00 am

SESSION 2

LOCATION: CONV. CTR. ROOM 330 .. THU 11:00 AM TO 12:30 PM

Fiber Bragg Grating Sensors I

Session Chair: **Gary Pickrell,**
Virginia Polytechnic Institute and State Univ. (USA)

11:00 am: **High-speed structural sensing using fiber grating sensors** *(Invited Paper)*, Eric Udd, Columbia Gorge Research (USA) . . . . . [9098-7]

11:30 am: **Development of a long gauge vibration sensor**, Peter Kung, QPS Photronics Inc. (Canada); Maria Cominici, McGill Univ. (Canada) . . . . . [9098-8]

11:50 am: **Ultrahigh-speed fiber optic strain measurements based on rapid edge-filter monitoring of fiber grating spectra**, Brian J. Soller, Todd C. Haber, Micron Optics, Inc. (USA) . . . . . [9098-9]

12:10 pm: **High-speed fiber grating pressure sensors**, Eric Udd, Columbia Gorge Research (USA); George Rodriguez, Richard L. Sandberg, Los Alamos National Lab. (USA) . . . . . [9098-10]

Lunch Break . . . . . Thu 12:30 pm to 1:40 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 330 . . . . THU 1:40 PM TO 3:00 PM

Fiber Bragg Grating Sensors II

Session Chair: **Fei Tian,** Stevens Institute of Technology (USA)

1:40 pm: **High-pressure sensing and dynamics using high-speed fiber Bragg grating interrogation systems**, George Rodriguez, Richard L. Sandberg, Dana M. Dattelbaum, Los Alamos National Lab. (USA); Eric Udd, Columbia Gorge Research (USA); Brandon Lalone, National Security Technologies, LLC (USA); Bruce Marshall, National Security Technologies, LLC (USA) and Special Technologies Lab. (USA). . . . . [9098-11]

2:00 pm: **Design and implementation of an FBG emulator for a scanning laser based fiber optic interrogator**, Nader Kuhenuri Chami, Philipp Putzer, Technische Univ. München (Germany); Andreas Hurni, Kayser-Threde GmbH (Germany); Johannes Obermaier, Technische Univ. München (Germany); Sebastian M. Schweyer, Kayser-Threde GmbH (Germany); Alexander W. Koch, Technische Univ. München (Germany) . . . . . [9098-12]

2:20 pm: **High signal to noise acoustic sensor using phase shift gratings interrogated by the Pound Drever Hall technique**, Peter Kung, QPS Photronics Inc. (Canada); Maria Cominici, McGill Univ. (Canada) . . . . . [9098-13]

2:40 pm: **Study of interlaminar strain transfer of advanced composites by fiber Bragg gratings**, Ataman Deniz, Esat S. Kocaman, Mehmet Yıldız, Sabanci Univ. (Turkey). . . . . [9098-14]

Coffee Break . . . . . Thu 3:00 pm to 3:20 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 330 . . . . THU 3:20 PM TO 5:50 PM

Interferometric Sensors

Session Chair: **Eric Udd,** Columbia Gorge Research (USA)

3:20 pm: **Using a multimode fiber as a high-resolution low-loss spectrometer** *(Invited Paper)*, Brandon Redding, Hui Cao, Yale Univ. (USA) . . . . . [9098-15]

3:50 pm: **Optical carrier based microwave interferometers for sensing application**, Jie Huang, Xinwei Lan, Hanzheng Wang, Hai Xiao, Lei Yuan, Clemson Univ. (USA). . . . . [9098-16]

4:10 pm: **Optical vibration sensor based on Michelson interferometer arrangement with polarization-maintaining fibers**, Jakub Cubik, Stanislav Kepak, Andrej Liner, Martin Papes, Tomas Kajnar, Ondrej Zboril, Vladimír Vašinek, VŠB-Technical Univ. of Ostrava (Czech Republic) . . . . . [9098-17]

4:30 pm: **Fast-light enhanced fiber sensing: experiments, modeling, and practical design**, Caleb A. Christensen, Anton Zavriyev, MagiQ Technologies, Inc. (USA). . . . . [9098-18]

4:50 pm: **Random drift modelling and noise compensation algorithm for fiber optic gyroscope signal**, Mundla M. Narasimhappa, Samrat L. Sabat, Univ. of Hyderabad (India); Jagannath Nayak, Research Ctr. Imarat (India). . . . . [9098-19]

5:10 pm: **A novel adaptive mechanism for improving the accuracy of fiber optic gyroscope**, Mundla M. Narasimhappa, Samrat L. Sabat, Univ. of Hyderabad (India); Jagannath Nayak, Research Ctr. Imarat (India) . . . . [9098-20]

CONFERENCE 9098
LOCATION: CONV. CTR. ROOM 330

5:30 pm: **Highly sensitive and compact temperature sensor based on the multimode interference in a liquid-filled photonic crystal fiber**, Wei Lin, Nankai Univ. (China); Yinping Miao, Tianjin Univ. of Technology (China); Hao Zhang, Binbin Song, Bo Liu, Donglin Yan, Yan-Ge Liu, Weiwei Liu, Shengjiang Chang, Nankai Univ. (China) . . . . . [9098-21]

POSTERS-THURSDAY
LOCATION: CONV. CTR. HALL C . . . . . .THU 6:00 PM 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 session. 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 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.

Novel diaphragm micro fabrication techniques for high-sensitivity biomedical fiber optic Fabry-Perot interferometric sensors, Sven Poeggel, Daniele Tosi, Dinesh Babu Duraibabu, James Kelly, Maria Munroe, Gabriel Leen, Elfed Lewis, Univ. of Limerick (Ireland) . . . . . [9098-23]

Study on pattern recognition technology based on fiber perimeter security system, Haiyan Xu, Hohai Univ. (China) . . . . . [9098-40]

Measurement of the microwave emitter's inhomogeneity using optical fiber DTS, Jakub Jaros, Andrej Liner, Martin Papes, VŠB-Technical Univ. of Ostrava (Czech Republic); Pavel Smira, Andrea Nasswettrova, Thermo Sanace s.r.o. (Czech Republic); Vladimír Vašinek, Jakub Cubik, VŠB-Technical Univ. of Ostrava (Czech Republic); Stanislav Kepak, Technical University of Ostrava (Czech Republic) ` . . . . . [9098-41]

Laser line wavelength sensor by strain and temperature variations based in a dual-wavelength fiber laser with a Hi-Bi loop Sagnac interferometer, Manuel Durán-Sánchez, Ricardo I. Álvarez-Tamayo, Univ. Tecnológica de Puebla (Mexico); Olivier J. M. Pottiez, Ctr. de Investigaciones en Óptica, A.C. (Mexico); Evgeny A. Kuzin, Baldemar Ibarra-Escamilla, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Antonio Barcelata-Pinzón, Univ. Tecnológica de Puebla (Mexico) . . . . . [9098-42]

Fiber laser strain sensor based in the measurement of Sagnac interferometer optical power spectrum, Ricardo I. Álvarez-Tamayo, Manuel Durán-Sánchez, Univ. Tecnológica de Puebla (Mexico); Olivier J. M. Pottiez, Ctr. de Investigaciones en Óptica, A.C. (Mexico); Evgeny A. Kuzin, Baldemar Ibarra-Escamilla, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Antonio Barcelata-Pinzón, Univ. Tecnológica de Puebla (Mexico) . . . . . [9098-43]

Research on structural health monitoring of wind turbine blade by FBG sensors and Lamb wave, Yongkai Zhu, Nanjing Univ. of Aeronautics and Astronautics (China) . . . . . [9098-44]

Smartfiber: a strongly miniaturized embedded interrogator for a FBG sensor network in composite materials, Andrea Trita, Univ. Gent (Belgium); Tahira Ahmed, Airborn Technology Ctr. B.V. (Netherlands); Geert Luyckx, Univ. Gent (Belgium); Eli Voet, FBGS Technologies GmbH (Germany); Garrie Vickers, Optocap Ltd. (United Kingdom); Iker Mayordomo, Fraunhofer-Institut für Integrierte Schaltungen (Germany); Dries Van Thourhout, Univ. Gent (Belgium); Jan P. Vermeiren, Xenics NV (Belgium). . . . . [9098-46]

FRIDAY 9 MAY

SESSION 5
LOCATION: CONV. CTR. ROOM 330 . . . FRI 8:50 AM TO 10:20 AM

Sensors for Human Health

Session Chair: **Anbo Wang,**
Virginia Polytechnic Institute and State Univ. (USA)

8:50 am: **Lab-on-fiber optofluidic platform for in-situ monitoring of drug release from therapeutic-eluting polyelectrolyte films** *(Invited Paper)*, Fei Tian, Stevens Institute of Technology (USA); Jouha Min, Massachusetts Institute of Technology (USA); Jiri Kanka, Institute of Photonics and Electronics of the ASCR, v.v.i. (Czech Republic); Xiangzhi Li, Stevens Institute of Technology (USA); Paula T. Hammond, Massachusetts Institute of Technology (USA); Henry H. Du, Stevens Institute of Technology (USA) . . . . . [9098-22]

9:20 am: **Fiber loop ringdown glucose sensors: sensing human diabetic urines**, Malik Kaya, Chuji Wang, Mississippi State Univ. (USA) . . . . . [9098-24]

9:40 am: **Fiber optic SERS diagnosis of kidney transplant acute rejection using urine**, Jingmao Chi, Hui Chen, Peter Tolias, Henry H. Du, Stevens Institute of Technology (USA) . . . . . [9098-25]

10:00 am: **Understanding the role of hemoglobin in altering multilayered tissue intrinsic fluorescence in the visible region using fiber optics**, Bala K. Nivetha, Narayanan U. Sujatha, Indian Institute of Technology Madras (India). . . . . [9098-26]

Coffee Break . . . . . Fri 10:20 am to 10:50 am

SESSION 6
LOCATION: CONV. CTR. ROOM 330 . . .FRI 10:50 AM TO 12:30 PM

Chemical Sensors

Session Chair: **Jerry J. Benterou,**
Lawrence Livermore National Lab. (USA)

10:50 am: **Exploration of higher-order mode coupling in long-period gratings for sensitive monitoring of polyelectrolyte self-assembly at the nanoscale**, Fei Tian, Stevens Institute of Technology (USA); Jiri Kanka, Institute of Photonics and Electronics of the ASCR, v.v.i. (Czech Republic); Xiangzhi Li, Henry H. Du, Stevens Institute of Technology (USA) . . . . . [9098-27]

11:10 am: **Fiber pigtailed thin wall capillary coupler for excitation of microsphere WGM resonator in chemical/thermal sensing**, Hanzheng Wang, Xinwei Lan, Jie Huang, Lei Yuan, Hai Xiao, Clemson Univ. (USA) . . . . . [9098-28]

11:30 am: **Sapphire fiber sensor based on evanescent-field surface-enhanced Raman scattering**, Hui Chen, Fei Tian, Jingmao Chi, 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) . . . . . [9098-29]

11:50 am: **Gas diffusion in micro-machined HC-PCF methane sensors**, Mohammad Amanzadeh, Saiied M. Aminossadati, The Univ. of Queensland (Australia). . . . . [9098-30]

12:10 pm: **Multimaterial fibers: a new concept in infrared fiber optics**, Guangming Tao, Ayman F. Abouraddy, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . . . [9098-31]

Lunch Break . . . . . Fri 12:30 pm to 2:00 pm

SESSION 7
LOCATION: CONV. CTR. ROOM 330 . . . . FRI 2:00 PM TO 5:00 PM

Distributed and Other Advanced Sensors

Session Chair: **Christopher S. Baldwin,**
Weatherford International Ltd. (USA)

2:00 pm: **A multicore optical fiber for distributed sensing** *(Invited Paper)*, Xiaoguang Sun, Jie Li, David T. Burgess, Mike Hines, OFS (USA) . . . . . [9098-32]

2:30 pm: **Analysis of the suitability of fiber optic cables for illicit connections localization within sewers using the fiber optic distributed temperature sensing**, Martin Papes, Petr Koudelka, Andrej Liner, Petr Siska, Jakub Jaros, Stanislav Kepak, Vladimír Vašinek, VŠB-Technical Univ. of Ostrava (Czech Republic) . . . . . [9098-33]

2:50 pm: **Balanced PIN-TIA photoreceiver with integrated 3 dB fiber coupler for distributed fiber optic sensors**, Shubhashish Datta, Sruti Rajagopalan, Shaun Lemke, Abhay M. Joshi, Discovery Semiconductors, Inc. (USA) [9098-34]

3:10 pm: **Fast variable optical attenuator based optical current transformer**, Pu Wei, Xiaohan Sun, Southeast Univ. (China) . . . . . [9098-35]

Coffee Break . . . . . Fri 3:30 pm to 4:00 pm

4:00 pm: **A fiber optic voltage sensor based on intensity modulation**, Musa Ndiaye, Copperbelt Univ. (Zambia) and Northumbria Univ. (United Kingdom) . . . . . [9098-36]

4:20 pm: **Intensity insensitive one-dimensional optical fiber tilt sensor**, Badrinath Vadakkapattu Canthadai, Vidya Jyothi Institute of Technology (India); Dipankar Sengupta, Univ. degli Studi di Padova (Italy); Kishore Putha, National Institute of Technology, Warangal (India) . . . . . [9098-37]

4:40 pm: **Development of a low cost tilt sensor using plastic optical fiber**, Dipankar Sengupta, Univ. degli Studi di Padova (Italy); Badrinath Vadakkapattu Canthadai, Vidya Jyothi Institute of Technology (India); Kishore Putha, National Institute of Technology, Warangal (India) . . . . . [9098-38]

CONFERENCE 9099

LOCATION: CONV. CTR. ROOM 342

Monday - Tuesday 5 - 6 May 2014 • Proceedings of SPIE Vol. 9099

Polarization: Measurement, Analysis, and Remote Sensing XI

Conference Chairs: **David B. Chenault,** Polaris Sensor Technologies, Inc. (USA); **Dennis H. Goldstein,** Air Force Research Lab. (USA)

Program Committee: **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); **Charles Kim,** Northrop Grumman Electronic Systems (USA); **Michael W. Kudenov,** College of Optical Sciences, The Univ. of Arizona (USA); **Daniel A. LeMaster,** Air Force Research Lab. (USA); **Joao M. Romano,** U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Joseph A. Shaw,** Montana State Univ. (USA); **H. Hatcher Tynes,** Ideal Innovations, Inc. (USA); **J. Scott Tyo,** College of Optical Sciences, The Univ. of Arizona (USA)

MONDAY 5 MAY

OVERVIEW

LOCATION: CONV. CTR. ROOM 342 MON 8:00 AM TO 8:20 AM

Polarization Nomenclature

Session Chair: **David B. Chenault,**
Polaris Sensor Technologies, Inc. (USA)

This presentation provides a brief overview of imaging polarimetry, the mathematics of polarization, and a description of common polarimeters. This overview is intended to provide common ground for authors and audience members alike with standard terminology and standard definitions.

SESSION 1

LOCATION: CONV. CTR. ROOM 342 . .MON 8:20 AM TO 10:00 AM

Division of Focal Plane Sensors

Session Chair: **Joseph A. Shaw,** Montana State Univ. (USA)

8:20 am: **Underwater polarization camera for real-time and high definition imaging**, Samuel B. Powell, Viktor Gruev, Washington Univ. in St. Louis (USA) . . . . . [9099-1]

8:40 am: **Snap-shot imaging polarimeter: performance and applications**, Neal Brock, Charles M. Crandall, James E. Millerd, 4D Technology Corp. (USA) . . . . . [9099-2]

9:00 am: **Polarization in a snap: imaging polarimetry with microgrid polarizer arrays**, Dmitry Vorobiev, Michael G. Gartley, Zoran Ninkov, Rochester Institute of Technology (USA) . . . . . [9099-3]

9:20 am: **GP-grid image interpolation and denoising for division of focal plane sensors**, Elad Gilboa, Arye Nehorai, Washington Univ. in St. Louis (USA); John P. Cunningham, Columbia Univ. (USA); Viktor Gruev, Washington Univ. in St. Louis (USA) . . . . . [9099-4]

9:40 am: **Hardware and demosaicing algorithms for improved microgrid polarimeters**, Daniel A. LeMaster, Air Force Research Lab. (USA); Keigo Hirakawa, Univ. of Dayton (USA). . . . . [9099-5]

Coffee Break . . . . . Mon 10:00 am to 10:25 am

SESSION 2

LOCATION: CONV. CTR. ROOM 342 . .MON 10:25 AM TO 11:45 AM

Measurements and Analysis of Atmospheric and Scattering Polarization

Session Chair: **Charles Kim,**
Northrop Grumman Electronic Systems (USA)

10:25 am: **Effects of wildfire smoke on atmospheric polarization**, Joseph A. Shaw, Nathan J. Pust, Elizabeth Forbes, Montana State Univ. (USA) . . . [9099-6]

10:45 am: **Increasing range and minimizing polarization mixing with circularly polarized light through scattering environments**, John D. van der Laan, College of Optical Sciences, The Univ. of Arizona (USA); David A. Scrymgeour, Shanalyn A. Kemme, Sandia National Labs. (USA); Eustace L. Dereniak, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [9099-7]

11:05 am: **An assessment of forward 1D vector radiative transfer modeling accuracy with aerosol remote sensing in mind**, Anthony B. Davis, Olga Kalashnikova, David J. Diner, Michael J. Garay, California Institute of Technology (USA); Alexei I. Lyapustin, Sergey V. Korkin, NASA Goddard Space Flight Ctr. (USA); John V. Martonchik, Vijay Natraj, Suniti Sanghavi, Feng Xu, California Institute of Technology (USA); Pengwang Zhai, NASA Langley Research Ctr. (USA); Alexander A. Kokhanovsky, Univ. Bremen (Germany) and EUMETSAT (Germany) . . . . . [9099-8]

11:25 am: **Atmospheric aerosol characterization through ground-based SPEX and iSPEX multi-angle spectropolarimetry**, Gerard van Harten, Frans Snik, Jos de Boer, Leiden Univ. (Netherlands); Jeroen H. H. Rietjens, Job M. Smit, SRON Netherlands Institute for Space Research (Netherlands); Hester Volten, Rijksinstituut voor Volksgezondheid en Milieu (Netherlands); Arnoud Apituley, Koninklijk Nederlands Meteorologisch Instituut (Netherlands); Bas Mijling, Rijksinstituut voor Volksgezondheid en Milieu (Netherlands); Antonio di Noia, Otto P. Hasekamp, SRON Netherlands Institute for Space Research (Netherlands); Christoph U. Keller, Leiden Univ. (Netherlands). . . . . [9099-9]

Lunch Break . . . . . Mon 11:45 am to 12:55 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 342 . . .MON 12:55 PM TO 3:05 PM

Applications of Polarimetry

Session Chair: **Joao M. Romano,** U.S. Army Armament Research, Development and Engineering Ctr. (USA)

12:55 pm: **An overview of polarimetric sensing techniques and technology within different research fields** *(Invited Paper)*, Frans Snik, Leiden Univ. (Netherlands); Julia M. Craven-Jones, Sandia National Labs. (USA); Antonello De Martino, Ecole Polytechnique (France); Michael J. Escuti, North Carolina State Univ. (USA); Silvano Fineschi, INAF - Osservatorio Astronomico di Torino (Italy); David M. Harrington, Univ. of Hawai'i (USA); Dimitri P. Mawet, European Southern Observatory (Chile); Jérôme Riedi, Univ. des Sciences et Technologies de Lille (France); J. Scott Tyo, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [9099-10]

1:25 pm: **Activity-based intelligence tipping and cueing using polarimetric sensors**, Christian Lewis, David Messinger, Michael G. Gartley, Rochester Institute of Technology (USA) . . . . . [9099-11]

1:45 pm: **Preliminary measurements of the polarimetric signatures of human targets**, Van A. Hodgkin, Dawne M. Deaver, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Daniel A. LeMaster, Air Force Research Lab. (USA) . . . . . [9099-12]

2:05 pm: **A covariance-based anomaly detector for polarimetric remote sensing applications**, Joao M. Romano, U.S. Army Armament Research, Development and Engineering Ctr. (USA); Dalton S. Rosario, U.S. Army Research Lab. (USA) . . . . . [9099-13]

2:25 pm: **High-speed birefringence mapping by polarization camera and its application for film orientation tracking**, Takashi Onuma, Yukitoshi Otani, Utsunomiya Univ. (Japan) . . . . . [9099-15]

2:45 pm: **LWIR polarimetry for enhanced facial recognition in thermal imagery**, Kristan P. Gurton, Alex J. Yuffa, U.S. Army Research Lab. (USA) . . . . . [9099-16]

Coffee Break . . . . . Mon 3:05 pm to 3:30 pm

CONFERENCE 9099

LOCATION: CONV. CTR. ROOM 342

SESSION 4

LOCATION: CONV. CTR. ROOM 342 . . . MON 3:30 PM TO 4:50 PM

Calibration and Analysis of Polarimeters

Session Chair: **Kristan P. Gurton,** U.S. Army Research Lab. (USA)

3:30 pm: **Quantification of image registration error**, Adoum H. Mahamat, Univ. of Arizona (USA); Eric A. Shields, Sandia National Labs. (USA) . . [9099-17]

3:50 pm: **Spatial calibration of full stokes polarization imaging camera**, Mathieu Vedel, Sebastien Breugnot, Nicolas Lechocinski, Bossa Nova Technologies (USA) . . . . . [9099-18]

4:10 pm: **Calibration methodology and performance characterization of a polarimetric hyperspectral imager**, Kevin C. Gross, Air Force Institute of Technology (USA) and Polaris Sensor Technologies, Inc. (USA) . . . . . [9099-19]

4:30 pm: **Phase error in Fourier transform spectrometers employing polarization interferometers**, Julia M. Craven-Jones, Sandia National Labs. (USA); Michael W. Kudenov, North Carolina State Univ. (USA) . . . . . [9099-40]

TUESDAY 6 MAY

OVERVIEW

LOCATION: CONV. CTR. ROOM 342 TUE 8:00 AM TO 8:20 AM

Polarization Nomenclature

Session Chair: **David B. Chenault,**
Polaris Sensor Technologies, Inc. (USA)

This presentation provides a brief overview of imaging polarimetry, the mathematics of polarization, and a description of common polarimeters. This overview is intended to provide common ground for authors and audience members alike with standard terminology and standard definitions.

SESSION 5

LOCATION: CONV. CTR. ROOM 342 . . TUE 8:20 AM TO 10:00 AM

Polarization Instruments I

Session Chair: **Daniel A. LeMaster,** Air Force Research Lab. (USA)

8:20 am: **Five-dimensional optical instrumentation: combining polarimetry with time-resolved integral-field spectroscopy**, Michiel Rodenhuis, Frans Snik, Gerard van Harten, Jens Hoeijmakers, Ronniy Joseph, Christoph U. Keller, Leiden Univ. (Netherlands) . . . . . [9099-20]

8:40 am: **Birefringent snapshot imaging spatial heterodyne spectrometer**, Michael W. Kudenov, Bryan Maione, David Luo, Matthew N. Miskiewicz, Michael J. Escuti, North Carolina State Univ. (USA) . . . . . [9099-21]

9:00 am: **Development of spectropolarimetric imagers from 400 to 1700 nm**, Neelam Gupta, U.S. Army Research Lab. (USA). . . . . [9099-22]

9:20 am: **Exploring polarimetric hyperspectral imaging as a tool for improved material identification**, Kevin C. Gross, Air Force Institute of Technology (USA) . . . . . [9099-23]

9:40 am: **IR polarimetric camcorder**, David B. Chenault, John S. Harchanko, Joseph L. Pezzaniti, Brian Hyatt, Todd Aycock, Justin P. Vaden, Polaris Sensor Technologies, Inc. (USA) . . . . . [9099-24]

Coffee/Exhibition Break. . . . . Tue 10:00 am to 10:40 am

SESSION 6

LOCATION: CONV. CTR. ROOM 342 . .TUE 10:40 AM TO 12:00 PM

Polarization Instruments II

Session Chair: **Neelam Gupta,** U.S. Army Research Lab. (USA)

10:40 am: **A novel IR polarization staring imaging system designed by a four-camera-array**, Xiaopeng Shao, Fei Liu, Pingli Han, Xidian Univ. (China) . . . . . [9099-25]

11:00 am: **Beyond polarization microscopy: Mueller matrix microscopy with frequency demodulation**, Oriol Arteaga, Ertan Kuntman, Marta Baldrís, Juan Antó i Roca, Adolf Canillas Biosca, Enric Bertran Serra, Univ. de Barcelona (Spain) . . . . . [9099-26]

11:20 am: **Polarized standoff thermal hyperspectral imaging of minerals and materials**, Marc-André Gagnon, Vincent Farley, Pierre Tremblay, Simon Savary, Martin Chamberland, Telops (Canada) . . . . . [9099-27]

11:40 am: **Integrated quantitative multispectral polarimetric immunohistochemistry (IHC) of lung cancer tissue microarrays**, George C. Giakos, Tri Quang, Tannaz Farrahi, Chaya Narayan, Aditi Deshpande, Suman Shrestha, Na Ying, The Univ. of Akron (USA) . . . . . [9099-28]

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

SESSION 7

LOCATION: CONV. CTR. ROOM 342 . . . . TUE 1:30 PM TO 2:50 PM

Polarization Signatures and Phenemonology

Session Chair: **Dennis H. Goldstein,**
Polaris Sensor Technologies, Inc. (USA)

1:30 pm: **Modeling of a polarization tag for hydrogen fluoride gas monitoring**, Adoum H. Mahamat, College of Optical Sciences, The Univ. of Arizona (USA); Julia M. Craven-Jones, Sandia National Labs. (USA); J. Scott Tyo, College of Optical Sciences, The Univ. of Arizona (USA) . . . . . [9099-29]

1:50 pm: **On the accuracy of broadband circular polarization signatures**, Michael G. Gartley, Rochester Institute of Technology (USA) . . . . . [9099-30]

2:10 pm: **Polarization analysis of target imaging in an underwater environment**, Yalong Gu, Alexander Gilerson, Carlos Carrizo, Amir Ibrahim, Samir Ahmed, The City College of New York (USA) . . . . . [9099-31]

2:30 pm: **Analysis of the detectable range of infrared polarization imaging system used in sea-surface environment**, Runqiu Xia, Xia Wang, Weiqi Jin, Jianan Liang, Beijing Institute of Technology (China) . . . . . [9099-32]

Coffee/Exhibition Break. . . . . Tue 2:50 pm to 3:30 pm

SESSION 8

LOCATION: CONV. CTR. ROOM 342 . . . . TUE 3:30 PM TO 5:30 PM

Components and Devices

Session Chair: **Michael G. Gartley,**
Rochester Institute of Technology (USA)

3:30 pm: **Multiband retardation control using multitwist retarders**, Kathryn J. Hornburg, Ravi K. Komanduri, Michael J. Escuti, North Carolina State Univ. (USA) . . . . . [9099-33]

3:50 pm: **Liquid crystals for polarization control in the MWIR**, Erika Petrak, Thomas G. Baur, Meadowlark Optics, Inc. (USA) . . . . . [9099-34]

4:10 pm: **First prototypes of vortex retarders obtained by polarization holography**, Pierre Piron, Pascal Blain, Univ. de Liège (Belgium); Dimitri P. Mawet, European Southern Observatory (Chile); Serge Habraken, Univ. de Liège (Belgium) . . . . . [9099-35]

4:30 pm: **Imaging with photoelastic modulators**, John Freudenthal, Hinds Instruments, Inc. (USA); Shane Nichols, New York Univ. (USA); Oriol Arteaga, Univ. de Barcelona (Spain); Bart Kahr, New York Univ. (USA) . . . . . [9099-36]

4:50 pm: **A polarization-sensitive mid-infrared plasmonic absorber for multiband resonance**, Yongqian Li, Binbin Wang, Zili Zhou, Northwestern Polytechnical Univ. (China) . . . . . [9099-37]

5:10 pm: **Polarimetric evaluation of commercial pellicles and beamsplitter**, Dennis H. Goldstein, Jennifer L. Massman, David G. Edwards, Air Force Research Lab. (USA) . . . . . [9099-38]

POSTERS-TUESDAY

LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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.

CONFERENCE 9100

LOCATION: CONV. CTR. ROOM 321

Wednesday - Thursday 7 - 8 May 2014 • Proceedings of SPIE Vol. 9100

Image Sensing Technologies: Materials, Devices, Systems, and Applications

Conference Chairs: **Nibir K. Dhar,** Defense Advanced Research Projects Agency (USA); **Achyut K. Dutta,** Banpil Photonics, Inc. (USA)

Program Committee: **Homayoon Ansari,** Jet Propulsion Lab. (USA); **Arvind I. D'Souza,** DRS Sensors & Targeting Systems, Inc. (USA); **Ravi Dutt,** Booz Allen Hamilton Inc. (USA); **Michael D. Gerhold,** U.S. Army Research Office (USA); **John E. Hubbs,** Ball Aerospace & Technologies Corp. (USA); **Nobuhiko P. Kobayashi,** Univ. of California, Santa Cruz (USA); **Sanjay Krishna,** The Univ. of New Mexico (USA); **Robert Olah,** Banpil Photonics, Inc. (USA); **Adam Piotrowski,** VIGO Systems S.A. (Poland); **Siva Sivananthan,** EPIR Technologies, Inc. (USA); **Krishna Swaminathan,** Intel Corp. (USA); **Rama Venkatasubramanian,** RTI International (USA); **Priyalal S. Wijewarnasuriya,** U.S. Army Research Lab. (USA)

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

OPENING REMARKS

LOCATION: CONV. CTR. ROOM 321 . . . . . 10:30 AM TO 10:35 AM

Session Chair: **Nibir K. Dhar,**
Defense Advanced Research Projects Agency (USA)

SESSION 1

LOCATION: CONV. CTR. ROOM 321 . . WED 10:35 AM TO 12:00 PM

Advanced Focal Plane Array Technologies I

Session Chairs: **Nibir K. Dhar,** Defense Advanced Research Projects Agency (USA); **Achyut K. Dutta,** Banpil Photonics, Inc. (USA)

10:35 am: **Architectures for gigapixel video** *(Keynote Presentation)*, David J. Brady, Duke Univ. (USA) . . . . . [9100-1]

11:05 am: **Uncooled microbolometers at DRS in 2014** *(Invited Paper)*, George D. Skidmore, Chien-Jih Han, DRS Technologies, Inc. (USA); Chuan C. Li, N2 Imaging Systems, LLC (USA) . . . . . [9100-2]

11:25 am: **Performance of PHOTONIS' low light level CMOS imaging sensors for long range observation**, Loig E. Bourree, PHOTONIS USA (USA) . . . . . [9100-3]

11:40 am: **A 33-mpixel 120-fps CMOS image sensor using 0.11-µm CIS process** *(Invited Paper)*, Toshio Yasue, Tetsuya Hayashida, Jun Yonai, Kazuya Kitamura, Japan Broadcasting Corp. (Japan); Toshihisa Watabe, NHK Engineering System, Inc. (Japan) and Shizuoka Univ. (Japan); Hiroshi Ootake, Hiroshi Shimamoto, NHK Japan Broadcasting Corp. (Japan); Tomohiko Kosugi, Takashi Watanabe, Satoshi Aoyama, Brookman Technology, Inc. (Japan); Shoji Kawahito, Shizuoka Univ. (Japan) and Brookman Technology, Inc. (Japan) . . . . . [9100-4]

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

SESSION 2

LOCATION: CONV. CTR. ROOM 321 . . . . .WED 1:10 PM TO 3:00 PM

Advanced Focal Plane Array Technologies II

Session Chairs: **Nibir K. Dhar,** Defense Advanced Research Projects Agency (USA); **Achyut K. Dutta,** Banpil Photonics, Inc. (USA)

1:10 pm: **Low-cost high-performance multispectral camera system for dual-use applications** *(Invited Paper)*, Patrick Oduor, Genki Mizuno, Robert Olah, Achyut K. Dutta, Banpil Photonics, Inc. (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA). . . . . [9100-5]

1:30 pm: **Cots-based approach for lowering costs in high-performance infrared cameras** *(Invited Paper)*, S. Raja Krishnamoorthi, Christopher Anton, Episensors, Inc. (USA). . . . . [9100-6]

1:50 pm: **Advanced low cost uncooled thermal imaging camera development at Raytheon** *(Invited Paper)*, Paolo Masini, Matthew Kuiken, Mark J. Lamb, Donald D. Chi, Matthew W. Brick, Raytheon Co. (USA) . . . . . [9100-7]

2:10 pm: **High-density interconnect bonding for 3d integrated imaging systems**, Matthew Lueck, John M. Lannon Jr., Chris W. Gregory, Dean M. Malta, Alan Huffman, Dorota S. Temple, RTI International (USA) . . . . . [9100-8]

2:25 pm: **In-plane carrier transport in InAs/InGaSb superlattices for VLWIR detectors**, Hemendra Kala, Gilberto A. Umana-Membreno, The Univ. of Western Australia (Australia); Mikhail A. Patrashin, Iwao Hosako, Kouichi Akahane, National Institute of Information and Communications Technology (Japan); Jarek Antoszewski, Lorenzo Faraone, The Univ. of Western Australia (Australia). . . . . [9100-9]

2:40 pm: **InAsSb detector and FPA data and analysis** *(Invited Paper)*, Arvind I. D'Souza, DRS Sensors & Targeting Systems, Inc. (USA) . . . . . [9100-10]

Coffee/Exhibition Break. . . . . .Wed 3:00 pm to 3:40 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 321 . . . . WED 3:40 PM TO 5:10 PM

Novel Technologies for Imaging

Session Chairs: **Qiaoqiang Gan,** Univ. at Buffalo (USA); **Achyut K. Dutta,** Banpil Photonics, Inc. (USA)

3:40 pm: **Materials for imaging acousto-optic tunable filters** *(Invited Paper)*, Neelam Gupta, U.S. Army Research Lab. (USA). . . . . [9100-11]

4:00 pm: **Silicon nitride microphotonics for mid-infrared sensing applications**, Pao T. Lin, Vivek Singh, Lionel C. Kimerling, Massachusetts Institute of Technology (USA); Dawn Tan, Singapore Univ. of Technology & Design (Singapore); Anuradha M. Agarwal, Massachusetts Institute of Technology (USA) . . . . . [9100-12]

4:15 pm: **Enhanced light-matter interaction using plasmonic metamaterial structures for thin-film photodetector elements**, Qiaoqiang Gan, Univ. at Buffalo (USA) . . . . . [9100-13]

4:30 pm: **Miniaturized imaging spectrometer based on Fabry-Perot MOEMS filters and HgCdTe infrared focal plane arrays** *(Invited Paper)*, Silviu Velicu, Jeremy D. Bergeson, Chris Buurma, EPIR Technologies, Inc. (USA); Tae Sung Kim, EPIR Technologies, Inc. (USA) and Univ. of California, Santa Cruz (USA); Joel Kubby, Univ. of California, Santa Cruz (USA); Neelam Gupta, U.S. Army Research Lab. (USA) . . . . . [9100-14]

4:50 pm: **Physiologic cardiovascular strain and intrinsic wave imaging** *(Invited Paper)*, Elisa E. Konofagou, Columbia Univ. (USA) . . . . . [9100-15]

THURSDAY 8 MAY

SESSION 4
LOCATION: CONV. CTR. ROOM 321 . . . THU 8:00 AM TO 10:25 AM

Small Pixels and Related Technologies

Session Chairs: **Nibir K. Dhar,** Defense Advanced Research Projects Agency (USA); **Achyut K. Dutta,** Banpil Photonics, Inc. (USA)

8:00 am: **A review on antimonide-based semiconductors for high-performance optoelectronic devices in center for quantum devices** *(Keynote Presentation)*, Manijeh Razeghi, Northwestern Univ. (USA) . . . . . [9100-16]

8:30 am: **Case for small pixels: system perspective and FPA challenge** *(Invited Paper)*, Jim Robinson, Michael A. Kinch, Michael J. Marquis, Duke Littlejohn, Kristina Jeppson, DRS RSTA, Inc. (USA) . . . . . [9100-17]

8:50 am: **Performance benefits of sub-diffraction sized pixels in imaging sensors** *(Invited Paper)*, John T. Caulfield, Cyan Systems (USA). . . . . [9100-18]

9:10 am: **Effect of dense planer focal plane array on device performances**, Chieh-Ting Lin, Robert Olah, Achyut K. Dutta, Banpil Photonics, Inc. (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA). . . . . [9100-19]

9:25 am: **Enabling more capability within smaller pixels: advanced wafer-level process technologies for integration of FPAs with readout electronics** *(Invited Paper)*, Dorota S. Temple, Erik P. Vick, Matthew R. Lueck, Dean Malta, RTI International (USA); Mark R. Skokan, Christopher M. Masterjohn, Mark S. Muzilla, DRS Technologies, Inc. (USA) . . . . . [9100-20]

9:45 am: **Direct optimization and solution space visualization of wafer-level manufactured LWIR systems for maximized detection range and minimized SWAP-C** *(Invited Paper)*, Kenneth S. Kubala, Robert M. Bates, FiveFocal LLC (USA) . . . . . [9100-21]

10:05 am: **Nanostructured detector technologies for optical sensing applications** *(Invited Paper)*, Ashok K. Sood, Magnolia Optical Technologies, Inc. (USA); Roger E. Welser, Magnolia Solar, Inc. (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA); Dennis L. Polla, Univ. of Minnesota-Twin Cities (USA); Madan Dubey, Priyalal S. Wijewarnasuriya, U.S. Army Research Lab. (USA) . . . . . [9100-22]

POSTERS-THURSDAY

LOCATION: CONV. CTR. HALL C . . . . . .THU 6:00 PM TO 7:30 PM

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Applications of the Lambert W function to analyze digital camera sensors, Daniel Villegas, Univ. EAFIT (Colombia) . . . . . [9100-23]

Application of the Ornstein- Uhlenbeck equations for biomedical image processing, Juan P. Mesa Lopez, Univ. EAFIT (Colombia) . . . . . [9100-24]

Improvements to quality of mass produced sapphire, John P. Ciraldo, Rubicon Technology Inc. (USA) . . . . . [9100-25]

Design of p-on-N+ HgCdTe heterojunction photodiodes on Si substrate, Peng Zhang, Zhenhua Ye, Shanghai Institute of Technical Physics (China) . . . . . [9100-27]

New approach for underwater imaging and processing, Yanan Wen, Weijian Tian, Bing Zheng, Guozun Zhou, Hui Dong, Qiong Wu, Qingdao Academy for Opto-Electronics Engineering (China) . . . . . [9100-28]

Analysis and simulation of a new kind of noise at the input stage of readout integrated circuit, Zhangcheng Huang, Yu Chen, Songlei Huang, Jiaxiong Fang, Shanghai Institute of Technical Physics (China) . . . . . [9100-29]

Responsivity performance of extended wavelength InGaAs shortwave infrared detector arrays, Tao Li, Xue Li, Xiumei Shao, Heng-Jing Tang, Haimei Gong, Shanghai Institute of Technical Physics (China). . . . . [9100-30]

A revolutionary solution for shipping container identification and management, James Morrison, Jonathan Williams, Robert Fish, McQ, Inc. (USA) . . . . . [9100-31]

Quality assessment of pan-sharpened color image in comparison with 1-chip Bayer filter color and 3-chip color images in various lighting conditions, Sina Adhamkhiabani, Yun Zhang, Univ. of New Brunswick (Canada) . . . . . [9100-32]

Influence of pixel size and bit depth of the low resolution color image on the quality of pan-sharpened imagery: a case study with security video image frames, Sina Adhamkhiabani, Yun Zhang, Univ. of New Brunswick (Canada) . . . . . [9100-33]

High-resolution unified touch screen for sensing capacitive touches and reading fingerprints, Pranav N. Koundinya, Sandhya Theril, Tao Feng, Weidong Shi, Univ. of Houston (USA) . . . . . [9100-34]

Technology and application trends in IR photodetectors, Thierry Robin, TEMATYS (France) . . . . . [9100-35]

Performance of near-infrared InGaAs focal plane array with different series resistances to p-InP layer, Xiumei Shao, Xue Li, Tao Li, Zhangcheng Huang, Yu Chen, Heng-Jing Tang, Haimei Gong, Shanghai Institute of Technical Physics (China) . . . . . [9100-36]

Wide dynamic range and high-sensitivity CMOS active pixel sensor using output voltage feedback structure, Sung-Hyun Jo, Myunghan Bae, Jang-Kyoo Shin, Kyungpook National Univ. (Korea, Republic of) . . . . . [9100-57]

CONFERENCE 9101

LOCATION: CONV. CTR. ROOM 321

Monday - Tuesday 5 - 6 May 2014 • Proceedings of SPIE Vol. 9101

Next-Generation Spectroscopic Technologies VII

Conference Chairs: **Mark A. Druy,** Physical Sciences Inc. (USA); **Richard A. Crocombe,** Thermo Fisher Scientific Inc. (USA)

Program Committee: **Leigh J. Bromley,** Daylight Solutions (USA); **John M. Dell,** The Univ. of Western Australia (Australia); **Richard D. Driver,** Headwall Photonics Inc. (USA); **Michael B. Frish,** Physical Sciences Inc. (USA); **Fredrick 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); **John Seelenbinder,** Agilent Technologies (USA)

MONDAY 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 321 . . . MON 8:30 AM TO 10:40 AM

Novel Spectrometer Technologies I

Session Chair: **Mark A. Druy,** Physical Sciences Inc. (USA)

8:30 am: **Development, characterization, and application of compact spectrometers based on MEMS devices with in plane capacitive drives** *(Invited Paper)*, Andreas Kenda, Martin Kraft, Werner Scherf, Carinthian Tech Research AG (Austria); Thilo Sandner, Harald Schenk, Fraunhofer-Institut für Photonische Mikrosysteme (Germany); Stephan Luettjohann, Bruker Optik GmbH (Germany). . . . . [9101-1]

9:00 am: **Fourier transform infrared phase shift cavity ring down spectrometer**, Elizabeth C. Schundler, James R. Engel, David J. Mansur, Robert Vaillancourt, Ryan Benedict-Gill, Scott P. Newbry, OPTRA, Inc. (USA) . . . . . [9101-2]

9:20 am: **Multiple-order staircase etalon spectroscopy**, Michael K. Yetzbacher, Christopher W. Miller, Drew J. Boudreau, Marc Christophersen, Michael J. DePrenger, U.S. Naval Research Lab. (USA). . . . . [9101-3]

9:40 am: **On-chip random spectrometer**, Brandon Redding, Seng-Fatt Liew, Raktim Sarma, Hui Cao, Yale Univ. (USA). . . . . [9101-4]

10:00 am: **Overview of microplasmas-on-chips: from fundamentals to applications**, Karthik Kommera, Vassili Karanassios, Univ. of Waterloo (Canada) . . . . . [9101-5]

10:20 am: **Infrared molecular binding spectroscopy realized in sorbent coated microfabricated devices**, R. Andrew McGill, Todd H. Stievater, Marcel W. Pruessner, U.S. Naval Research Lab. (USA); Scott A. Holmstrom, The Univ. of Tulsa (USA); Rachel C. McGill, Viet Q. Nguyen, Doewon Park, Christopher A. Kendziora, Robert Furstenberg, U.S. Naval Research Lab. (USA) . . . . . [9101-6]

Coffee Break . . . . . Mon 10:40 am to 11:00 am

SESSION 2

LOCATION: CONV. CTR. ROOM 321 . . . MON 11:00 AM TO 12:30 PM

Novel Spectrometer Technologies II

Session Chair: **Richard A. Crocombe,**
Thermo Fisher Scientific Inc. (USA)

11:00 am: **Recent developments towards MEMS based spectrometers** *(Invited Paper)*, Dilusha K. K. M. B. Silva, John M. Dell, Lorenzo Faraone, The Univ. of Western Australia (Australia) . . . . . [9101-7]

11:30 am: **Optical design of MOEMS-based micromechatronic modules for applications in spectroscopy**, Andreas Tortschanoff, Matthias Kremer, Carinthian Tech Research AG (Austria); Thilo Sandner, Fraunhofer-Institut für Photonische Mikrosysteme (Germany); Andreas Kenda, Carinthian Tech Research AG (Austria) . . . . . [9101-8]

11:50 am: **Compact multispectral photodiode arrays using micropatterned dichroic filters**, Dave Fish, Randel Mercer, Pixelteq, Inc. (USA) . . . . . [9101-9]

12:10 pm: **Pure rotational spectrometers for trace-level VOC detection and chemical analysis**, Justin L. Neill, Brent J. Harris, Robin L. Pulliam, Matt T. Muckle, Roger Reynolds, David McDaniel, BrightSpec (USA); Brooks H. Pate, BrightSpec (USA) and Univ. of Virginia (USA) . . . . . [9101-24]

Lunch Break . . . . . Mon 12:30 pm to 1:40 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 321 . . . . . MON 1:40 PM TO 3:10 PM

Novel Spectrometer Technologies III

Session Chair: **Richard A. Crocombe,**
Thermo Fisher Scientific Inc. (USA)

1:40 pm: **Advances in miniature spectrometer and sensor development** *(Invited Paper)*, Jouko O. Malinen, Anna Rissanen, Heikki K. Saari, Pentti Karioja, VTT Technical Research Ctr. of Finland (Finland) . . . . . [9101-10]

2:10 pm: **High-pressure mass spectrometry**, Christopher D. Brown, 908 Devices Inc. (USA). . . . . [9101-11]

2:30 pm: **Multivariate optical element platform for compressed detection of fluorescence markers**, Ryan J. Priore, CIRTEMO (USA) . . . . . [9101-12]

2:50 pm: **Low-cost photonic crystal spectral sensors made by projection lithography**, Tanya C. Garza, James I. Scholtz, Michael J. Gazes, Chromation (USA); Ioannis Kymissis, Chromation (USA), Columbia Univ. (USA); Nadia K. Pervez, Chromation (USA) . . . . . [9101-13]

Coffee Break . . . . . Mon 3:10 pm to 3:40 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 321 . . . . MON 3:40 PM TO 6:00 PM

Laser Spectroscopy and LIBS: Technologies and Applications

Session Chair: **Leigh J. Bromley,** Daylight Solutions Inc. (USA)

3:40 pm: **Mid-infrared distributed feedback interband cascade lasers for spectroscopic applications**, Lars Naehle, nanoplus GmbH (Germany) [9101-14]

4:00 pm: **Current and emerging laser sensors for greenhouse gas sensing and leak detection**, Michael B. Frish, Physical Sciences Inc. (USA). . . [9101-15]

4:20 pm: **The design and performance characterization of a tunable external cavity quantum cascade laser utilizing thermo-optically tuned thin film filters**, Don Kuehl, Eugene Y. Ma, Chip Marshall, Jinhong Kim, Richard Sharp, RedShift Systems Corp. (USA) . . . . . [9101-16]

4:40 pm: **A spectroscopic tool for identifying fragments and sources of origin for materials of military interest**, Andrzej W. Miziolek, Frank C. De Lucia Jr., U.S. Army Research Lab. (USA) . . . . . [9101-17]

5:00 pm: **Portable, real-time alloy identification of metallic wear debris from machinery lubrication systems: laser-induced breakdown spectroscopy versus x-ray fluorescence**, Pooja Suresh, GasTOPS Ltd. (Canada) . . [9101-18]

5:20 pm: **Approaching the PPB detection limits for copper in water using laser induced breakdown spectroscopy**, Walid T. Mohamed, King Saud Univ. (Saudi Arabia) and Cairo Univ. (Egypt); Sausan Sawaf, King Saud Univ. (Saudi Arabia) . . . . . [9101-19]

5:40 pm: **Laser-induced breakdown spectroscopy and spectral analysis of improvised explosive materials**, Amy J. R. Bauer, Applied Research Associates, Inc. (USA); Andrzej W. Miziolek, U.S. Army Research Lab. (USA) . . . . . [9101-20]

TUESDAY 6 MAY

SESSION 5
LOCATION: CONV. CTR. ROOM 321 . . . TUE 8:40 AM TO 10:00 AM

Novel or Portable Infrared and Raman Spectrometers I

Session Chair: **Richard A. Crocombe,** Thermo Fisher Scientific Inc. (USA)

8:40 am: **Continuously sample, trap, and measure Raman spectra of individual single airborne particles**, Yongle Pan, U.S. Army Research Lab. (USA); Chuji Wang, Mississippi State Univ. (USA); Mark Coleman, U.S. Army Research Lab. (USA); Joshua L. Santarpia, Sandia National Labs. (USA) . . . . . [9101-22]

9:00 am: **Pocket-size near-infrared spectrometer for narcotic materials identification**, Nada A. O'Brien, Christopher G. Pederson, Donald M. Friedrich, Chang Hsiung, Marc von Gunten, JDSU (USA) . . . . . [9101-23]

9:20 am: **Sensitive algorithm for multiple-excitation-wavelength resonance Raman spectroscopy**, Balakishore Yellampalle, Hai-Shan Wu, William B. McCormick, Mikhail Sluch, Robert B. Martin, Robert V. Ice, Brian E. Lemoff, West Virginia High Technology Consortium Foundation (USA) . . . . . [9101-26]

9:40 am: **Advancements in the detection of explosives using a Raman handheld instrument (ACE ID)**, Josep Arnó, Michael Frunzi, Brian Sparano, Paul Hetherington, David Valovich, David St. Pierre, Smiths Detection (USA) . . . . . [9101-27]

Coffee/Exhibition Break. . . . . Tue 10:00 am to 10:40 am

SESSION 6
LOCATION: CONV. CTR. ROOM 321 . . .TUE 10:40 AM TO 12:00 PM

Novel or Portable Infrared and Raman Spectrometers II

Session Chair: **Mark A. Druy,** Physical Sciences Inc. (USA)

10:40 am: **An FT-IR performance simulator to guide design decisions for miniature FT-IR spectrometers**, David W. Schiering, John T. Stein, Michael Frunzi, Peng Zou, Smiths Detection (USA) . . . . . [9101-29]

11:00 am: **A military grade field usable Raman analyzer: measurement of captured fuels**, Stuart R. Farquharson, Wayne W. Smith, Carl R. Brouillette, Real-Time Analyzers, Inc. (USA) . . . . . [9101-30]

11:20 am: **Detection of chemical warfare simulants using Raman excitation at 1064 nm**, Mark Mabry, Claire Dentinger, Claude Robotham, Rigaku Raman Technologies (USA) . . . . . [9101-31]

11:40 am: **Combination of a spectrometer-on-chip and an array of Young's interferometers for laser spectrum monitoring**, A. Koshelev, Nano-Optic Devices (USA); G. Calafiore, C. Peroz, abeam Technologies, Inc. (USA); S. Dhuey, S. Cabrini, Lawrence Berkeley National Lab. (USA); P. Sasorov, A. Goltsov, Nano-Optic Devices (USA) . . . . . [9101-48]

Lunch Break . . . . . Tue 12:00 pm to 1:30 pm

SESSION 7
LOCATION: CONV. CTR. ROOM 321 . . . . . TUE 1:30 PM TO 3:30 PM

Innovations in Imaging Spectrometers I

Session Chair: **Ellen V. Miseo,** Analytical Answers, Inc. (USA)

1:30 pm: **Remote gas sensing and imaging with NASA's hyperspectral thermal emission spectrometer (HYTES)**, William R. Johnson, Glynn Hulley, Simon J. Hook, Jet Propulsion Lab. (USA) . . . . . [9101-32]

1:50 pm: **Miniaturized handheld hyperspectral imager**, Huawen O. Wu, Eric A. Bergles, William Yang, Charlie Zhang, BaySpec Inc. (USA) . . . . [9101-33]

2:10 pm: **Spectral imaging and standoff sensing with HTVS technology**, Bradford B. Behr, Tornado Spectral Systems (USA); Yusuf Bismilla, Andrew T. Cenko, Brandon DesRoches, Jeffrey T. Meade, Elizabeth A. Munro, Jared Slaa, Arsen R. Hajian, Tornado Spectral Systems (Canada) . . . . . [9101-34]

2:30 pm: **Dynamic 3D chemical agent cloud mapping using a sensor constellation deployed on mobile platforms**, Bogdan R. Cosofret, Daisei Konno, David C. Rossi, William J. Marinelli, Peter R. Seem, Physical Sciences Inc. (USA). . . . . [9101-35]

2:50 pm: **LWIR hyperspectral micro-imager for detection of trace explosive particles**, Adam L. Bingham, Spectrum Photonics, Inc. (USA); Paul G. Lucey, Univ. of Hawai'i (USA); Jason T. Akagi, John L. Hinrichs, Edward T. Knobbe, Spectrum Photonics, Inc. (USA) . . . . . [9101-36]

3:10 pm: **A compact Fourier transform imaging spectrometer employing a variable gap Fabry-Perot interferometer**, Paul G. Lucey, Univ. of Hawai'i (USA); Adam L. Bingham, John L. Hinrichs, Jason T. Akagi, Edward T. Knobbe, Spectrum Photonics, Inc. (USA) . . . . . [9101-37]

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

SESSION 8
LOCATION: CONV. CTR. ROOM 321 . . . . TUE 4:00 PM TO 4:40 PM

Innovations in Imaging Spectrometers II

Session Chair: **Ellen V. Miseo,** Analytical Answers, Inc. (USA)

4:00 pm: **Adaptive hyperspectral imaging with a MEMS-based full-frame programmable spectral filter**, David L. Graff, Steven P. Love, Los Alamos National Lab. (USA) . . . . . [9101-38]

4:20 pm: **Advancements in terahertz (THz) spectroscopy and imaging**, David A. Heaps, Eiji Kato, Edward King, Richard McKay, Mark Sullivan, Xiao Hua Zhou, Akiyoshi Irisawa, Motoki Imamura, Advantest America, Inc. (USA) . . . . . [9101-40]

CONFERENCE 9102

LOCATION: CONV. CTR. ROOM 345

Monday - Tuesday 5 - 6 May 2014 • Proceedings of SPIE Vol. 9102

Terahertz Physics, Devices, and Systems VIII: Advanced Applications in Industry and Defense

Conference Chairs: **Mehdi F. Anwar,** Univ. of Connecticut (USA); **Thomas W. Crowe,** Virginia Diodes, Inc. (USA); **Tariq Manzur,** Naval Undersea Warfare Ctr. (USA)

Program Committee: **Giles Davies,** Univ. of Leeds (United Kingdom); **Gottfried H. Döhler,** Max Planck Institute for the Science of Light (Germany); **Achyut K. Dutta,** Banpil Photonics, Inc. (USA); **M. Saif Islam,** Univ. of California, Davis (USA); **Hiroshi Ito,** Kitasato Univ. (Japan); **Peter Uhd Jepsen,** Technical Univ. of Denmark (Denmark); **Edmund H. Linfield,** Univ. of Leeds (United Kingdom); **Amir Hamed Majedi,** Univ. of Waterloo (Canada); **Taiichi Otsuji,** Tohoku Univ. (Japan); **Nezih Pala,** Florida International Univ. (USA); **Azizur Rahman,** City Univ. London (United Kingdom); **Victor Ryzhii,** Univ. of Aizu (Japan); **Ashok K. Sood,** Magnolia Optical Technologies, Inc. (USA); **Sigfrid K. Yngvesson,** Univ. of Massachusetts Amherst (USA); **Weili Zhang,** Oklahoma State Univ. (USA)

MONDAY 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 345 . . MON 8:30 AM TO 10:30 AM

THz Imaging

Session Chairs: **Tariq Manzur,** Naval Undersea Warfare Ctr. (USA); **Thomas W. Crowe,** Virginia Diodes, Inc. (USA)

8:30 am: **Image reconstruction method for non-synchronous THz signals**, Naoki Oda, NEC Corp. (Japan); Syuichi Okubo, Nippon Avionics Co., Ltd. (Japan); Takayuki Sudou, NEC Corp. (Japan); Goro Isoyama, Ryukou Kato, Akinori Irizawa, Keigo Kawase, Osaka Univ. (Japan) . . . . . [9102-1]

8:50 am: **Peculiarities of the detection and identification of substance at long distance** , Vyacheslav A. Trofimov, Vladislav V. Trofimov, Vasily V. Tikhomirov, Lomonosov Moscow State Univ. (Russian Federation). . . . . [9102-2]

9:10 am: **Subterahertz active imaging in transmission and reflection modes based on uncooled rectifying or bolometer type detectors**, Aleksandr G. Golenkov, Igor O. Lysiuk, Anya V. Shevchik-Shekera, Fiodor F. Sizov, Zinovia F. Tsybrii, Vyacheslav V. Zabudsky, Vladimir A. Petriakov, Svetlana G. Bunchuk, Maria V. Apatskaya, Mariya I. Smoliy, Vladimir P. Reva, Sergei V. Korinets, V.E. Lashkaryov Institute of Semiconductor Physics (Ukraine) . . . . . [9102-3]

9:30 am: **Initial results of a real-time, quad-frequency band, polarization-sensitive THz line camera**, Christoph A. Roedig, Don J. Burdette, Howard L. Mosbacker, Jeremy Law, Traycer Systems, Inc. (USA); Kubilay Sertel, Georgios Trichopoulos, The Ohio State Univ. (USA) . . . . . [9102-4]

9:50 am: **3D THz range finder of concealed objects**, Aleksander Sešek, Janez Trontelj, Univ. of Ljubljana (Slovenia); Andrej Švigelj, Letrika Lab. d.o.o. (Slovenia) . . . . . [9102-5]

10:10 am: **Approaching real-time terahertz imaging using photo-induced reconfigurable aperture arrays**, Md. Itrat Bin Shams, Zhenguo Jiang, Syed M. Rahman, Jubaid A. Qayyum, Huili G. Xing, Patrick Fay, Lei Liu, Univ. of Notre Dame (USA). . . . . [9102-6]

Coffee Break . . . . . Mon 10:30 am to 11:00 am

SESSION 2

LOCATION: CONV. CTR. ROOM 345 . . MON 11:00 AM TO 12:10 PM

THz Sources I

Session Chairs: **Azizur Rahman,** City Univ. London (United Kingdom); **Mehdi Anwar,** Univ. of Connecticut (USA)

11:00 am: **Microdisk resonators for difference frequency generation in THz range** *(Invited Paper)*, Raju Sinha, Mustafa Karabiyik, Chowdhury G. Al-Amin, Phani Kiran Vabbina, Nezih Pala, Florida International Univ. (USA); Michael S. Shur, Rensselaer Polytechnic Institute (USA) . . . . . [9102-7]

11:30 am: **10 aJ-level detection of ns pulse below 10 THz by frequency upconversion via DAST-DFG: more than a 4K bolometer**, Feng Qi, Shuzhen Fan, Takashi Notake, Kouji Nawata, Takeshi Matsukawa, Yuma Takida, Hiroaki Minamide, RIKEN (Japan) . . . . . [9102-8]

11:50 am: **Dynamic lithography of V-shaped antennas for beam steering applications**, Tamelia Ali, Ada-Simona Popescu, Igor Bendoym, The City College of New York (USA); Alain Bergeron, Marc Terroux, Linda Marchese, INO (Canada); Andrii B. Golovin, David T. Crouse, The City College of New York (USA) . . . . . [9102-9]

Lunch Break . . . . . Mon 12:10 pm to 1:30 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 345 . . . MON 1:30 PM TO 3:00 PM

THz Detection

Session Chairs: **Taiichi Otsuji,** Tohoku Univ. (Japan); **Tariq Manzur,** Naval Undersea Warfare Ctr. (USA)

1:30 pm: **THz plasmonic detection of high-intensity terahertz radiation** *(Invited Paper)*, Michael S. Shur, Alexey Gutin, Rensselaer Polytechnic Institute (USA); Trond Ytterdal, Norwegian Institute of Technology (Norway); Sergey Rudin, Greg Rupper, U.S. Army Research Lab. (USA) . . . . . [9102-10]

2:00 pm: **Comparison of terahertz technologies for detection and identification of explosives**, Rene Beigang, Technische Univ. Kaiserslautern (Germany); Sandra G. Biedron, Colorado State Univ. (USA); Slawomir Dyjak, Military Univ. of Technology (Poland); Frank Ellrich, Fraunhofer-Institut für Physikalische Messtechnik (Germany); Magnus W. Haakestad, Norwegian Defence Research Establishment (Norway); Daniel Hübsch, HÜBNER GmbH & Co. KG (Germany); Tolga Kartaloglu, Bilkent Univ. (Turkey); Frank Ospald, Technische Univ. Kaiserslautern (Germany); Norbert Palka, Military Univ. of Technology (Poland); Uros Puc, Jožef Stefan Institute (Slovenia); Elzbieta Rurka, Military Univ. of Technology (Poland); Asaf Sahin, Yildirim Beyazit Univ. (Turkey); Aleksander Sešek, Janez Trontelj, Andrej Švigelj, Univ. of Ljubljana (Slovenia); Arthur D. van Rheenen, Norwegian Defence Research Establishment (Norway); Michal Walczakowski, Military Univ. of Technology (Poland) . . . . . [9102-11]

2:20 pm: **Terahertz properties YAG optical ceramics**, S. K. Sundaram, Daniel W. Steere, New York State College of Ceramics at Alfred Univ. (USA); Romain Gaume, Univ. of Central Florida (USA). . . . . [9102-12]

2:40 pm: **High-resolution terahertz atmospheric water vapor continuum measurements**, David M. Slocum, Thomas M. Goyette, Robert H. Giles, Univ. of Massachusetts Lowell (USA); Williams E. Nixon, National Ground Intelligence Ctr. (USA). . . . . [9102-13]

Coffee Break . . . . . Mon 3:00 pm to 3:30 pm

SESSION 4
LOCATION: CONV. CTR. ROOM 345 . . . MON 3:30 PM TO 4:40 PM

THz Sources II

Session Chairs: **Mehdi F. Anwar,** Univ. of Connecticut (USA); **Thomas W. Crowe,** Virginia Diodes, Inc. (USA)

3:30 pm: **Characterisation of graphene-based devices for THz Systems** *(Invited Paper)*, Christos Themistos, Frederick Univ. (Cyprus); B. M. Azizur Rahman, City Univ. London (United Kingdom); Christos Markides, Frederick Univ. (Cyprus); Md. Uthman, A. Quadir, N. Kejalakshmy, City Univ. London (United Kingdom). . . . . [9102-14]

4:00 pm: **Multiband terahertz quasi-optical balanced hot-electron mixers based on dual-polarization sinuous antennas**, Zhenguo Jiang, Syed M. Rahman, Patrick Fay, Steven T. Ruggiero, Lei Liu, Univ. of Notre Dame (USA) . . . . . [9102-15]

4:20 pm: **Wideband 220-GHz solid state power amplifier MMIC within minimal die size**, Jerome Cheron, Erich N. Grossman, National Institute of Standards and Technology (USA). . . . . [9102-16]

TUESDAY 6 MAY

SESSION 5
LOCATION: CONV. CTR. ROOM 345 . . .TUE 8:30 AM TO 10:20 AM

Novel Concepts and Applications I

Session Chairs: **Nezih Pala,** Florida International Univ. (USA); **Thomas W. Crowe,** Virginia Diodes, Inc. (USA)

8:30 am: **Giant terahertz gain by excitation of surface plasmon polarities in optically pumped graphene** *(Invited Paper)*, Taiichi Otsuji, Tohoku Univ (Japan). . . . . [9102-17]

9:00 am: **Exploiting plasmonics for THz and infrared sensing** *(Invited Paper)*, Stephen M. Hanham, Imperial College London (United Kingdom) . . . . . [9102-18]

9:30 am: **Dispersion studies in THz plasmonic devices with cavities**, Mustafa Karabiyik, Nezih Pala, Chowdhury G. Al-Amin, Raju Sinha, Florida International Univ. (USA) . . . . . [9102-19]

9:50 am: **Coherent phenomena in terahertz 2D plasmonic structures: strong coupling, plasmonic crystals, and induced transparency by coupling of localized modes** *(Invited Paper)*, Gregory C. Dyer, Sandia National Labs. (USA); Gregory R. Aizin, Kingsborough Community College (USA); S. James Allen Jr., Univ. of California, Santa Barbara (USA); Albert D. Grine, Don Bethke, John L. Reno, Eric A. Shaner, Sandia National Labs. (USA) . . . . . [9102-20]

Coffee/Exhibition Break. . . . . Tue 10:20 am to 11:00 am

KEYNOTE SESSION
LOCATION: CONV. CTR. ROOM 345 TUE 11:00 AM TO 12:10 PM

Session Chairs: **Tariq Manzur,** Naval Undersea Warfare Ctr. (USA); **Thomas W. Crowe,** Virginia Diodes, Inc. (USA)

11:00 am: **Terahertz signals for chemical and biological sensing and identification** *(Keynote Presentation)*, Kiki Ikossi, Defense Threat Reduction Agency (USA) . . . . . [9102-21]

11:50 am: **Three-dimensional metamaterial devices functioning at terahertz frequencies** *(Invited Paper)*, Weili Zhang, Oklahoma State Univ. (USA) . . . . . [9102-22]

Lunch/Exhibition Break . . . . . Tue 12:10 pm to 1:50 pm

SESSION 6
LOCATION: CONV. CTR. ROOM 345 . . . . TUE 1:50 PM TO 3:30 PM

Novel Concepts and Applications II

Session Chairs: **Mehdi F. Anwar,** Univ. of Connecticut (USA); **Nezih Pala,** Florida International Univ. (USA)

1:50 pm: **Noncontact doping profile recognition in photovoltaic cells using terahertz time domain spectroscopy**, Chih-Yu Jen, Christiaan Richter, Rochester Institute of Technology (USA) . . . . . [9102-23]

2:10 pm: **T-ray detection in 0.35-µm CMOS technology**, Gregory J. Fertig, Chao Zhang, Zoran Ninkov, Rochester Institute of Technology (USA); Mark V. Bocko, Zeljko Ignjatovic, Judith L. Pipher, Craig W. McMurtry, Xi-Cheng Zhang, Univ. of Rochester (USA); J. Daniel Newman, Paul P. K. Lee, Andrew P. Sacco, Kenneth D. Fourspring, ITT Exelis (USA). . . . . [9102-24]

2:30 pm: **THz imaging Si MOSFET device characterization**, J. Daniel Newman, Paul P. K. Lee, Andrew P. Sacco, Kenneth D. Fourspring, ITT Exelis (USA); Mark V. Bocko, Zeljko Ignjatovic, Judith L. Pipher, Craig W. McMurtry, Xi-Cheng Zhang, Univ. of Rochester (USA); Chao Zhang, Zoran Ninkov, Rochester Institute of Technology (USA) . . . . . [9102-25]

2:50 pm: **Radar cross section of frequency selective terahertz retroreflectors**, Richard J. Williams, Andrew J. Gatesman, Robert H. Giles, Univ. of Massachusetts Lowell (USA); Williams E. Nixon, National Ground Intelligence Ctr. (USA); Thomas M. Goyette, Univ. of Massachusetts Lowell (USA) . . . . . [9102-26]

3:10 pm: **Broadband THz superlens grating**, Chen Wang, Cheng Sun, Northwestern Univ. (USA) . . . . . [9102-27]

POSTERS-TUESDAY
LOCATION: CONV. CTR. HALL C . . . . . .TUE 6:00 PM 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 session. 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 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 concealed weapon detection in visible, infrared, and terahertz, Marcin Kowalski, Mariusz Kastek, Henryk Polakowski, Norbert Palka, Marek Piszczek, Mieczyslaw Szustakowski, Military Univ. of Technology (Poland) . . . . . [9102-28]

Advanced designs for non-imaging submillimeter-wave Winston cone concentrators, Andrew O. Nelson, Erich N. Grossman, National Institute of Standards and Technology (USA). . . . . [9102-29]

CONFERENCE 9103

LOCATION: CONV. CTR. ROOM 334

Wednesday - Thursday 7 - 8 May 2014 • Proceedings of SPIE Vol. 9103

Wireless Sensing, Localization, and Processing IX

Conference Chairs: **Sohail A. Dianat,** Rochester Institute of Technology (USA); **Michael David Zoltowski,** Purdue Univ. (USA)

Program Committee: **John W. Nieto,** Harris Corp. (USA); **Raghuveer M. Rao,** U.S. Army Research Lab. (USA); **Yimin D. Zhang,** Villanova Univ. (USA)

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

SESSION 1

LOCATION: CONV. CTR. ROOM 334 . WED 10:30 AM TO 11:30 AM

Digital Modulation/Demodulation Techniques

Session Chair: **James A. Norris,** Harris Corp. (USA)

10:30 am: **Investigating the effects of digital filtering on digital modulations**, John W. Nieto, Harris Corp. (USA) . . . . . [9103-1]

10:50 am: **Demodulation improvement analysis of FEC quasi-coherent CPM**, James A. Norris, John W. Nieto, Harris Corp. (USA) . . . . . [9103-2]

11:10 am: **Performance analysis of MIMO multiuser DS-CDMA wireless communication systems under generalized receiver employment over Rayleigh fading channels**, Vyacheslav P. Tuzlukov, Kyungpook National Univ. (Korea, Republic of). . . . . [9103-3]

Lunch/Exhibition Break . . . . . .Wed 11:30 am to 1:00 pm

SESSION 2

LOCATION: CONV. CTR. ROOM 334 . . . WED 1:00 PM TO 3:00 PM

Sensor Networks

Session Chair: **John W. Nieto,** Harris Corp. (USA)

1:00 pm: **A cyber threat model for tactical radio networks**, Michael T. Kurdziel, Harris Corp. (USA) . . . . . [9103-4]

1:20 pm: **Node localization via analyzing multi-path signals in ultrasonic sensor networks**, William J. Tomlinson Jr., Bo Dong, Stephan Lorenz, Subir Biswas, Michigan State Univ. (USA) . . . . . [9103-5]

1:40 pm: **Wireless sensors in complex networks: study and performance evaluation of a new hybrid model**, Peppino Fazio, Vincenzo Curia, Francesco Mirabelli, Univ. della Calabria (Italy); Miroslav Voznak, V?B-Technical Univ. of Ostrava (Czech Republic) . . . . . [9103-6]

2:00 pm: **SmartHome: a domotic framework based on smart sensing and actuator network to reduce energy wastes**, Amilcare Francesco Santamaria, Domenico Falbo, Domenico Barletta, Floriano De Rango, Univ. della Calabria (Italy) . . . . . [9103-7]

2:20 pm: **Predicting impact of multi-paths on phase change in map-based vehicular ad hoc networks**, Mark D. Rahmes, George Lemieux, Harris Corp. (USA); Jerome Sonnenberg, Harris Corp. GCSD (USA); David B. Chester, Harris Corp. (USA) . . . . . [9103-8]

2:40 pm: **Data analysis and integration of environmental sensors to meet human needs**, Amilcare Francesco Santamaria, Domenico Barletta, Domenico Falbo, Floriano De Rango, Alessandro Imbrogno, Univ. della Calabria (Italy) . . . . . [9103-9]

Coffee Break . . . . . .Wed 3:00 pm to 3:30 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 334 . . . WED 3:30 PM TO 4:30 PM

Diversity and Multicarrier Techniques

Session Chair: **Michael D. Zoltowski,** Purdue Univ. (USA)

3:30 pm: **A low complexity approach for spread OFDM signal detection**, Ali A. Elghariani, Michael D. Zoltowski, Purdue Univ. (USA) . . . . . [9103-10]

3:50 pm: **Improving BER in a MIMO free space optical communication system in a turbulence channel with spatial arrangement of the receiver array**, Anjan K. Ghosh, Tripura Univ. (India); Digvijay Panchratna, Dhirubhai Ambani Institute of Information and Communication Technology (India)[9103-12]

4:10 pm: **MIMO space-time codes with decoding algorithm of low dimensionality**, Xinjia Chen, Ernest L. Walker, Southern Univ. and A&M College (USA) . . . . . [9103-13]

THURSDAY 8 MAY

SESSION 4

LOCATION: CONV. CTR. ROOM 334 . . THU 8:40 AM TO 10:20 AM

Detection and Localization

Session Chair: **Yimin D. Zhang,** Villanova Univ. (USA)

8:40 am: **DOA estimation exploiting coprime frequencies**, Si Qin, Yimin D. Zhang, Moeness G. Amin, Villanova Univ. (USA) . . . . . [9103-14]

9:00 am: **Direction estimation, source location, and modulation detection for RF sources using steerable 3D IIR beam filters**, Nilan Udayanga, Arjuna Madanayake, Chamith Wijenayake, The Univ. of Akron (USA) . . . . . [9103-15]

9:20 am: **Road safety alerting system with radar and GPS cooperation in a VANET environment**, Amilcare Francesco Santamaria, Cesare Sottile, Floriano De Rango, Univ. della Calabria (Italy); Miroslav Voznak, VŠB-Technical Univ. of Ostrava (Czech Republic) . . . . . [9103-16]

9:40 am: **Application of novel quasi-electrostatic sensor arrays for time based data collection and processing of supersonic, subsonic, and transonic revolving projectiles**, Christopher J. Benfield, Wesley B. Williams, The Univ. of North Carolina at Charlotte (USA). . . . . [9103-17]

10:00 am: **Entropy formulations for signal reconstruction from sensor arrays** *(Invited Paper)*, Raghuveer Rao, U.S. Army Research Lab. (USA); Prudhvi Gurram, MBO Partners Inc. (USA). . . . . [9103-23]

Coffee Break . . . . . Thu 10:20 am to 10:50 am

SESSION 5
LOCATION: CONV. CTR. ROOM 334 . . THU 10:50 AM TO 12:30 PM

Implementation and Applications

Session Chair: **Raghuveer M. Rao,** U.S. Army Research Lab. (USA)

10:50 am: **Single source noise reduction of received HF audio: experimental study**, Eric Campbell, Carlos O. Alva, Harris Corp. (USA) . . . . . [9103-18]

11:10 am: **Smart sensing to drive real-time loads scheduling algorithm in a domotic architecture**, Amilcare Francesco Santamaria, Floriano De Rango, Andrea Vaccaro, Pierfrancesco Raimondo, Univ. della Calabria (Italy). . [9103-19]

11:30 am: **A wireless time synchronized event control system**, Robert Klug, Peter Scheffel, Jonathan Williams, McQ, Inc. (USA). . . . . [9103-20]

11:50 am: **Distributive security mechanism for mobile cellular users in GSM cellular networks**, Suresh K. Vashist, Maharshi Dayanand Univ., Rohtak (India) . . . . . [9103-21]

12:10 pm: **Sensing technologies for monitoring and conservation of cultural heritage: wireless detection of decay factors**, M. I. Martínez-Garrido, R. Fort, Instituto de Geociencias (Spain) and Campus Moncloa (Spain). . . . . [9103-22]

POSTERS-THURSDAY

LOCATION: CONV. CTR. HALL C. . . . . 6:00 PM 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 session. 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 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.

Features and range of the FSO by use of the OFDM and QAM modulation in different atmospheric conditions, Andrej Liner, Jakub Jaros, Martin Papes, Petr Koudelka, Jan Latal, Jakub Cubik, Frantisek Perecar, Vladimír Vašinek, VŠB-Technical Univ. of Ostrava (Czech Republic) . . . . . [9103-11]

CONFERENCE 9104

LOCATION: CONV. CTR. ROOM 335

Thursday 8 May 2014 • Proceedings of SPIE Vol. 9104

Spectral Imaging Sensor Technologies: Innovation Driving Advanced Application Capabilities

Conference Chair: **David P. Bannon,** Headwall Photonics, Inc. (USA)

THURSDAY 8 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 335 . . .THU 8:00 AM TO 10:10 AM

Satellite and Airborne Hyperspectral Sensors

Session Chair: **David P. Bannon,** Headwall Photonics Inc. (USA)

8:00 am: **Small satellite sensor payloads: hyperspectral imaging implications for earth monitoring and remote sensing** *(Invited Paper)*, David G. Goodenough, Univ. of Victoria (Canada) . . . . . [9104-1]

8:30 am: **SYSIPHE: focus on SIELETERS, the medium and longwave infrared spectral imaging instrument**, Yann Ferrec, Christophe Coudrain, Sophie Thétas, Jérôme Primot, Laurent Rousset-Rouviere, Remi Gouyon, Marc Jacquart, Marcel Caes, Michel Tauvy, Sylvie Bernhardt, Joel R. Deschamps, Didier Henry, Alain P. Kattnig, Philippe Perrault, Gilles Le Coadou, Roland Domel, Patricia Cymbalista, ONERA (France) . . . . . [9104-2]

8:50 am: **Optical design of wide swath hyperspectral imager**, Yueming Wang, Shanghai Institute of Technical Physics (China); Jun-Wei Lang, Xizhong Xiao, Shanghai Institute of Technical Physics (China) and Univ. of Chinese Academy of Sciences (China); Zhikang Bao, Jianyu Wang, Shanghai Institute of Technical Physics (China) . . . . . [9104-3]

9:10 am: **Development of co-boresighted Vis-NIR-SWIR hyperspectral imaging systems**, Kwok-Keung Wong, Headwall Photonics Inc (USA) . [9104-4]

9:30 am: **Lightweight airborne imaging spectrometer remote sensing system for mineral exploration in China**, Taixia Wu, Lifu Zhang, Yi Cen, Jinnian Wang, Qingxi Tong, Institute of Remote Sensing and Digital Earth (China) . . . . . [9104-5]

9:50 am: **Demosaicking for full motion video 9-band SWIR sensor**, Andrey Kanaev, Mary R. Kutteruf, Michael K. Yetzbacher, U.S. Naval Research Lab. (USA); Michael J. DePrenger, Marjorie Rawhouser, Tekla Research Inc. (USA) . . . . . [9104-6]

Coffee Break . . . . . Thu 10:10 am to 10:40 am

SESSION 2

LOCATION: CONV. CTR. ROOM 335 . THU 10:40 AM TO 12:00 PM

Sensor Integration with UAVs and Ground-Truth Analysis

Session Chair: **David P. Bannon,** Headwall Photonics Inc. (USA)

10:40 am: **Remote sensing: correlation of airborne hyperspectral and ground-truthing data**, Brian Curtiss, Analytical Spectral Devices, Inc. (USA) . . . . . [9104-7]

11:00 am: **Integration of UAVs and manned aircraft for future concept**, Mustafa Özartan, Turkish Air Force Academy (Turkey) . . . . . [9104-8]

11:20 am: **Miniaturization of sub-meter resolution hyperspectral imagers on unmanned aerial systems**, Samuel Hill, Headwall Photonics Inc. (USA) . . . . . [9104-9]

11:40 am: **Integration of spectral sensors onto multi-rotor UAVs: from Hollywood to remote sensing**, Jeff Jackson, Infinite Jib Inc. (Canada) . . . . . [9104-10]

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

SESSION 3

LOCATION: CONV. CTR. ROOM 335 . . . . .THU 1:30 PM TO 3:10 PM

Laboratory and Process Line Hyperspectral Applications I

Session Chair: **David P. Bannon,** Headwall Photonics Inc. (USA)

1:30 pm: **Spectral imaging innovation: food safety and food quality applications**, Moon S. Kim, Agricultural Research Service (USA) . . . . . [9104-11]

1:50 pm: **Spectral imaging for cultural and historical preservation**, Gregory Bearman, ANE Image (USA) . . . . . [9104-12]

2:10 pm: **Utility of hyperspectral imagers in the mining industry: Italy's gypsum reserves**, Janette H. Wilson, Headwall Photonics, Inc. (USA) . [9104-13]

2:30 pm: **Classification and identification of different level of aflatoxin B1 on maize kernels surface using infrared reflectance hyperspectral imaging**, Wei Wang, China Agricultural Univ. (China); Kurt C. Lawrence, Seung-Chul Yoon, Gerald W. Heitschmidt, William R. Windham, Peggy Feldner, Agricultural Research Service (USA); Xuan Chu, China Agricultural Univ. (China). . . [9104-14]

2:50 pm: **Active gated imaging for automotive safety applications**, Yoav Grauer, Ezri Sonn, BrightWay Vision Ltd. (Israel) . . . . . [9104-15]

Coffee Break . . . . . Thu 3:10 pm to 3:40 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 335 . . . THU 3:40 PM TO 4:40 PM

Laboratory and Process Line Hyperspectral Applications II

Session Chair: **David P. Bannon,** Headwall Photonics Inc. (USA)

3:40 pm: **Correction of scene turbulence and scene jitters by use of a dual port imaging Fourier-transform spectrometer**, Louis M. Moreau, Florent M. Prel, Stéphane M. Lantagne, Claude B. Roy, ABB Analytical Measurement (Canada) . . . . . [9104-16]

4:00 pm: **Pulsed quantum cascade laser based hypertemporal real-time headspace measurements**, Charles C. Harb, Toby K. Boyson, The Univ. of New South Wales (Australia); Thomas G. Spence, Loyola Univ. New Orleans (USA); David S. Moore, Los Alamos National Lab. (USA); David B. Arnone, David B. Caffey, Leigh J. Bromley, Daylight Solutions Inc. (USA). . . . . [9104-17]

4:20 pm: **Discrete frequency infrared spectroscopic imaging with guided Fano resonators**, Jui-Nung Liu, Matthew V. Schulmerich, Rohit Bhargava, Brian T. Cunningham, Univ. of Illinois at Urbana-Champaign (USA) . . . [9104-18]

CONFERENCE 9105

LOCATION: CONV. CTR. ROOM 320

Monday - Wednesday 5 - 7 May 2014 • Proceedings of SPIE Vol. 9105

Thermosense: Thermal Infrared Applications XXXVI

Conference Chairs: **Fred P. Colbert,** Colbert Infrared Services (USA); **Sheng-Jen (Tony) Hsieh,** Texas A&M Univ. (USA)

Program Committee: **Andrea Acosta,** Colbert Infrared Services (USA); **Nicolas Avdelidis,** National Technical Univ. of Athens (Greece); **Jeff R. Brown,** Hope College (USA); **Douglas Burleigh,** La Jolla Cove Consulting (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); **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 Entreprises Inc. (USA); **Andres E. Rozlosnik,** SI Termografía 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); **Gregory R. Stockton,** Stockton Infrared Thermographic Services, Inc. (USA); **Vladimir P. Vavilov,** Tomsk Polytechnic Univ. (Russian Federation); **Xiong Yu,** Case Western Reserve Univ. (USA); **Joseph N. Zalameda,** NASA Langley Research Ctr. (USA)

ThermoSense Mission Statement

The Infrared Applications, ThermoSense conference promotes the worldwide exchange of information about the uses or applications of thermal infrared sensing, imaging and measuring instruments through papers, workshops and short-courses. Over the past thirty four years these activities have included topics from the fundamentals of imaging and calibration to virtually all civilian applications of infrared equipment with special emphasis on problem solving and 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

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CONFERENCE 9105
LOCATION: CONV. CTR. ROOM 320

MONDAY 5 MAY

VENDOR SESSION
LOCATION: CONV. CTR. ROOM 316 . . . . . 12:00 PM TO 4:40 PM

NOTE ROOM CHANGE

The Infrared Applications: ThermoSense XXXVI Vendor Session

Moderators: **Andrés E. Rozlosnik,** Si Termografia Infrarroja (Argentina), and **Herb Kaplan,** Honeyhill Technical Co. (USA)

The Infrared Applications: ThermoSense XXXVI Vendor Session will be held on Monday afternoon, 5 May 2014 as part of SPIE's DSS 2014 Conference in Baltimore. 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 Vendor Session was started ten 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.

Plan your travel to arrive early enough to get this valuable preview of evolving technology.

VENDORS IN PRESENTATION ORDER:

Telops (Booth 1112)
A New Rugged Line of High Performance Infrared Cameras
Presenter: **Vincent Farley,** Business Development Manager

New Infrared Technologies (Booth 877)
The CORE-S: an affordable solution for industrial process monitoring using uncooled MWIR FPAs, and its evolution towards larger imaging arrays (256x256)
Presenter: **Rodrigo Linares,** Business Development Manager

ULIS (Booth 809)
ULIS uncooled IR detectors and new developments
Presenter: **Ludovic Brasse,** Sales Manager

StingRay Optics, LLC (Booth 962)
StingRay Optics Standard Products 2014
Presenter: **Sam Wyman,** Standard Products Specialist

SCD.USA, LLC (Booth 716)
New Infrared Detector Technology from SCD
Presenter: **Robert McDaniel,** President and CEO SCD.USA

New Imaging Technologies (NIT) (Booth 1048)
Advantages of Native High Dynamic range in SWIR
Presenter: **Jean-Louis Laurent,** Sales Director

Xenics (Booth 1025)
A low SWaP gimbal, equipped with SWIR and LWIR camera cores for UAS operation
Presenter: **Jan Vermieren,** Technical Adviser and Business Development Manager

Magnity Electronics (Booth 1070)
Recent advances in thermal imaging technologies and products at Magnity
Presenter: **Chongfei Shen,** Magnity Electronics CEO

CI Systems, Inc. (Booth 1001)
RadIR: True Temperature Cameraby CI Systems
Presenter: **ILya Koshkin,** Technology and Business Development at CI Systems

JENOPTIK (Booth 107)
New High Definition Camera from JENOPTIK
Presenter: **David Fisher,** Sales Manager Infrared Camera Products

Heimann Sensor GmbH (Booth 1005)
New low cost thermopile focal planes to enable consumer applications
Presenter: **Bodo Forg,** Project Manager

Sensors Unlimited - UTC Aerospace Systems (Booth 817)
Highest sensitivity, highest resolution SWIR imaging cameras
Presenter: **Shannon Larbig,** Sales Manager, Component Products

Opgal Optronic Industries Ltd. (Booth 512)
Therm-App™: Merging the thermal imaging world with the Android smartphone
Presenter: **Craig Beal,** Product Manager

PHOTONIS Digital Imaging (Booth 1213)
Low Light Digital Imaging as a Platform for Fusion Technologies
Presenter: **Löig E. Bourrée,** Vice President of Night Vision Technologies

TUESDAY 6 MAY

SESSION 1
LOCATION: CONV. CTR. ROOM 320 . . . TUE 8:00 AM TO 9:40 AM

Manufacturing and Processing Industries

Session Chairs: **Joseph N. Zalameda,** NASA Langley Research Ctr. (USA); **Xavier P. V. Maldague,** Univ. Laval (Canada)

8:00 am: **Infrared imaging of the e-beam melting 3D-printing process**, Ralph B. Dinwiddie, Ryan R. Dehoff, Frederick A. List III, Larry E. Lowe, Kevin D. Harper, Oak Ridge National Lab. (USA) . . . . . [9105-1]

8:20 am: **NIST emittance metrology in support of advanced manufacturing process control and modeling**, Sergey N. Mekhontsev, Weston L. Tew, Leonard M. Hanssen, National Institute of Standards and Technology (USA) . . . . . [9105-2]

8:40 am: **Method for improving visualization of infrared images**, Mario Cimbalista Jr., THERMOTRONICS (Brazil) . . . . . [9105-30]

9:00 am: **Monitoring of industrial welding processes using high-speed uncooled MWIR imaging sensors**, Rodrigo Linares Herrero, German Vergara, Raul Gutierrez Alvarez, Carlos Fernandez-Montojo, Maria Teresa Montojo Supervielle, Arturo Baldasano-Ramirez, Victor Villamayor, Luis J. Gómez, Maria Gonzalez, New Infrared Technologies, S.L. (Spain) . . . . . [9105-4]

9:20 am: **Infrared imaging of the polymer 3D-printing process**, Ralph B. Dinwiddie, Lonnie J. Love, John C. Rowe, Oak Ridge National Lab. (USA) . . . . . [9105-5]

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 320 TUE 9:40 AM TO 10:00 AM

Manufacturing and Processing Industries

Coffee/Exhibition Break. . . . . Tue 10:00 to 10:50 am

SESSION 2
LOCATION: CONV. CTR. ROOM 320 . . TUE 10:50 AM TO 11:50 AM

Medical

Session Chairs: **Gary E. Strahan,** Infrared Cameras, Inc. (USA); **Andrea D. Acosta,** Colbert Infrared Services, Inc. (USA)

10:50 am: **Thermal camera used for the assessment of metabolism and functions of the rat brain**, Mariusz Kastek, Tadeusz Piatkowski, Henryk Polakowski, Military Univ. of Technology (Poland); Zbigniew Czernicki, Ewa Kozniewska, Katarzyna Kaczmarska, Lukasz Przykaza, Mossakowski Medical Research Ctr. (Poland) . . . . . [9105-7]

11:10 am: **Intraoperative application of thermal camera for the assessment of during surgical resection or biopsy of human's brain tumors**, Mariusz Kastek, Tadeusz Piatkowski, Henryk Polakowski, Military Univ. of Technology (Poland); Zbigniew Czernicki, Jacek Bogucki, Mossakowski Medical Research Ctr. (Poland); Marta Zebala, Medical Univ. of Warsaw (Poland); Katarzyna Kaczmarska, Mossakowski Medical Research Ctr. (Poland) . . . . . [9105-8]

11:30 am: **A combined approach for using thermography for the detection of diabetes mellitus**, Bob Berry, Thermal Vision (Ireland) . . . . . [9105-31]

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 320 TUE 11:50 AM TO 12:10 PM

Medical

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

SESSION 3
LOCATION: CONV. CTR. ROOM 320 . . . . TUE 1:30 PM TO 2:50 PM

Materials Evaluation

Session Chairs: **Ralph B. Dinwiddie,** Oak Ridge National Lab. (USA); **Morteza Safai,** The Boeing Co. (USA)

1:30 pm: **Center crack detection during continuous casting of aluminum by laser ultrasonic measurements**, Hubert Grün, Thomas Mitter, Jürgen Roither, RECENDT GmbH (Austria); Andreas Betz, Salar Bozorgi, AIT Austrian Institute of Technology GmbH (Austria); Peter Burgholzer, RECENDT GmbH (Austria) . . . . . [9105-9]

1:50 pm: **Infrared imaging analysis of ballistic impacts of composite armor materials**, Robert Furstenberg, Michael R. Papantonakis, Viet Nguyen, Christopher A. Kendziora, R. Andrew McGill, U.S. Naval Research Lab. (USA) . . . . . [9105-10]

2:10 pm: **Thermal inspection of composite honeycomb structures**, Joseph N. Zalameda, F. Raymond Parker, Jeffrey P. Seebo, NASA Langley Research Ctr. (USA). . . . . [9105-11]

2:30 pm: **Fiber orientation assessment on surface and beneath surface of carbon fiber reinforced composites using active infrared thermography**, Henrique C. Fernandes, Xavier P. V. Maldague, Univ. Laval (Canada) . . [9105-12]

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 320 . TUE 2:50 PM TO 3:10 PM

Materials Evaluation

Coffee/Exhibition Break. . . . . Tue 3:10 to 3:40 pm

SESSION 4
LOCATION: CONV. CTR. ROOM 320 . . . . TUE 3:40 PM TO 4:20 PM

Building Applications

Session Chairs: **Monica A. Saenz; Fred P. Colbert,** Colbert Infrared Services, Inc. (USA)

3:40 pm: **Comparison of image processing techniques for the on-site evaluation of damaged frescoes**, Paolo Bison, Alessandro Bortolin, Gianluca Cadelano, Giovanni Ferrarini, Consiglio Nazionale delle Ricerche (Italy); Fernando López, Univ. Federal de Santa Catarina (Brazil); Xavier P. V. Maldague, Univ. Laval (Canada) . . . . . [9105-13]

4:00 pm: **heatWave: the next generation of thermography devices**, Peyman Moghadam, Commonwealth Scientific and Industrial Research Organisation (Australia); Stephen Vidas, Queensland Univ. of Technology (Australia) [9105-14]

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 320 TUE 4:20 PM TO 4:40 PM

Building Applications

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 320 TUE 4:40 PM TO 5:00 PM

ThermoSense

CONFERENCE 9105
LOCATION: CONV. CTR. ROOM 320

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

SESSION 6
LOCATION: CONV. CTR. ROOM 320 . .WED 10:50 AM TO 11:10 AM

Security

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

10:50 am: **Rapid rotation invariant face detection and pose estimation in thermal infrared spectrum**, Fang Hua, Stephanie Schuckers, Clarkson Univ. (USA) . . . . . [9105-16]

SESSION 7
LOCATION: CONV. CTR. ROOM 320 . . WED 11:10 AM TO 11:50 AM

Research and Development

Session Chair: **Steven M. Shepard,** Thermal Wave Imaging, Inc. (USA)

11:10 am: **Pattern extraction and tracking on fast-moving objects in a binary IR thermal image**, Chialun John Hu, SunnyFuture (USA) . . . . . [9105-17]

11:30 am: **The effect of a pre-lens aperture on the temperature range and image uniformity of microbolometer infrared cameras**, Ralph B. Dinwiddie, Oak Ridge National Lab. (USA); Jonathan Grimm, Farragut High School (USA) . . . . . [9105-18]

SESSION 8
LOCATION: CONV. CTR. ROOM 320 . .WED 11:50 AM TO 12:50 PM

NDT I

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

11:50 am: **IR thermographic characterization of low energy impact damage in carbon/carbon composite by applying optical and ultrasonic stimulation**, Vladimir P. Vavilov, Darya A. Derusova, Tomsk Polytechnic Univ. (Russian Federation) . . . . . [9105-19]

12:10 pm: **Artificial neural network and active thermography for prediction of nonmetallic coating thickness**, Hongjin Wang, Sheng-Jen Hsieh, Texas A&M Univ. (USA) . . . . . [9105-20]

12:30 pm: **A hybrid frequency-spatial domain infrared image enhancement approach evaluated by fuzzy entropy**, Qiong Zhang, Julien Fleuret, Xavier P. V. Maldague, Univ. Laval (Canada) . . . . . [9105-21]

Lunch/Exhibition Break . . . . . .Wed 12:50 pm to 1:50 pm

SESSION 9
LOCATION: CONV. CTR. ROOM 320 . . . WED 1:50 PM TO 2:50 PM

NDT II

Session Chairs: **Ernesto Gallo,** Transequipos Ltda. (Colombia); **John W. Pratten III,** Proactive Maintenance Consultants, LLC (USA)

1:50 pm: **Pulse compression approach to digitized frequency modulated infrared imaging for nondestructive testing of carbon fibre reinforced polymers**, Ravibabu Mulaveesala, Indian Institute of Technology, Ropar (India); Juned A. Siddiqui, Indian Institute of Information Technology (India); Vanita Arora, Indian Institute of Technology, Ropar (India); Amarnath Muniyappa, PDPM IIITDM Jabalpur (India) . . . . . [9105-22]

2:10 pm: **On the application of a frequency identification technique on thermal data to identify defects in a material**, Galid Arroud, Univ. Antwerpen (Belgium); Patrick Guillaume, Vrije Univ. Brussel (Belgium); Mahmoud El-Kafafy, Vrije Univ. Brussel (Belgium); Gunther Steenackers, Univ. Antwerpen (Belgium) . . . . . [9105-23]

2:30 pm: **Computational reduction of specimen noise to enable improved thermography characterization of flaws in graphite polymer composites**, William P. Winfree, Patricia A. Howell, Joseph N. Zalameda, NASA Langley Research Ctr. (USA) . . . . . [9105-24]

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 320 WED 2:50 PM TO 3:10 PM

NDT I and II

Coffee Break . . . . . .Wed 3:10 to 3:40 pm

SESSION 10
LOCATION: CONV. CTR. ROOM 320 . . . WED 3:40 PM TO 5:20 PM

NDT III

3:40 pm: **Survey of thermography in electronics inspection**, Sheng-Jen Hsieh, Texas A&M Univ. (USA) . . . . . [9105-25]

4:00 pm: **Modelling and predicting hidden solder joint shape using parametric numerical analysis and active thermography**, Jose Giron-Palomares, Zhejiang Univ. (China); Sheng-Jen Hsieh, Texas A&M Univ. (USA) . . . . . [9105-26]

4:20 pm: **Nonstationary thermal wave imaging for nondestructive testing and evaluation**, Ravibabu Mulaveesala, Vanita Arora, Indian Institute of Technology, Ropar (India); Juned A. Siddiqui, Indian Institute of Information Technology (India); Amarnath Muniyappa, PDPM IIITDM Jabalpur (India) . . . . . [9105-27]

4:40 pm: **Applications of infrared thermography for nondestructive testing of fatigue cracks in steel bridges**, Takahide Sakagami, Kobe Univ. (Japan); Yui Izumi, Univ. of Shiga Prefecture (Japan); Sunao Kawabata, Yoshiaki Mizokami, Honshu-Shikoku Bridge Expressway Company Ltd. (Japan) [9105-28]

5:00 pm: **Numerical approach to binary complementary Golay coded infrared thermal wave imaging**, Ravibabu Mulaveesala, Indian Institute of Technology, Ropar (India); Amarnath Muniyappa, PDPM IIITDM Jabalpur (India); Juned A. Siddiqui, Indian Institute of Information Technology (India); Vanita Arora, Indian Institute of Technology, Ropar (India) . . . . . [9105-29]

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 320 WED 5:20 PM TO 5:40 PM

NDT III

CONFERENCE 9106

LOCATION: CONV. CTR. ROOM 335

Monday - Tuesday 5 - 6 May 2014 • Proceedings of SPIE Vol. 9106

Advanced Environmental, Chemical, and Biological Sensing Technologies XI

Conference Chairs: **Tuan Vo-Dinh,** Fitzpatrick Institute for Photonics, Duke Univ. (USA); **Robert A. Lieberman,** Intelligent Optical Systems, Inc. (USA); **Günter G. Gauglitz,** Eberhard Karls Univ. Tübingen (Germany)

Program Committee: **Zane A. Arp,** GlaxoSmithKline (USA); **Francesco Baldini,** Istituto di Fisica Applicata Nello Carrara (Italy); **Luigi Campanella,** Univ. degli Studi di Roma La Sapienza (Italy); **Jesus Delgado Alonso,** Intelligent Optical Systems, Inc. (USA); **Franz Ludwig Dickert,** Univ. Wien (Austria); **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,** Karlsruher Institut für Technologie (Germany); **David L. Stokes,** EOIR Technologies (USA)

MONDAY 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 335 . . MON 9:10 AM TO 10:10 AM

Remote Sensing and LIDAR

Session Chair: **Tuan Vo-Dinh,** Duke Univ. (USA)

9:10 am: **Compact remote optical system for real time measurement of fugitive aerosol emissions**, Gregor A. Waldherr, Hai Lin, Michael T. V. Wylie, Hal Technology, LLC (USA). . . . . [9106-1]

9:30 am: **Lidar applications: detection of flame**, Gold R. D. Hood, Kevin Kochersberger, Virginia Polytechnic Institute and State Univ. (USA) . . . . [9106-2]

9:50 am: **The Northwest Infrared (NWIR) gas-phase spectral database of industrial and environmental chemicals for in situ and remote sensing: recent updates**, Carolyn S. Brauer, Timothy J. Johnson, Thomas A. Blake, Steven W. Sharpe, Robert L. Sams, Russell G. Tonkyn, Pacific Northwest National Lab. (USA) . . . . . [9106-3]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

SESSION 2

LOCATION: CONV. CTR. ROOM 335 . MON 10:40 AM TO 12:00 PM

Sensors and Microchips

Session Chair: **Tuan Vo-Dinh,**
Fitzpatrick Institute for Photonics, Duke Univ. (USA)

10:40 am: **Effect of film thickness on localized surface plasmon enhanced chemical sensor**, Aschalew Kassu, Carlton W. Farley III, Anup Sharma, Alabama A&M Univ. (USA); Junpeng Guo, Wonkyu Kim, The Univ. of Alabama in Huntsville (USA). . . . . [9106-4]

11:00 am: **Comparison of plasmonic bioanalytical sensing platforms based on thin metallic layer, nanoparticles layer, or single nanoparticles**, Jacqueline Jatschka, Ondrej Stranik, André Dathe, David Zopf, Andrea Csaki, Wolfgang Fritzsche, Institut für Photonische Technologien e.V. (Germany) . . . . . [9106-5]

11:20 am: **Large area broad-band resonant substrate for surface-enhanced Raman scattering**, Nan Zhang, Kai Liu, Haomin Song, Xie Zeng, Dengxin Ji, Qiaoqiang Gan, Univ. at Buffalo (USA) . . . . . [9106-6]

11:40 am: **Plasmonic chip for chemical and biological sensing** *(Invited Paper)*, Hoan Thanh Ngo, Andrew M. Fales, Tuan Vo-Dinh, Duke Univ. (USA) . . . . . [9106-7]

Lunch Break . . . . . Mon 12:00 pm to 1:30 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 335 . . . .MON 1:30 PM TO 3:30 PM

Hyperspectral Imaging

Session Chair: **David L. Stokes,** EOIR Technologies (USA)

1:30 pm: **Hyperspectral domains and methods for chemical detection in ambient environment** *(Invited Paper)*, George G. He, EOIR Technologies (USA) . . . . . [9106-8]

2:00 pm: **Active (quantum cascade lasers) and passive (FTIR) infrared spectroscopy for detection of environmental threats** *(Invited Paper)*, Erik R. Deutsch, Petros Kotidis, Anish K. Goyal, Block Engineering, Inc. (USA) . [9106-9]

2:30 pm: **Pigment identification in pictorial layers by hyperspectral imaging**, Giuseppe Capobianco, Giuseppe Bonifazi, Univ. degli Studi di Roma La Sapienza (Italy); Fernanda Prestileo, Istituto per la Conservazione e la Valorizzazione dei Beni Culturali (Italy); Silvia Serranti, Univ. degli Studi di Roma La Sapienza (Italy) . . . . . [9106-10]

2:50 pm: **Airborne midwave and longwave infrared hyperspectral imaging of gases**, Marc-André Gagnon, Pierre Tremblay, Simon Savary, Vincent Farley, Martin Chamberland, Marc Duval, Telops (Canada) . . . . . [9106-11]

3:10 pm: **Automatic detection and classification of EOL-concrete and resulting recovered products by hyperspectral imaging**, Roberta Palmieri, Giuseppe Bonifazi, Silvia Serranti, Univ. degli Studi di Roma La Sapienza (Italy) . . . . . [9106-12]

Coffee Break . . . . . Mon 3:30 pm to 4:00 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 335 . . .MON 4:00 PM TO 5:00 PM

Sensing Applications

Session Chair: **Anna G. Mignani,**
Istituto di Fisica Applicata Nello Carrara (Italy)

4:00 pm: **LPG humidity sensor using double overlay**, R. S. Kaler, Thapar Univ. (India); Nidhi Chandel, Central Scientific Instruments Organisation (India) and Thapar Univ. (India); Pawan Kapur, Central Scientific Instruments Organisation (India). . . . . [9106-13]

4:20 pm: **Polarization resolved angular optical scattering of aerosol particles**, Brandon Redding, Yale Univ. (USA); Yongle Pan, U.S. Army Research Lab. (USA); Hui Cao, Yale Univ. (USA) . . . . . [9106-14]

4:40 pm: **Near-infrared spectroscopy and pattern-recognition processing for classifying wines of two Italian provinces**, Anna G. Mignani, Leonardo Ciaccheri, Istituto di Fisica Applicata Nello Carrara (Italy); Belén Gordillo, Univ. de Sevilla (Spain); Andrea A. Mencaglia, Istituto di Fisica Applicata Nello Carrara (Italy); Lourdes González Miret Martín, Francisco J. Heredia Mira, Univ. de Sevilla (Spain); Angelo Cichelli, Univ. degli Studi G. d'Annunzio (Italy). . [9106-15]

CONFERENCE 9106

LOCATION: CONV. CTR. ROOM 335 & ROOM 336

TUESDAY 6 MAY

SESSION 5

LOCATION: CONV. CTR. ROOM 335 . . . TUE 8:50 AM TO 10:10 AM

Sensor System Development

Session Chair: **Robert A. Lieberman,** Intelligent Optical Systems, Inc. (USA)

8:50 am: **Microfluidics for analytical applications: from etching to 3D printing**, R. Shatford, S. Eshaque, Vassili Karanassios, Univ. of Waterloo (Canada) . . . . . [9106-16]

9:10 am: **Temperature-stable low-power ring oscillator design for ASIC applications**, Hossein Jafarian, Ali Daneshkhah, Sudhir Shrestha, Mangilal Agarwal, Maher E. Rizkalla, Kody Varahramyan, Indiana Univ.-Purdue Univ. Indianapolis (USA) . . . . . [9106-17]

9:30 am: **Fabrication of D-type fiber optic sensors with a long interaction length and studying effects of critical parameters on sensor response**, Burcu Guleryuz, TÜBITAK Marmara Research Ctr. (Turkey) and Middle East Technical Univ. (Turkey); Caner Durucan, Middle East Technical Univ. (Turkey); Mustafa M. Aslan, TÜBITAK Marmara Research Ctr. (Turkey) . . . . . [9106-18]

9:50 am: **On-chip plasmonic interferometer array for portable multiplexed biosensing system**, Xie Zeng, Dengxin Ji, Nan Zhang, Haomin Song, Qiaoqiang Gan, Univ. at Buffalo (USA) . . . . . [9106-19]

Coffee Break . . . . . Tue 10:10 am to 10:50 am

SESSION 6

LOCATION: CONV. CTR. ROOM 335 . . TUE 10:50 AM TO 12:10 PM

Methods and Algorithms for Sensing

Session Chair: **Robert A. Lieberman,** Intelligent Optical Systems, Inc. (USA)

10:50 am: **Remote sensing modeling framework written in JavaScript language for interactive line-by-line transmission and lidar calculations using the HITRAN database**, Denis V. Pliutau, Consultant (USA) . . . . [9106-20]

11:10 am: **Optical characterization of nanoporous anodic alumina sensor substrate**, Aschalew Kassu, Carlton W. Farley III, Anup Sharma, Alabama A&M Univ. (USA) . . . . . [9106-21]

11:30 am: **Path Optimization For Oil Probe**, Anthony O. Smith, Mark D. Rahmes, Mark Blue, Harris Corp. (USA); Adrian Peter, Florida Institute of Technology (USA) . . . . . [9106-22]

11:50 am: **Cloud droplet number concentration observed over ocean from CALIOP/CALIPSO and MODIS/AQUA**, Shan Zeng, Oak Ridge Associated Universities (USA) and NASA Langley Research Ctr. (USA); Charles R. Trepte, Yong-Xiang Hu, David M. Winker, Lusheng Liang, NASA Langley Research Ctr. (USA) . . . . . [9106-28]

POSTERS-TUESDAY

LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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.

Optimal RS-measurements plan strengthening lab-measured information in coherent modes of nonlinear synergetic system, Galib G. Huseynov, Ivy Tech Community College (USA) and Northern Virginia Community College (USA) . . . . . [9106-23]

Humidity sensor based on zinc (II) oxide-titanium (II) oxide nanocomposite, Karunesh Tiwari, BBDNITM Lucknow (India); N. K. Pandey II, Lucknow Univ. (India) . . . . . [9106-24]

Analytical solution using computer algebra of a biosensor for detecting toxic substances in water, María Isabel Rua Taborda, EAFIT Univ. (Colombia) . . . . . [9106-27]

FRIDAY 9 MAY

SESSION 7

LOCATION: CONV. CTR. ROOM 336 . . . . FRI 2:00 PM TO 3:00 PM

NOTE ROOM CHANGE

Micro/Nanotechnologies for Lasers and Standoff Detection I

Joint Session with Conferences 9083/9073/9106

Session Chair: **Michael K. Rafailov,** Univ. of Alberta (Canada)

2:00 pm: **Re-engineering defense and homeland security applications using MWIR and LWIR QCLs** *(Keynote Presentation)*, C. Kumar N. Patel, Pranalytica, Inc. (USA) . . . . . [9083-90]

2:20 pm: **Ultrafast laser bleaching technique for stand-off characterization and augmentation** *(Invited Paper)*, Inna Zakharova, Univ. of Alberta (Canada) and Volyn State Univ. (Ukraine) . . . . . [9083-91]

2:40 pm: **Approaches to generation of tunable mid-IR ultrafast pulses with fiber sources** *(Invited Paper)*, Igor Pastirk, TOPTICA Photonics Inc. (USA); Andreas Brodschelm, Alexander Sell, TOPTICA Photonics AG (Germany) . . . . . [9083-92]

Coffee Break . . . . . Fri 3:00 pm to 3:30 pm

SESSION 8

LOCATION: CONV. CTR. ROOM 336 . . . . . FRI 3:30 PM TO 5:10 PM

NOTE ROOM CHANGE

Micro/Nanotechnologies for Lasers and Standoff Detection II

Joint Session with Conferences 9083/9073/9106

Session Chair: **Michael K. Rafailov,** Univ. of Alberta (Canada)

3:30 pm: **Ultrafast fiber lasers: practical applications** *(Invited Paper)*, Igor Pastirk, TOPTICA Photonics Inc. (USA) . . . . . [9083-93]

3:50 pm: **Standoff laser photoacoustic spectroscopic-based sensor for remote sensing** *(Invited Paper)*, Ramesh C. Sharma, Anil K. Maini, Laser Science and Technology Ctr. (India) . . . . . [9083-94]

4:10 pm: **A mobile platform for infrared photothermal imaging of trace explosives** *(Invited Paper)*, Christopher A. Kendziora, Robert Furstenberg, Michael R. Papantonakis, Viet Nguyen, Jeff M. Byers, R. Andrew McGill, U.S. Naval Research Lab. (USA) . . . . . [9083-95]

4:30 pm: **Point and standoff detection of trace explosives using quantum cascade lasers** *(Invited Paper)*, Seonghwan Kim, Univ. of Calgary (Canada); Dongkyu Lee, Xunchen Liu, Charles W. Van Neste, Thomas G. Thundat, Univ. of Alberta (Canada) . . . . . [9083-96]

4:50 pm: **Recent advances in quantum cascade external cavity laser systems for sensing applications** *(Invited Paper)*, Leigh J. Bromley, David B. Arnone, David B. Caffey, William B. Chapman, Sam Crivello, Timothy Day, Allen Priest, Michael Pushkarsky, Daylight Solutions Inc. (USA); Charles C. Harb, The Univ. of New South Wales (Australia) . . . . . [9083-97]

CONFERENCE 9107

LOCATION: CONV. CTR. ROOM 345

Wednesday - Friday 7 - 9 May 2014 • Proceedings of SPIE Vol. 9107

Smart Biomedical and Physiological Sensor Technology XI

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); **Christopher Anton,** Episensors, Inc. (USA); **Karl S. Booksh,** Univ. of Delaware (USA); **Jonathan C. Claussen,** U.S. Naval Research Lab. (USA); **Amethist S. Finch,** U.S. Army Research Lab. (USA); **Claudia Gärtner,** microfluidic ChipShop GmbH (Germany); **Christopher D. Geddes,** Univ. of Maryland, Baltimore (USA); **Ilko K. Ilev,** U.S. Food and Drug Administration (USA); **Douglas Kiehl,** Eli Lilly and Co. (USA); **Nicole Y. Morgan,** NIBIB/National Institutes of Health (USA); **T. Joshua Pfefer,** U.S. Food and Drug Administration (USA); **Marcin Ptaszek,** Univ. of Maryland, Baltimore County (USA); **Noriko Satake,** UC Davis Medical Ctr. (USA); **Shiv K. Sharma,** Univ. of Hawai'i (USA); **Narsingh B. Singh,** Univ. of Maryland, Baltimore County (USA); **Ryan J. White,** Univ. of Maryland, Baltimore County (USA)

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

SESSION 1

LOCATION: CONV. CTR. ROOM 345 . WED 10:30 AM TO 11:50 AM

Advances in Fiber Optic Sensing for Biomedical Applications

Session Chairs: **Ilko K. Ilev,** U.S. Food and Drug Administration (USA); **Brian M. Cullum,** Univ. of Maryland, Baltimore County (USA)

10:30 am: **Confocal laser method (CLM) for multiparameter sensing and quantitative evaluation of optical properties of intraocular lens (IOL) implants**, Bennett N. Walker, Robert H. James, Don Calogero, Ilko K. Ilev, U.S. Food and Drug Administration (USA) . . . . . [9107-1]

10:50 am: **Novel fiber optic Fourier transform infrared (FO-FTIR) spectroscopy platforms for label-free remote sensing of biochemical contamination**, Moinuddin Hassan, Ilko K. Ilev, U.S. Food and Drug Administration (USA) . . . . . [9107-2]

11:10 am: **High resolution optical fibre pressure and temperature sensor for medical usage in cardiovascular and in-vivo urodynamic measurements**, Sven Poeggel, Daniele Tosi, Univ. of Limerick (Ireland); Simone Sannino, Laura Lupoli, Univ. degli Studi di Napoli Federico II (Italy); Dinesh Babu Duraibabu, Univ. of Limerick (Ireland); Fernando Fusco, Juliet Ippolito, Vincenzo Mirone, Univ. degli Studi di Napoli Federico II (Italy); Gabriel Leen, Elfed Lewis, Univ. of Limerick (Ireland) . . . . . [9107-4]

11:30 am: **Multifunction medical endoscope system with optical fiber temperature sensor**, Zhengquan He, Yulin Li, Depeng Kong, Xi'an Institute of Optics and Precision Mechanics (China) . . . . . [9107-5]

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

SESSION 2

LOCATION: CONV. CTR. ROOM 345 . . . WED 1:40 PM TO 3:20 PM

Raman/SERS for Biomedical Sensing

Session Chairs: **Brian M. Cullum,** Univ. of Maryland, Baltimore County (USA); **Shiv K. Sharma,** Univ. of Hawai'i (USA)

1:40 pm: **Towards a portable ultrahigh resolution SERS imaging system**, Eric R. Languirand, John Kiser, Brian Cullum, Univ. of Maryland, Baltimore County (USA). . . . . [9107-6]

2:00 pm: **Noninvasive label-free and real-time sensing of hydrogen peroxide in human brain cancer cells through Raman spectroscopy**, Darrell B. Tata, U.S. Food and Drug Administration (USA) . . . . . [9107-7]

2:20 pm: **Characterization of ultrathin oxide based multilayer SERS nanoprobes for intracellular sensing**, Pietro Strobbia, Adam Mayer, Charles Klutse, Brian Cullum, Univ. of Maryland, Baltimore County (USA) . . . . . [9107-8]

2:40 pm: **Detection of illicit drugs in impaired driver saliva using a field-usable SERS analyzer**, Stuart R. Farquharson, Chetan S. Shende, Hermes Huang, Real-Time Analyzers, Inc. (USA) . . . . . [9107-9]

3:00 pm: **Rapid detection of Pseudomonas aeruginosa biomarkers in biological fluids using surface-enhanced Raman scattering**, Xiaomeng Wu, Jing Chen, The Univ. of Georgia (USA); Susu M. Zughaier, Emory Univ. (USA); Yiping Zhao, The Univ. of Georgia (USA) . . . . . [9107-10]

Coffee Break . . . . . .Wed 3:20 pm to 3:50 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 345 . . . WED 3:50 PM TO 5:30 PM

Imaging for Biomedical Applications

Session Chairs: **Narsingh B. Singh,** Univ. of Maryland, Baltimore County (USA); **Brian Cullum,** Univ. of Maryland, Baltimore County (USA)

3:50 pm: **Determining hearing loss due to perforation in the tympanic membrane using image processing techniques**, Neha R. Sardesai, Univ. of Maryland, Baltimore County (USA); Ravindra B. Sardesai, Jehangir Hospital (India); Chein-I Chang, Univ. of Maryland, Baltimore County (USA) . . . . [9107-11]

4:10 pm: **Quantitative analysis of low contrast detectability in optical coherence tomography using spin-coated phantoms**, Nicholas J. Woolsey, Hsing-Wen Wang, Univ. of Maryland, College Park (USA) and U.S. Food and Drug Administration (USA); Anant Agrawal, U.S. Food and Drug Administration (USA); Jianting Wang, Univ. of Maryland, College Park (USA) and U.S. Food and Drug Administration (USA); Chia-Pin Liang, Yu Chen, Univ. of Maryland, College Park (USA); T. Joshua Pfefer, U.S. Food and Drug Administration (USA) . . . . . [9107-12]

4:30 pm: **Contrast-detail and penetration depth phantoms for hyperspectral reflectance imaging**, Jianting Wang, Univ. of Maryland, College Park (USA); James Coburn, U.S. Food and Drug Administration (USA); Chia-Pin Liang, Nicholas J. Woolsey, Univ. of Maryland, College Park (USA); Jessica C. Ramella-Roman, The Catholic Univ. of America (USA); Yu Chen, Univ. of Maryland, College Park (USA); T. Joshua Pfefer, U.S. Food and Drug Administration (USA) . . . . . [9107-13]

4:50 pm: **Effect of surface texture to the biofilm attachment on medical device surfaces studied by hyperspectral imaging**, Hanh N. D. Le, Victoria M. Hitchins, Ilko K. Ilev, Do-Hyun Kim, U.S. Food and Drug Administration (USA) . . . . . [9107-14]

5:10 pm: **Use of high dynamic range technique for hyperspectral imaging for surgical applications**, Maritoni Litorja, National Institute of Standards and Technology (USA) . . . . . [9107-15]

THURSDAY 8 MAY

SESSION 4
LOCATION: CONV. CTR. ROOM 345 . . THU 8:00 AM TO 10:00 AM

Micro/Nanofluidic for Biomedical Sensing and Treatment

Session Chairs: **Douglas Kiehl,** Eli Lilly and Co. (USA); **Claudia Gärtner,** microfluidic ChipShop GmbH (Germany)

8:00 am: **Rapid biofluid analysis using paper-based devices and mass spectrometry**, Justin M. Wiseman, Prosolia, Inc. (USA); Nicholas E. Manicke, Purdue Univ. (USA) . . . . . [9107-16]

8:20 am: **Transient flow with memory in a nanocapillar**, Mateo Pineda Osorio, Univ. EAFIT (Colombia) . . . . . [9107-17]

8:40 am: **Characteristic impedance of a micro-capillar with two immiscible microfluids**, Daniela Jaramillo Raquejo, Univ. EAFIT (Colombia). . . . . [9107-18]

9:00 am: **Microfluidic preparation of radiopharmaceuticals for use in imaging studies**, Thomas L. Collier, Advion, Inc. (USA) . . . . . [9107-19]

9:20 am: **Generalized electroosmosis transport with a spatially modulated electric permittivity inside a cylindrical micro channel**, Juan José Cadavid Muñoz, Univ. EAFIT (Colombia). . . . . [9107-20]

9:40 am: **Nanofluidic structures for coupled sensing and remediation of toxins**, Kayla Shaw, Nicholas M. Contento, Univ. of Notre Dame (USA); Wei Xu, University of Notre Dame (USA); Paul W. Bohn, Univ. of Notre Dame (USA) . . . . . [9107-21]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

SESSION 5
LOCATION: CONV. CTR. ROOM 345 . . THU 10:30 AM TO 12:30 PM

Lab-on-a-Chip Technologies for Biosensing Applications

Session Chairs: **Claudia Gärtner,** microfluidic ChipShop GmbH (Germany); **Douglas Kiehl,** Eli Lilly and Co. (USA)

10:30 am: **Thermal effects in microfluidics with thermal conductivity spatially modulated**, Agustín Vargas Toro, Univ. EAFIT (Colombia) . . . [9107-22]

10:50 am: **Using Lambert W function and error function to model phase change on microfluidics**, Anderson Bermudez Garcia, Univ. EAFIT (Colombia) . . . . . [9107-23]

11:10 am: **Lab-on-a-chip PCR: real time PCR in miniaturized format for HLA diagnostics**, Claudia Gärtner, Holger Becker, Nadine Hlawatsch, Richard Klemm, René Sewart, Christian Moche, microfluidic ChipShop GmbH (Germany); Rainer Frank, Andreas Willems, inno-train Diagnostik GmbH (Germany) . . . . . [9107-24]

11:30 am: **Fluorescence detection in a lab-on-a-chip system using ultrafast nucleic acid amplification methods**, Rainer Gransee, Ralf Himmelreich, Julian Hoeth, Institut für Mikrotechnik Mainz GmbH (Germany) . . . . . [9107-25]

11:50 am: **Microsystem integrated immunosensor for the detection of the bioterrorist agent Francisella tularensis**, Samuel Dulay, Univ. Rovira i Virgili (Spain); Sandra Julich, Herbert Tomasso, Friedrich-Loeffler-Institut (Germany); Sebastian Schattschneider, Claudia Gärtner, microfluidic ChipShop GmbH (Germany); Rainer Gransee, Institut für Mikrotechnik Mainz GmbH (Germany); Ciara K. O'Sullivan, Univ. Rovira i Virgili (Spain) . . . . . [9107-26]

12:10 pm: **Lab-on-a-chip modules for detection of highly pathogenic bacteria: from sample preparation to detection**, Sandra Julich, Friedrich-Loeffler-Institut (Germany); Rok Kopinc, Institute of Microbial Sciences and Technologies (Slovenia); Nadine Hlawatsch, Richard Klemm, Christian Moche, microfluidic ChipShop GmbH (Germany); Ales Lapanje, Institute of Microbial Sciences and Technologies (Slovenia); Claudia Gärtner, microfluidic ChipShop GmbH (Germany); Herbert Tomaso, Friedrich-Loeffler-Institut (Germany) . . . . . [9107-27]

Lunch Break . . . . . Thu 12:30 pm to 1:40 pm

SESSION 6
LOCATION: CONV. CTR. ROOM 345 . . . . THU 1:40 PM TO 3:00 PM

Advances in Electrochemical Biosensing Materials and Devices

Session Chairs: **Ryan J. White,** Univ. of Maryland, Baltimore County (USA); **Eric S. McLamore,** Univ. of Florida (USA)

1:40 pm: **Multiplexed molecular detection of bioterrorist agents using microsystem integrated electrochemical genosensor array**, Samuel Dulay, Univ. Rovira i Virgili (Spain); Sandra Julich, Herbert Tomasso, Friedrich-Loeffler-Institut (Germany); Sebastian Schattschneider, Claudia Gärtner, microfluidic ChipShop GmbH (Germany); Rainer Gransee, Institut für Mikrotechnik Mainz GmbH (Germany); Ciara K. O'Sullivan, Univ. Rovira i Virgili (Spain) . . . . [9107-28]

2:00 pm: **A pulsed sonoelectrodeposition technique for controlling nanomaterial structure in biosensing**, Masashige Taguchi, Nate Garland, Neil Schwalb, Diana C. Vanegas-Gamboa, Stephanie L. Burrs, Eric S. McLamore, Univ. of Florida (USA) . . . . . [9107-29]

2:20 pm: **Zinc oxide nanostructures for electrochemical cortisol biosensing**, Phani Kiran Vabbina, Ajeet Kaushik, Nezih Pala, Shekhar Bhansali, Florida International Univ. (USA) . . . . . [9107-30]

2:40 pm: **Real-time monitoring of food threats** , Diana C. Vanegas-Gamboa, Univ. of Florida (USA) and Univ. del Valle (Colombia); Eric S. McLamore, Univ. of Florida (USA) . . . . . [9107-31]

Coffee Break . . . . . Thu 3:00 pm to 3:20 pm

SESSION 7
LOCATION: CONV. CTR. ROOM 336 . . . . THU 3:20 PM TO 5:50 PM

NOTE ROOM CHANGE

Innovations in Multimodal Molecular Probes

Joint Session with Conferences 9083 and 9107

Session Chairs: **Antonio Sastre,** National Institutes of Health (USA); **Richard Conroy,** National Institutes of Health (USA)

3:20 pm: **The era of nanomedicine: perspectives and potential applications in oncology** *(Keynote Presentation)*, Samuel Achilefu, Washington Univ. School of Medicine in St. Louis (USA). . . . . [9083-74]

3:50 pm: **Clinically-translated ultra-small silica nanoparticles for cancer-targeted imaging** *(Invited Paper)*, Michelle S. Bradbury, Pat B. Zanzonico, Snehal Patel, Richard Carvajal, Steven M. Larson, Memorial Sloan-Kettering Cancer Ctr. (USA); Ulrich B. Wiesner, Cornell Univ. (USA) . . . . . [9083-75]

4:10 pm: **Bimodal imaging probes: design and applications** *(Invited Paper)*, Peter Caravan, Massachusetts General Hospital (USA) . . . . . [9083-76]

4:30 pm: **Quantitative simultaneous PET-MR imaging** *(Invited Paper)*, Georges El Fakhri, Massachusetts General Hospital (USA) . . . . . [9083-77]

4:50 pm: **Translational molecular imaging in oncology** *(Invited Paper)*, Sridhar Nimmagadda, Johns Hopkins Univ. (USA) . . . . . [9083-78]

5:10 pm: **18F-PET/fluorescent multimodality imaging and an 18F-analogue to the 99mTc generator for solid-phase 18F-PET/fluorescent antibody generation** *(Invited Paper)*, Richard Ting, Univ. of California, San Diego (USA) . . . . . [9083-79]

5:30 pm: **Ultrasound-switchable fluorescence at near-infrared wavelength for deep-tissue high-resolution imaging** *(Invited Paper)*, Baohong Yuan, Mingyuan Wei, Yanbo Pei, Yuan Liu, Zhiwei Xie, Bingbing Cheng, Kytai T. Nguyen, The Univ. of Texas at Arlington (USA). . . . . [9083-80]

FRIDAY 9 MAY

SESSION 8
LOCATION: CONV. CTR. ROOM 345 . . . FRI 8:00 AM TO 10:10 AM

Advances in Luminescent Biosensing and Biomolecular Logic

Session Chairs: **Jonathan C. Claussen,** U.S. Naval Research Lab. (USA); **Amethist S. Finch,** U.S. Army Research Lab. (USA)

8:00 am: **Sensing more with less: new strategies for assays with quantum dots** *(Invited Paper)*, W. Russ Algar, Eleonora Petryayeva, Miao Wu, Hyungki Kim, Cheryl Y. W. Ng, Erin Conroy, Melissa Massey, The Univ. of British Columbia (Canada) . . . . . [9107-32]

8:30 am: **Optical nanosystems for biomolecular recognition and reaction kinetics studies** *(Invited Paper)*, Jong Hyun Choi, Purdue Univ. (USA) . [9107-33]

9:00 am: **DNA-based switching using fluorescence resonance energy transfer** *(Invited Paper)*, Susan Buckhout-White, Ellen R. Goldman, Jonathan C. Claussen, Mario G. Ancona, Igor L. Medintz, U.S. Naval Research Lab. (USA) . . . . . [9107-34]

9:20 am: **Biomolecular logic systems: applications to biosensors and bioactuators** *(Invited Paper)*, Evgeny Katz, Clarkson Univ. (USA) . . . . . [9107-35]

9:50 am: **Creating bionanophotonic logic devices and monitoring enzyme kinetics with quantum dot bioconjugates** *(Invited Paper)*, Jonathan C. Claussen, U.S. Naval Research Lab. (USA); Niko Hildebrandt, Institut d'Électronique Fondamentale (France); Kimihiro Susumu, Mario G. Ancona, Igor L. Medintz, U.S. Naval Research Lab. (USA) . . . . . [9107-36]

Coffee Break . . . . . Fri 10:10 am to 10:30 am

SESSION 9
LOCATION: CONV. CTR. ROOM 345 . . . FRI 10:30 AM TO 11:50 AM

Advanced Smart Materials for Potential Biosensing/Bioimaging Applications

Session Chairs: **Amethist S. Finch,** U.S. Army Research Lab. (USA); **Jonathan C. Claussen,** U.S. Naval Research Lab. (USA)

10:30 am: **Peptide-based protein capture agents with high affinity, selectivity, and stability as antibody replacements in biodetection assays**, Matthew B. Coppock, U.S. Army Research Lab. (USA); Blake Farrow, California Institute of Technology (USA); Amethist S. Finch, U.S. Army Research Lab. (USA); Bert Lai, Indi Molecular (USA); Deborah A. Sarkes, U.S. Army Research Lab. (USA); James R. Heath, California Institute of Technology (USA); Dimitra N. Stratis-Cullum, U.S. Army Research Lab. (USA). . . . . [9107-37]

10:50 am: **PPy/PMMA/PEG-based sensor for low-concentration acetone detection**, Ali Daneshkhah, Sudhir Shrestha, Mangilal Agarwal, Kody Varahramyan, Indiana Univ.-Purdue Univ. Indianapolis (USA) . . . . . [9107-38]

11:10 am: **Design of LWIR crystal and AOTF for compositional analysis of asteroid**, Narsingh B. Singh, Bradley Arnold, L. D. Topoleski, Ronghui Ma, Brian Cullum, Univ. of Maryland, Baltimore County (USA); Narasimha S. Prasad, NASA Langley Research Ctr. (USA); Dennis Suhre, Milton Gottlieb, DRS Scientific Inc. (USA) . . . . . [9107-39]

11:30 am: **Physical vapor transport growth of lead tin selenide for MWIR detectors**, Narsingh B. Singh, Univ. of Maryland, Baltimore County (USA); Narasimha S. Prasad, NASA Langley Research Ctr. (USA); Philip DiPaula, Pietro Strobbia, Bradley Arnold, Lisa Kelly, Brian Cullum, Univ. of Maryland, Baltimore County (USA). . . . . [9107-40]

Lunch Break . . . . . Fri 11:50 am to 1:20 pm

SESSION 10
LOCATION: CONV. CTR. ROOM 345 . . . . . FRI 1:20 PM TO 2:20 PM

Biosensing and Therapy for the Central Nervous System

Session Chairs: **Noriko Satake,** UC Davis Medical Ctr. (USA); **Eric S. McLamore,** Univ. of Florida (USA)

1:20 pm: **Low-power MEMS acceleration sensors for mild-TBI early warning**, Ryan R. Knight, David Lunking, Brian Isaacson, U.S. Army Research Lab. (USA); Larry Thomas, TechniMagic, Inc. (USA); Christopher J. Morris, Luke J. Currano, U.S. Army Research Lab. (USA). . . . . [9107-41]

1:40 pm: **Control channels in the brain and their influence on brain executive functions**, Qinglei Meng, Fow-Sen Choa, Univ. of Maryland, Baltimore County (USA); Elliot Hong, Univ. of Maryland School of Medicine (USA); Zhiguang Wang, Mohammad Islam, Univ. of Maryland, Baltimore County (USA) . . . . . [9107-42]

2:00 pm: **Rehabilitation and motor learning through vibrotactile feedback**, Roshan Panchanathan, Univ. of California, Berkeley (USA); Jacob Rosenthal, HeatSync Labs. (USA); Troy McDaniel, Arizona State Univ. (USA). . . . . [9107-43]

SESSION 11
LOCATION: CONV. CTR. ROOM 345 . . . . FRI 2:20 PM TO 3:40 PM

Optical Biopsy and Photoacoustic Sensing/Bioimaging

Session Chairs: **Joshua Pfefer,** U.S. Food and Drug Administration (USA); **Brian M. Cullum,** Univ. of Maryland, Baltimore County (USA)

2:20 pm: **Dynamic tissue phantoms and their use in assessment of a non-invasive optical plethysmography imaging device**, Jeffrey E. Thatcher, Kevin D. Plant, Darlene King, Spectral MD™ (USA); Ken Block, Ken Block Consulting (USA); Wensheng Fan, J. Michael DiMaio, Spectral MD™ (USA) . . . . . [9107-44]

2:40 pm: **Characterization of tissue-simulating polymers for photoacoustic vascular imaging**, William C. Vogt, T. Joshua Pfefer, U.S. Food and Drug Administration (USA) . . . . . [9107-45]

3:00 pm: **Characterization of endogenous species in tissues using non-resonant multiphoton photoacoustic spectroscopy**, Sudhir Dahal, Univ. of Maryland, Baltimore County (USA) . . . . . [9107-46]

3:20 pm: **High-resolution all-optical photo acoustic imaging system for remote interrogation of biological specimens**, Ashwin Sampathkumar, Riverside Research Institute (USA) . . . . . [9107-47]

Coffee Break . . . . . Fri 3:40 pm to 4:00 pm

SESSION 12
LOCATION: CONV. CTR. ROOM 345 . . . . FRI 4:00 PM TO 5:20 PM

Modeling Drug Delivery Approaches

Session Chairs: **Eric S. McLamore,** Univ. of Florida (USA); **Douglas Kiehl,** Eli Lilly and Co. (USA)

4:00 pm: **Analytical solution for the diffusion model of transdermal patches**, Felipe Diaz Jaramillo, Univ. EAFIT (Colombia) . . . . . [9107-50]

4:20 pm: **Spherical drug delivery device with a radial modulated difussivity with lateral discharge through a thin ring**, Natalia A. Gutierrez, Univ. EAFIT (Colombia) . . . . . [9107-48]

4:40 pm: **Analytical solution of a model for shrinking and expanding drug-loaded microspheres**, Daniela D. B. M. Bolaños Marin, Univ. EAFIT (Colombia) . . . . . [9107-49]

5:00 pm: **Drug diffusion in a stratum corneum with diffusivity spatially modulated**, Isabel Montoya Arroyave, Univ. EAFIT (Colombia) . . . . . [9107-51]

CONFERENCE 9108

LOCATION: CONV. CTR. ROOM 315

Tuesday - Wednesday 6 - 7 May 2014 • Proceedings of SPIE Vol. 9108

Sensing for Agriculture and Food Quality and Safety VI

Conference Chairs: **Moon S. Kim,** USDA Agricultural Research Service (USA); **Kuanglin Chao,** USDA Agricultural Research Service (USA)

Program Committee: **Arun K. Bhunia,** Ctr. for Food Safety Engineering, Purdue Univ. (USA); **Suming Chen,** National Taiwan Univ. (Taiwan); **Bryan A. 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 Agricultural Science (Korea, Republic of); **Alan M. Lefcourt,** USDA Agricultural Research Service (USA); **Changying (Charlie) Li,** The Univ. of Georgia (USA); **Renfu Lu,** USDA Agricultural Research Service (USA); **Bosoon Park,** USDA Agricultural Research Service (USA); **Yang Tao,** Univ. of Maryland, College Park (USA); **Yankun Peng,** China Agricultural Univ. (China); **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 6 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 315 . . . . . TUE 1:40 PM TO 3:00 PM

Biosensors for Pathogen Detection

Session Chair: **Bryan A. Chin,** Auburn Univ. (USA)

1:40 pm: **Effects of food surface topography on phage-based magnetoelastic biosensor detection**, Shin Horikawa, Yating Chai, Ruiting Zhao, Howard C. Wikle III, Bryan A. Chin, Auburn Univ. (USA) . . . . . [9108-8]

2:00 pm: **Real-time bacteria detection on fresh food surfaces with a microfabricated coil detector and magnetoelastic biosensors**, Yating Chai, Shin Horikawa, Howard C. Wikle III, Ruiting Zhao, Bryan A. Chin, Auburn Univ. (USA) . . . . . [9108-9]

2:20 pm: **Pulsed excitation system to measure the resonant frequency of magnetoelastic biosensors**, Hong Xie, Yating Chai, Shin Horikawa, Howard C. Wikle III, Bryan A. Chin, Auburn Univ. (USA). . . . . [9108-10]

2:40 pm: **Self-propelled, phage-based magnetoelastic biosentinels for detection of pathogens in liquid**, Ruiting Zhao, Yating Chai, Shin Horikawa, Howard C. Wikle III, Bryan A. Chin, Auburn Univ. (USA). . . . . [9108-18]

POSTERS-TUESDAY

LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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 of UVA and violet LED excitation lighting system for hyperspectral fluorescence line-scan imaging, Hoyoung Lee, Moon S. Kim, Agricultural Research Service (USA); Colm D. Everard, Univ. College Dublin (Ireland); Jong-Guk Lim, National Academy of Agricultural Science (Korea, Republic of) . . . . . [9108-16]

Lock-in phase imaging of near/mid infrared signals for the detection of bruise on fruit, Ghiseok Kim, Geonhee Kim, Korea Basic Science Institute (Korea, Republic of); Dae Yong Kim, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of) . . . . . [9108-24]

Analytical model of contamination during the drying of cylinders of jamonable muscle, Isabel Montoya Arroyave, Univ. EAFIT (Colombia) . [9108-1]

A model of freezing foods with liquid nitrogen using special functions, Martin Rodriguez, Univ. EAFIT (Colombia) . . . . . [9108-5]

An analytically resolved model of a potato's thermal processing using Heun functions, Agustín Vargas Toro, Univ. EAFIT (Colombia). . . . . [9108-6]

Mathematical model for solar drying of potato cylinders with thermal conductivity radially modulated , Mariana Trujillo Arredondo, Universidad EAFIT (Colombia). . . . . [9108-7]

Rapid detection of chlorpyrifos pesticide residue concentration in agro-product using Raman spectroscopy, Sagar Dhakal, Yongyu Li, Yankun Peng, Leilei Zhang, Tianfeng Xu, China Agricultural Univ. (China) . . . . . [9108-11]

A portable detection instrument based on DSP for beef marbling, Tong Zhou, Yankun Peng, China Agricultural Univ. (China) . . . . . [9108-12]

A portable device for rapid nondestructive detection of meat quality attributes, Wan Lin, Yankun Peng, China Agricultural Univ. (China); Caiping Wang, Xinjiang Yurun Co. (China) . . . . . [9108-13]

Nondestructive detection of fresh pork comprehensive quality based on spectroscopy and support vector machine, Yuanyuan Liu, Yankun Peng, Leilei Zhang, Sagar Dhakal, China Agricultural Univ. (China) . . . . . [9108-14]

Detection of the total viable counts in chicken based on visible/near-infrared spectroscopy, Xiuying Tang, Yuan Long, Yankun Peng, Linlin Zhao, China Agricultural Univ. (China). . . . . [9108-23]

Online measurement of sugar content of cherry tomato using VIS/NIR spectrometer, Hong-Suck Lee, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of). . . . . [9108-28]

Evaluation of food freshness by surface acoustic wave sensor, Ki-Bok Kim, Korea Research Institute of Standards and Science (Korea, Republic of); Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of); Byounggab Lim, Master Korea Co., Ltd (Korea, Republic of) . . . . . [9108-31]

A hyperspectral imaging (HSI)-based approach for bio-digestate real time monitoring, Giuseppe Bonifazi, Silvia Serranti, Andrea Fabbri, Univ. degli Studi di Roma La Sapienza (Italy). . . . . [9108-4]

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

SESSION 2
LOCATION: CONV. CTR. ROOM 315 . . WED 10:30 AM TO 12:00 PM

Hyperspectral Imaging

Session Chair: **Jianwei Qin,** Agricultural Research Service (USA)

10:30 am: **Calibrations transfer method for use with multiple hyperspectral imaging systems** *(Invited Paper)*, Kurt C. Lawrence, William R. Windham, Seung-Chul Yoon, Bosoon Park, Agricultural Research Service (USA) . [9108-29]

11:00 am: **Development of algorithms for senescence and quality detection on fluorescence images of peppers**, Carlos Esquerre, Univ. College Dublin (Ireland) and Agricultural Research Service (USA); John R. Stommel, Agricultural Research Service (USA); Colm P. O'Donnell, Univ. College Dublin (Ireland); Moon S. Kim, Stephen R. Delwiche, Agricultural Research Service (USA) . . . . . [9108-19]

11:20 am: **Spectral imaging analysis for determination of viability of vegetable seeds**, Hyungjin Bae, Chungnam National Univ. (Korea, Republic of); Moon S. Kim, USDA Agricultural Research Service (USA); Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of). . . . . [9108-27]

11:40 am: **Hyperspectral imaging for unified safety inspection of poultry carcasses**, Seung-Chul Yoon, Bosoon Park, Kurt C. Lawrence, William R. Windham, Kuanglin Chao, Chun-Chieh Yang, Moon S. Kim, Agricultural Research Service (USA) . . . . . [9108-20]

Lunch Break . . . . . .Wed 12:00 pm to 1:50 pm

SESSION 3
LOCATION: CONV. CTR. ROOM 315 . . . . . WED 1:50 PM TO 3:10 PM

Hyperspectral and Multispectral Imaging

Session Chair: **Seung-Chul Yoon,** Agricultural Research Service (USA)

1:50 pm: **Hyperspectral fluorescence imaging coupled with multivariate image analysis techniques for contaminant screening of leafy greens**, Colm D. Everard, Univ. College Dublin (Ireland); Moon S. Kim, Hoyoung Lee, Agricultural Research Service (USA). . . . . [9108-21]

2:10 pm: **Differentiating glyphosate resistant and glyphosate sensitive Italian ryegrass using hyperspectral imagery**, Matthew A. Lee, Yanbo Huang, Vijay K. Nandula, Krishna N. Reddy, Agricultural Research Service (USA). . . . . [9108-22]

2:30 pm: **Bidirectional reflectance distribution function features on different wheat geometry varieties**, Wenjiang Huang, Juan Zhao, Institute of Remote Sensing and Digital Earth (China); Juhua Luo, Nanjing Institute of Geography and Limnology (China). . . . . [9108-25]

2:50 pm: **Using NOAA/AVHRR based vegetation health indices and principal component regression method for estimation of Aman rice yield in Bangladesh.**, Mohammad Nizamuddin, Kawsar A. Akhand, Leonid Roytman, The City College of New York (USA); Felix Kogan, Mitch Goldberg, National Environmental Satellite, Data, and Information Service (USA) . . . . . [9108-15]

Coffee Break . . . . . .Wed 3:10 pm to 3:40 pm

SESSION 4
LOCATION: CONV. CTR. ROOM 315 . . . . WED 3:40 PM TO 5:00 PM

Raman Spectroscopy and Imaging

Session Chair: **Byoung-Kwan Cho,** Chungnam National Univ. (Korea, Republic of)

3:40 pm: **Raman and NIR imaging for food adulterant detection**, Moon S. Kim, Agricultural Research Service (USA) . . . . . [9108-32]

4:00 pm: **High-throughput Raman chemical imaging for evaluating food safety and quality**, Jianwei Qin, Kuanglin Chao, Moon S. Kim, Agricultural Research Service (USA) . . . . . [9108-17]

4:20 pm: **Detection of pathogens in food using a SERS-based assay in just a few hours**, Stuart R. Farquharson, Atanu Sengupta, Chetan S. Shende, Frank E. Inscore, Real-Time Analyzers, Inc. (USA); Jay F. Sperry, The Univ. of Rhode Island (USA) . . . . . [9108-26]

4:40 pm: **Temperature-dependent Raman spectroscopy**, Walter F. Schmidt, Moon S. Kim, Kuanglin Chao, Jianwei Qin, Hoyoung Lee, Julie K. Nguyen, Agricultural Research Service (USA) . . . . . [9108-30]

CONFERENCE 9109

LOCATION: CONV. CTR. ROOM 332 & ROOM 332

Wednesday - Friday 7 - 9 May 2014 • Proceedings of SPIE Vol. 9109

Compressive Sensing III

Conference Chair: **Fauzia Ahmad,** Villanova Univ. (USA)

Program Committee: **Gonzalo R. Arce,** Univ. of Delaware (USA); **Moeness G. Amin,** Villanova Univ. (USA); **Abdesselam Salim Bouzerdoum,** Univ. of Wollongong (Australia); **Matthew A. Herman,** InView Technology Corp. (USA); **Rabinder N. Madan,** Office of Naval Research (USA); **Eric L. Mokole,** U.S. Naval Research Lab. (USA); **Ram M. Narayanan,** The Pennsylvania State Univ. (USA); **Dimitris A. Pados,** Univ. at Buffalo (USA); **Athina P. Petropulu,** Rutgers, The State Univ. of New Jersey (USA); **Lei (Leslie) Ying,** Univ. at Buffalo (USA)

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

SESSION 1

LOCATION: CONV. CTR. ROOM 322 . . . WED 1:40 PM TO 3:20 PM

NOTE ROOM CHANGE

Compressive Sensing for Radar I

Joint Session with 9077 and 9109

Session Chair: **Lam H. Nguyen,** U.S. Army Research Lab. (USA)

1:40 pm: **SAR moving target imaging in complex scenes using sparse and low-rank decomposition**, Kang-Yu Ni, Shankar R. Rao, HRL Labs., LLC (USA) . . . . . [9077-50]

2:00 pm: **Lidar compressive sensing using chaotic waveform**, Berenice Verdin, Ricardo von Borries, The Univ. of Texas at El Paso (USA) . . . . . [9077-51]

2:20 pm: **Off-grid compressive sensing ultra-wideband radar imaging**, Shugao Xia, Delaware State Univ. (USA) . . . . . [9077-52]

2:40 pm: **Wideband aperture array using RF channelizers and massively-parallel digital 2D IIR filterbank**, Arindam Sengupta, Arjuna Madanayake, The Univ. of Akron (USA); Roberto Gómez-García, Univ. de Alcalá (Spain); Erik Engeberg, The Univ. of Akron (USA) . . . . . [9077-53]

3:00 pm: **Signal processing techniques for stepped frequency ultra-wideband radar**, Lam H. Nguyen, U.S. Army Research Lab. (USA) . . . [9077-54]

Coffee Break . . . . . .Wed 3:20 pm to 3:50 pm

SESSION 2

LOCATION: CONV. CTR. ROOM 322 . . . WED 3:50 PM TO 5:30 PM

NOTE ROOM CHANGE

Compressive Sensing for Radar II

Joint Session with 9077 and 9109

Session Chair: **Eric L. Mokole,** U.S. Naval Research Lab. (USA)

3:50 pm: **Multi-static passive SAR imaging based on Bayesian compressive sensing**, Qisong Wu, Yimin D. Zhang, Moeness G. Amin, Villanova Univ. (USA); Braham Himed, Air Force Research Lab. (USA) . . . . . [9109-1]

4:10 pm: **Multi-target compressive laser ranging**, Pushkar P. Pandit, Zeb Barber, W. Randall Babbitt, Jason Dahl, Montana State Univ. (USA). . . . [9109-2]

4:30 pm: **Sparsity-based ranging for dual-frequency radars**, Khodour Al Kadry, Moeness G. Amin, Fauzia Ahmad, Villanova Univ. (USA) . . . . . [9109-3]

4:50 pm: **Experimental results concerning compressive noise radar**, Mahesh C. Shastry, 3M Co. (USA); Ram M. Narayanan, The Pennsylvania State Univ. (USA); Muralidhar Rangaswamy, Air Force Research Lab. (USA). . . . . [9109-4]

5:10 pm: **Through-the-wall imaging using CS-MIMO radars**, Yao Yu, Rutgers, The State Univ. of New Jersey (USA); Fauzia Ahmad, Villanova Univ. (USA); Athina P. Petropulu, Rutgers, The State Univ. of New Jersey (USA); Moeness G. Amin, Villanova Univ. (USA). . . . . [9109-5]

THURSDAY 8 MAY

SESSION 3

LOCATION: CONV. CTR. ROOM 332 . . THU 8:00 AM TO 10:00 AM

NOTE ROOM CHANGE

Compressive Sensing Signal Processing

Session Chair: **Emre Ertin,** The Ohio State Univ. (USA)

8:00 am: **Asynchronous sampling and reconstruction of analog sparse signals**, Azime Can-Cimino, Ervin Sejdic, Luis F. Chaparro, Univ. of Pittsburgh (USA) . . . . . [9109-6]

8:20 am: **Multiple-window sparse reconstruction of FM signals from random observations**, Moeness G. Amin, Yimin D. Zhang, Branka Jokanovic, Villanova Univ. (USA). . . . . [9109-7]

8:40 am: **Noise SAR image reconstruction based on compressed sensing**, Zhijun G. Qiao, Yufeng Cao, The Univ. of Texas-Pan American (USA); Huihuang Zhao, Hengyang Normal Univ. (China) . . . . . [9109-8]

9:00 am: **Compressive sensing of direct sequence spread spectrum signals**, Feng Liu, Michael W. Marcellin, The Univ. of Arizona (USA); Nathan A. Goodman, The Univ. of Oklahoma (USA); Ali Bilgin, The Univ. of Arizona (USA) . . . . . [9109-9]

9:20 am: **Time-frequency kernel design for compressive sensing**, Branka Jokanovic, Moeness G. Amin, Yimin D. Zhang, Villanova Univ. (USA) . . . . . [9109-10]

9:40 am: **Using computer algebra to perform image compression with wavelet transform and SVD**, Felipe Diaz Jaramillo, Univ. EAFIT (Colombia) . . . . . [9109-11]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

SESSION 4
LOCATION: CONV. CTR. ROOM 332 . . THU 10:30 AM TO 11:50 AM

Compressive Sensing for Spectral Imaging, Optical Imaging, and Video I

Session Chair: **Gonzalo R. Arce,** Univ. of Delaware (USA)

10:30 am: **Compressive spectral polarization imaging**, Chen Fu, Univ. of Delaware (USA); Henry Arguello, Univ. Industrial de Santander (Colombia); Gonzalo R. Arce, Virginia O. Lorenz, Univ. of Delaware (USA) . . . . . [9109-12]

10:50 am: **3D imaging using compressive sensing active serial imaging system**, Bing Ouyang, Frank M. Caimi, Fraser R. Dalgleish, Gero Nootz, Walter Britton, Anni K. Vuorenkoski, Harbor Branch Oceanographic Institute (USA) . . . . . [9109-13]

11:10 am: **A comparison between three compressive hyperspectral sensing methods**, Adrian Stern, Yitzhak August, Vladimir Farber, Yaniv Oiknine, Ben-Gurion Univ. of the Negev (Israel) . . . . . [9109-14]

11:30 am: **A panchromatic super-resolution camera for remote sensing**, Justin C. Flake, Booz Allen Hamilton Inc. (USA); John Greer, National Geospatial-Intelligence Agency (USA); Gary Euliss, The MITRE Corp. (USA); Stephanie Shubert, National Geospatial-Intelligence Agency (USA) . . . [9109-15]

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

SESSION 5
LOCATION: CONV. CTR. ROOM 332 . . . . THU 1:40 PM TO 3:20 PM

Sparse Recovery Algorithms and Implementations

Session Chair: **Ram M. Narayanan,** The Pennsylvania State Univ. (USA)

1:40 pm: **Parallel heterogeneous architectures for efficient OMP compressive sensing reconstruction**, Amey M. Kulkarni, Univ. of Maryland, Baltimore County (USA); Tinoosh Mohsenin, EEHPC Lab, University of Maryland, Baltimore County (USA); Jerome L.V.M. Stanislaus, Univ. of Maryland, Baltimore County. . . . . [9109-17]

2:00 pm: **A photonics hardware based wideband compressive sensing analog to digital architecture and signal recovery method**, Mohiuddin Ahmed, HRL Labs., LLC (USA) . . . . . [9109-18]

2:20 pm: **Groundwater monitoring using sparse recovery algorithm**, Joon Young Lee, Tae-Woo Lee, Arizona State Univ. (USA). . . . . [9109-39]

2:40 pm: **Direction finding with L1-norm subspaces**, Panos P. Markopoulos, Nicholas Tsagkarakis, Dimitris A. Pados, Univ. at Buffalo (USA); George N. Karystinos, Technical Univ. of Crete (Greece). . . . . [9109-20]

3:00 pm: **Tomographic reconstruction of an unstable flame with compressive sensing and double ART algorithm: a comparison**, Juan C. Aguilar, Luís R. Berriel-Valdos, Carlos Gerardo Trevino Palacios, Jose Felix Aguilar, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) [9109-21]

Coffee Break . . . . . Thu 3:20 pm to 3:50 pm

SESSION 6
LOCATION: CONV. CTR. ROOM 332 . . . . THU 3:50 PM TO 5:30 PM

Compressive Sensing for Medical, Acoustical, and Ultrasound Applications

Session Chair: **Ervin Sejdic,** Univ. of Pittsburgh (USA)

3:50 pm: **Compressive sensing optical coherence tomography using randomly accessible tunable lasers**, Mark Harfouche, California Institute of Technology (USA); Naresh Satyan, California Institute of Technology (USA) and Telaris, Inc. (USA); Amnon Yariv, California Institute of Technology (USA) . . . . . [9109-22]

4:10 pm: **Understanding differences between healthy swallows and penetration-aspiration via compressive sensing of tri-axial swallowing accelerometry signals**, Ervin Sejdic, Joshua M. Dudik, Atsuko Kurosu, Iva Jestrovic, James L. Coyle, Univ. of Pittsburgh (USA) . . . . . [9109-23]

4:30 pm: **Highly accelerated 3D dynamic contrast enhanced MRI from sparse spiral sampling using integrated partial separability model and JSENSE**, Jingyuan Lyu, Univ. at Buffalo (USA); Pascal Spincemaille, Yi Wang, Weill Cornell Medical College (USA); Fuquan Ren, Leslie Ying, Univ. at Buffalo (USA) . . . . . [9109-24]

4:50 pm: **Graphics processing units accelerated MIMO tomographic image reconstruction using target sparseness**, Yuanwei Jin, Univ. of Maryland Eastern Shore (USA); Pedro Bello-Maldonado, Florida International Univ. (USA); Agustin Rivera-Longoria, Texas State Univ. San Marcos (USA); Mark Idleman, Ahmerst College (USA); Enyue Lu, Salisbury Univ. (USA). . . . . [9109-25]

5:10 pm: **Multimodal sparse reconstruction in Lamb wave-based nondestructive evaluation**, Andrew Golato, Sridhar Santhanam, Fauzia Ahmad, Moeness G. Amin, Villanova Univ. (USA) . . . . . [9109-26]

FRIDAY 9 MAY

SESSION 7
LOCATION: CONV. CTR. ROOM 332 . . . FRI 8:20 AM TO 10:00 AM

Compressive Sensing for Spectral Imaging, Optical Imaging, and Video II

Session Chair: **Ervin Sejdic,** Univ. of Pittsburgh (USA)

8:20 am: **A new class of masks and algorithms for efficient coded aperture imaging and decoding**, Michael J. DeWeert, BAE Systems (USA) . . . . [9109-27]

8:40 am: **Rate-distortion optimization for compressive video sampling**, Ying Liu, Joohee Kim, Illinois Institute of Technology (USA). . . . . [9109-28]

9:00 am: **Image estimation from projective measurements using low dimensional manifolds**, Johann Veras, Robert R. Muise, Lockheed Martin Corp. (USA) . . . . . [9109-29]

9:20 am: **A fast target detection and imaging method for compressive sensing Earth observation**, Chuanrong Li, Academy of Opto-Electronics (China); Qi Wang, Academy of Opto-Electronics (China) and Univ. of Chinese Academy of Sciences (China); Changyong Cao, NOAA National Environmental Satellite, Data, and Information Service (USA); Xi Shao, Univ. of Maryland, College Park (USA); Lingling Ma, Yongsheng Zhou, Academy of Opto-Electronics (China); Shi Qiu, Univ. of Maryland, College Park (USA); Jianjian Li, Academy of Opto-Electronics (China) and Univ. of Chinese Academy of Sciences (China) and NOAA National Environmental Satellite, Data, and Information Service (USA) . . . . . [9109-30]

9:40 am: **A new approach to apply compressive sensing to lidar sensing**, Richard C. Lau, T. K. Woodward, Applied Communication Sciences (USA) . . . . . [9109-31]

CONFERENCE 9110

LOCATION: CONV. CTR. ROOM 340

Monday - Tuesday 5 - 6 May 2014 • Proceedings of SPIE Vol. 9110

Dimensional Optical Metrology and Inspection for Practical Applications III

Conference Chairs: **Kevin G. Harding,** GE Global Research (USA); **Toru Yoshizawa,** NPO 3D Associates (Japan)

Conference Co-Chair: **Song Zhang,** Iowa State Univ. (USA)

Program Committee: **Yasuhiko Arai,** Kansai Univ. (Japan); **Anand Krishna Asundi,** Nanyang Technological Univ. (Singapore); **Mehdi Daneshpanah,** KLA-Tencor Corp. (USA); **Khaled J. Habib,** Kuwait Institute for Scientific Research (Kuwait); **Qingying Jim Hu,** QUEST Integrated, Inc. (USA); **Katsuichi Kitagawa,** Toray Precision Co., Ltd. (Japan); **Peter Kühmstedt,** Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); **Yukitoshi Otani,** Utsunomiya Univ. (Japan); **Xianyu Su,** Sichuan Univ. (China); **Takamasa Suzuki,** Niigata Univ. (Japan); **Joseph D. Tobiason,** Micro Encoder Inc. (USA); **Rainer Tutsch,** Technische Univ. Braunschweig (Germany); **Jiangtao Xi,** Univ. of Wollongong (Australia)

MONDAY 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 340 . . MON 9:00 AM TO 11:40 AM

3D Analysis and Calibration

Session Chairs: **Kevin G. Harding,** GE Global Research (USA); **Yasuhiko Arai,** Kansai Univ. (Japan)

9:00 am: **Active versus passive projector nonlinear gamma compensation method for high-quality fringe pattern generation** *(Invited Paper)*, Song Zhang, Iowa State Univ. (USA) . . . . . [9110-1]

9:30 am: **Accurate projector calibration based on improved accuracy of points in projector images corresponding points in camera images**, Zhengrong Huang, Jiangtao Xi, Yanguang Yu, Qinghua Guo, Univ. of Wollongong (Australia). . . . . [9110-2]

9:50 am: **Comparing digital-light-processing (DLP) and liquid-crystal-on-silicon (LCOS) technologies for high-quality 3D shape measurement**, Chen Gong, Beiwen Li, Iowa State Univ. (USA); Kevin G. Harding, GE Global Research (USA); Song Zhang, Iowa State Univ. (USA) . . . . . [9110-3]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

10:40 am: **Influence of alpha factor on the stability limit of a semiconductor laser with optical feedback**, Yuanlong Fan, Yanguang Yu, Jiangtao Xi, Qinghua Guo, Univ. of Wollongong (Australia) . . . . . [9110-4]

11:00 am: **Improved measurement dynamic range for point triangulation probes**, Kevin G. Harding, GE Global Research (USA); Mehdi Daneshpanah, KLA Tencor (USA); Guangping Xie, Li Tao, GE Global Research (China) . [9110-5]

11:20 am: **Error correction for Moiré based creep measurement system**, Yi Liao, GE Global Research (USA). . . . . [9110-7]

Lunch Break . . . . . Mon 11:40 am to 1:30 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 340 . . . .MON 1:30 PM TO 3:30 PM

3D Methods I

Session Chair: **Toru Yoshizawa,** NPO 3D Associates (Japan)

1:30 pm: **Development of in-plane and out-of-plane deformation simultaneous measurement method by using only two speckle patterns** *(Invited Paper)*, Yasuhiko Arai, Kansai Univ. (Japan). . . . . [9110-9]

2:00 pm: **Low-coherence interferometer using a pulsation laser diode** *(Invited Paper)*, Takamasa Suzuki, Yusuke Ueno, Samuel Choi, Osami Sasaki, Niigata Univ. (Japan) . . . . . [9110-10]

2:30 pm: **Three-dimensional imaging with multiple wavelength speckle interferometry**, Bruce E. Bernacki, Bret D. Cannon, John T. Schiffern, Albert M. Mendoza, Pacific Northwest National Lab. (USA). . . . . [9110-11]

2:50 pm: **Real-time and uniaxial measurement of 3D profile by polarization camera**, Shuhei Shibata, Fumio Kobayashi, Daisuke Barada, Yukitoshi Otani, Utsunomiya Univ. (Japan) . . . . . [9110-12]

3:10 pm: **Digital fringe profilometry based on triangular fringe patterns and spatial shift estimation**, Jiangtao Xi, Pu Cao, Yanguang Yu, Qinghua Guo, Univ. of Wollongong (Australia) . . . . . [9110-13]

Coffee Break . . . . . Mon 3:30 pm to 4:00 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 340 . . .MON 4:00 PM TO 5:00 PM

3D Methods II

Session Chair: **Takamasa Suzuki,** Niigata Univ. (Japan)

4:00 pm: **Array-projected aperiodic sinusoidal fringes for high-speed 3D shape measurement**, Stefan Heist, Andreas Mann, Peter Kühmstedt, Gunther Notni, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) . . . . . [9110-14]

4:20 pm: **High-speed 3D surface measurement with a fringe projection based optical sensor**, Christian Bräuer-Burchardt, Stefan Heist, Peter Kühmstedt, Gunther Notni, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany). . . . . [9110-15]

4:40 pm: **Full-field step profile measurement with sinusoidal wavelength scanning Interferometer**, Samuel Choi, Osami Sasaki, Takamasa Suzuki, Niigata Univ. (Japan) . . . . . [9110-16]

TUESDAY 6 MAY

SESSION 5

LOCATION: CONV. CTR. ROOM 340 . . . TUE 8:20 AM TO 10:10 AM

3D Applications I

Session Chair: **Song Zhang,** Iowa State Univ. (USA)

8:20 am: **Advanced roughness and defect metrology solutions** *(Invited Paper)*, Erik L. Novak, 4D Technology Corp. (USA) . . . . . [9110-17]

8:50 am: **Development of a small size probe for inner profile measurement of pipes and holes**, Toru Yoshizawa, NPO 3D Associates (Japan); Toshitaka Wakayama, Saitama Medical Univ. (Japan); Masayuki Yamamoto, NPO 3D Associates (Japan); Kizuku Machi, Saitama Medical Univ. (Japan) . . . . [9110-18]

9:10 am: **Development of feature extraction analysis for a multi-functional optical profiling device applied to field engineering applications**, Guangping Xie, Xu Han, GE Global Research (China); Brandon Laflen, Guiju Song, GE Global Research (USA); Ming Jia, GE Global Research (China); Kevin G. Harding, GE Global Research (USA) . . . . . [9110-19]

9:30 am: **Deformation kinetics of layered personal protective material under ballistic impact via terahertz reflectometry**, Anis Rahman, Aunik K. Rahman, Applied Research & Photonics, Inc. (USA); Mark A. Mentzer, Neuroscience Applications Group, LLC (USA). . . . . [9110-21]

9:50 am: **Ultra-broadband high-resolution photo acoustic/photo thermal microscopy system for material characterization**, Ashwin Sampathkumar, Riverside Research Institute (USA) . . . . . [9110-22]

Coffee/Exhibition Break. . . . . Tue 10:10 am to 10:50 am

SESSION 6
LOCATION: CONV. CTR. ROOM 340 . . TUE 10:50 AM TO 12:20 PM

3D Applications II

Session Chair: **Jiangtao Xi,** Univ. of Wollongong (Australia)

10:50 am: **Progress in the specification of instruments for areal surface topography measurement** *(Invited Paper)*, Peter J. de Groot, Zygo Corporation (USA) . . . . . [9110-23]

11:20 am: **Metrology tool for fast measurement of patterned sapphire structure used in LED manufacturing**, Joanna Schmit, Son Bui, Ohkyu Kwon, Bruker AXS, Inc. (USA) . . . . . [9110-24

11:40 am: **Dimensional metrology on semiconductor packaging process using the optical comb**, Jonghan Jin, Korea Research Institute of Standards and Science (Korea, Republic of) and Univ. of Science and Technology (Korea, Republic of); Saerom Maeng, Korea Research Institute of Standards and Science (Korea, Republic of) and Chungnam National Univ. (Korea, Republic of); Jungjae Park, Korea Research Institute of Standards and Science (Korea, Republic of) . . . . . [9110-25]

12:00 pm: **System implementation of self-mixing interferometry technique-based measurement on material parameters**, Yanguang Yu, Ke Lin, Jiangtao Xi, Huijun Li, Qinghua Guo, Univ. of Wollongong (Australia) . . . . . [9110-26]

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

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 340 . TUE 1:40 PM TO 3:00 PM

Optical Metrology Trends

Moderator*:* **Kevin G. Harding**, GE Global Research (USA)

Panelists: **Scott Sandwith,** New River Kinematics (USA);
Peter J. de Groot, Zygo Corp. (USA);
Erik L. Novak, 4D Technology Corp. (USA);
Thomas M. Hedges, Nikon Metrology, Inc. (Japan)

Optical Metrology continues to see wider use in all areas of industry from additive manufacturing to nano fabrication to large structures. A panel of industry experts in the area of Optical Metrology will present their views on the future and challenges the industry faces in the coming years and answer questions from the audience.

Coffee Break . . . . . 3:00 to 3:30 pm

SESSION 7
LOCATION: CONV. CTR. ROOM 340 . . . . TUE 3:30 PM TO 5:10 PM

Metrology Applications

Session Chair: **Yukitoshi Otani,** Utsunomiya Univ. (Japan)

3:30 pm: **Development of portable 3D optical measuring system using structured light projection method**, Hiroshi Aoki, Nikon Corp. (Japan) . . . . . [9110-27]

3:50 pm: **Order and defectivity nanometrology by image processing and analysis of sub-20 nm BCPs features for lithographic applications**, Claudia Delgado Simão, Institut Català de Nanotecnologia (Spain); Andreas Amann, Univ. College Cork (Ireland); Worawut Khunsin, Institut Català de Nanotecnologia (Spain); Michael A. Morris, Univ. College Cork (Ireland); Clivia Sotomayor Torres, Institut Català de Nanotecnologia (Spain) . . . . . [9110-28]

4:10 pm: **A new fiber optic sensor for hard access area surface roughness measurement**, Zirong Zhai, Guangping Xie, GE Global Research (China); Paolo Trallori, GE Oil & Gas (Italy); Ming Jia, GE Global Research (China); Kevin G. Harding, GE Global Research (USA) . . . . . [9110-29]

4:30 pm: **Optical design of a structured light phase shift system with no moving parts**, Kevin G. Harding, GE Global Research (USA) . . . . . [9110-30]

4:50 pm: **Optical center alignment technique based on inner profile measurement method**, Toshitaka Wakayama, Saitama Medical Univ. (Japan); Toru Yoshizawa, NPO 3D Associates (Japan) . . . . . [9110-31]

POSTERS-TUESDAY
LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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.

Three-dimensional shape measurement system applied to superficial inspection of non-metallic pipings for the hydrocarbons transport, Carlos Ricardo Contreras Pico, Javier Ricardo Arciniegas, Univ. Industrial de Santander (Colombia); Andrés L. González Gómez, Univ. Industrial de Santander (Colombia) and Univ. Autónoma de Bucaramanga (Colombia); Jaime Enrique Meneses Fonseca, Luz Amparo Quintero Ortíz, Univ. Industrial de Santander (Colombia) . . . . . [9110-33]

Facial topographic exploration through a three dimensional reconstruction device with hand-held calibration and multiple acquisitions, Andrés L. González, Carlos R. Contreras, Jaime E. Meneses, Univ. Industrial de Santander (Colombia) . . . . . [9110-34]

Study on the stitching interferometry for the surface profile measurement of a large aperture component, Weirui Zhao, Beijing Institute of Technology (China) . . . . . [9110-35]

CONFERENCE 9111

LOCATION: CONV. CTR. ROOM 316

Tuesday - Wednesday 6 - 7 May 2014 • Proceedings of SPIE Vol. 9111

Ocean Sensing and Monitoring VI

Conference Chairs: **Weilin W. Hou,** U.S. Naval Research Lab. (USA); **Robert A. Arnone,** Univ. of Southern Mississippi (USA)

Program Committee: **Sam Ahmed,** The City College of New York (USA); **James H. Churnside,** National Oceanic and Atmospheric Administration (USA); **Richard L. Crout,** U.S. Naval Research Lab. (USA); **Alexander Ignatov,** National Oceanic and Atmospheric Administration (USA); **Linda J. Mullen,** Naval Air Systems Command (USA); **Mitchell A. Roffer,** Roffer's Ocean Fishing Forecasting Service, Inc. (USA); **Michael Twardowski,** WET Labs., Inc. (USA)

TUESDAY 6 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 316 . . .TUE 8:00 AM TO 12:00 PM

Ocean Remote Sensing

Session Chairs: **Sam Ahmed,** The City College of New York (USA); **Robert A. Arnone,** The Univ. of Southern Mississippi (USA)

8:00 am: **Observations of ocean diurnal variations from the Korean geostationary ocean color imager (GOCI)**, Menghua Wang, NOAA Ctr. for Weather and Climate Prediction (USA); SeungHyun Son, National Oceanic and Atmospheric Administration (USA); Lide Jiang, NOAA Ctr. for Weather and Climate Prediction (USA); Wei Shi, National Oceanic and Atmospheric Administration (USA) . . . . . [9111-1]

8:20 am: **Calibration uncertainty in ocean color satellite sensors and trends in long-term environmental records**, Kevin R. Turpie, Univ. of Maryland, Baltimore County (USA) and Joint Ctr. for Earth Systems Technology (USA); Robert E. Eplee Jr., SAIC (USA); Bryan A. Franz, Carlos Del Castillo, NASA Goddard Space Flight Ctr. (USA) . . . . . [9111-2]

8:40 am: **Impacts of the VIIRS processing procedures on the retrievals of ocean color data products in coastal regions**, Soe M. Hlaing, Ahmed El-Habashi, Alexander Gilerson, The City College of New York (USA); Alan Weidemann II, U.S. Naval Research Lab. (USA); Robert A. Arnone, The Univ. of Southern Mississippi (USA); Menghua Wang, NOAA Ctr. for Weather and Climate Prediction (USA); Samir Ahmed, The City College of New York (USA) . . . . . [9111-3]

9:00 am: **Sensitivity of calibration gains to ocean color processing in coastal and open waters using ensembles members for NPP-VIIRS**, Robert A. Arnone, Ryan A. Vandermeulen, The Univ. of Southern Mississippi (USA); Sherwin D. Ladner, U.S. Naval Research Lab. (USA); Jennifer B. Bowers, Paul M. Martinolich, Giuletta S. Fargion, Planning Systems Inc. (USA); Michael E. Ondrusek, NOAA Ctr. for Weather and Climate Prediction (USA) . . . . . [9111-4]

9:20 am: **VIIRS reflective solar bands calibration changes and potential impacts on ocean color applications**, Slawomir Blonski, Univ. of Maryland, College Park (USA); Changyong Cao, NOAA Ctr. for Weather and Climate Prediction (USA); Xi Shao, Univ. of Maryland, College Park (USA); Sirish Uprety, Colorado State Univ. (USA) . . . . . [9111-5]

9:40 am: **Inter-satellite comparison and evaluation of Navy Suomi-NPP VIIRS and MODIS aqua ocean color properties**, Sherwin D. Ladner, U.S. Naval Research Lab. (USA); Robert A. Arnone, The Univ. of Southern Mississippi (USA); Paul M. Martinolich, Planning Systems Inc. (USA); Adam Lawson, U.S. Naval Research Lab. (USA); Ryan A. Vandermeulen, The Univ. of Southern Mississippi (USA); Jennifer B. Bowers, Planning Systems Inc. (USA); Michael E. Ondrusek, NOAA Ctr. for Weather and Climate Prediction (USA); Richard L. Crout, U.S. Naval Research Lab. (USA) . . . . . [9111-6]

Coffee/Exhibition Break. . . . . Tue 10:00 am to 10:40 am

10:40 am: **Evaluation of in-situ radiometric data processing for calibration and validation of satellite ocean color remote sensing**, Puneeta Naik, NOAA Ctr. for Weather and Climate Prediction (USA) and Cooperative Institute for Research in the Atmosphere (USA); Menghua Wang, NOAA Ctr. for Weather and Climate Prediction (USA) . . . . . [9111-7]

GREEN PHOTONICS

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

Watch for this icon next to conferences discussing innovative ways to help our planet.

11:00 am: **Sea surface salinity in coastal waters of the Gulf of Mexico using visible channels on Suomi-NPP**, Ryan A. Vandermeulen, Robert A. Arnone, The Univ. of Southern Mississippi (USA); Sherwin D. Ladner, U.S. Naval Research Lab. (USA); Martín A. Montes-Hugo, Paul M. Martinolich, Planning Systems Inc. (USA) . . . . . [9111-8]

11:20 am: **Relationship between sea surface salinity from l-band radiometer and optical features in the East China Sea**, Bumjun Kil, The Univ. of Southern Mississippi (USA); Derek M. Burrage, Joel Wesson, U.S. Naval Research Lab. (USA); Stephan D. Howden, The Univ. of Southern Mississippi (USA) . . . [9111-9]

11:40 am: **Reducing ocean surface specular reflection in worldview-2 images**, Karen W. Patterson, U.S. Naval Research Lab. (USA) . . . . . [9111-10]

Lunch Break . . . . . Tue 12:00 pm to 1:30 pm

SESSION 2

LOCATION: CONV. CTR. ROOM 316 . . . . TUE 1:30 PM TO 5:30 PM

Sensing Sea Surface Temperature

Session Chair: **Alexander Ignatov,** National Oceanic and Atmospheric Administration (USA)

1:30 pm: **Sea-surface temperature from Suomi-NPP VIIRS: algorithm development and uncertainty estimation** *(Invited Paper)*, Peter J. Minnett, Robert H. Evans, Guillermo P. Podestá, Katherine A. Kilpatrick, Univ. of Miami (USA) . . . . . [9111-12]

2:00 pm: **Analysis of the VIIRS cloud mask: comparison with the NAVOCEANO cloud mask and how they complement each other**, Jean-François P. Cayula, QuinetiQ North America, Inc. (USA); Douglas A. May, Bruce D. McKenzie, Naval Oceanographic Office (USA) . . . . . [9111-45]

2:30 pm: **SST algorithms in ACSPO reanalysis of AVHRR GAC data from 2002-2013**, Boris Petrenko, Global Science & Technology, Inc. (USA) and NOAA Ctr. for Weather and Climate Prediction (USA) and National Environmental Satellite, Data, and Information Service (USA); Xinjia Zhou, Cooperative Institute for Research in the Atmosphere (USA); Alexander Ignatov, NOAA Ctr. for Weather and Climate Prediction (USA) . . . . . [9111-14]

2:50 pm: **Evaluation of ACSPO-reanalysis 2002-2013 time series for self- and cross-consistency**, Xinjia Zhou, NOAA Ctr. for Weather and Climate Prediction (USA); Prasanjit Dash, National Environmental Satellite, Data, and Information Service (USA); Alexander Ignatov, Boris Petrenko, NOAA Ctr. for Weather and Climate Prediction (USA) . . . . . [9111-15]

Coffee Break . . . . . Tue 3:10 pm to 3:40 pm

3:40 pm: **Exploring enhancements to ACSPO VIIRS cloud mask based on SST pattern analyses: potential and limitations** *(Invited Paper)*, Irina Gladkova, The City College of New York (USA); Fazlul Shahriar, The Graduate Ctr., The City Univ. of New York (USA); Yury Kihai, Boris Petrenko, Alexander Ignatov, NOAA Ctr. for Weather and Climate Prediction (USA) . . . . . [9111-16]

4:10 pm: **Reduction of striping for improved ACSPO SST imagery derived from S-NPP VIIRS and terra/aqua MODIS clear-sky radiances**, Marouan Bouali, NOAA Ctr. for Weather and Climate Prediction (USA) and Cooperative Institute for Research in the Atmosphere (USA); Alexander Ignatov, NOAA Ctr. for Weather and Climate Prediction (USA) . . . . . [9111-17]

4:30 pm: **Effect of consistent CRTM coefficients on M-O bias and DDS in micros**, XingMing Liang, NOAA Ctr. for Weather and Climate Prediction (USA) and Colorado State Univ. (USA) and Cooperative Institute for Research in the Atmosphere (USA); Alexander Ignatov, NOAA Ctr. for Weather and Climate Prediction (USA); Yong Chen, Univ. of Maryland, College Park (USA) . . [9111-18]

4:50 pm: **Polar SST and clear-sky radiance products and monitoring at NOAA**, Alexander Ignatov, NOAA Ctr. for Weather and Climate Prediction (USA); XingMing Liang, NOAA Ctr. for Weather and Climate Prediction (USA) and Colorado State Univ. (USA); Prasanjit Dash, National Environmental Satellite, Data, and Information Service (USA) and Colorado State Univ. (USA); Boris Petrenko, Feng Xu, Yury Kihai, NOAA Ctr. for Weather and Climate Prediction (USA) and Global Science & Technology, Inc. (USA); John Stroup, NOAA Ctr. for Weather and Climate Prediction (USA) and STG, Inc. (USA); Xinjia Zhou, Marouan Bouali, NOAA Ctr. for Weather and Climate Prediction (USA) and Colorado State Univ. (USA); John Sapper, NOAA / NESDIS Office of Satellite Operations (USA). . . . . [9111-19]

5:10 pm: **Towards Cal/Val of Sentinel-3 SST in NOAA SST quality monitor: initial evaluation of A(A)TSR reprocessing for climate (ARC)**, Prasanjit Dash, Alexander Ignatov, National Environmental Satellite, Data, and Information Service (USA); Boris Petrenko, Yury Kihai, National Environmental Satellite, Data, and Information Service (USA) and Global Science & Technology, Inc. (USA) . . . . . [9111-20]

POSTERS-TUESDAY

LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM TO 7:30 PM

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Comparison of VIIRS SST fields obtained from differing SST equations applied to a region covering the northern Gulf of Mexico and western North Atlantic *(Invited Paper)*, Jean-François P. Cayula, QuinetiQ North America, Inc. (USA); Douglas A. May, Naval Oceanographic Office (USA); Ryan A. Vandermeulen, The Univ. of Southern Mississippi (USA) . . . . . [9111-13]

Underwater pressure measurement using fibre optic extrinsic Fabry-Perot interferometric (EFPI) sensors, Dinesh Babu Duraibabu, Sven Poeggel, Elfed Lewis, Thomas Newe, Univ. of Limerick (Ireland) . . . . . [9111-38]

A model-based ELM for atmospheric correction over Case 2 water with Landsat 8, Javier A. Concha, Rochester Institute of Technology (USA) [9111-39]

The impact of turbulent fluctuations on light propagation in a controlled environment, Silvia Matt, Weilin Hou, Wesley Goode, U.S. Naval Research Lab. (USA) . . . . . [9111-40]

Vicarious calibration and regional adjustment of coastal VIIRS, Jennifer B. Bowers, Planning Systems Inc. (USA); Robert A. Arnone, The Univ. of Southern Mississippi (USA); Sherwin D. Ladner, U.S. Naval Research Lab. (USA); Paul M. Martinolich, Planning Systems Inc. (USA); Giulietta S. Fargion, San Diego State Univ. (USA); Adam Lawson, U.S. Naval Research Lab. (USA); Ryan A. Vandermeulen, The Univ. of Southern Mississippi (USA) . . . . . [9111-41]

Development of an aerosol microphysical and optical model in the marine and coastal environments, Gennady A. Kaloshin, V.E. Zuev Institute of Atmospheric Optics (Russian Federation). . . . . [9111-42]

Developing a universal classification tree model for mapping aquatic vegetation in Taihu Lake using different phase HJ-CCD image, Juhua Luo, Ronghua Ma, Xianfeng Zhou, Nanjing Institute of Geography and Limnology (China) . . . . . [9111-43]

VIIRS reflective solar bands on-orbit calibration, Junqiang Sun, Global Science & Technology, Inc. (USA); Menghua Wang, NOAA Ctr. for Weather and Climate Prediction (USA). . . . . [9111-44]

Algorithms for the remote estimation of chlorophyll-a in the Chesapeake Bay, Ioannis Ioannou, The City Univ. of New York (USA); Alexander Gilerson, The City College of New York (USA); Michael E. Ondrusek, NOAA Ctr. for Weather and Climate Prediction (USA); Robert Foster, The City College of New York (USA); Ahmed El-Habashi, Kaveh Bastani, The City Univ. of New York (USA); Samir Ahmed, The City College of New York (USA) . . . . . [9111-46]

Implications of a new phase function for autonomous underwater imaging, Charles C. Trees, Ctr. for Maritime Research & Experimentation (USA); Georges R. Fournier, Defence Research and Development Canada, Valcartier (Canada); Violeta Sanjuan Calzado, Ctr. for Maritime Research & Experimentation (Italy) . . . . . [9111-47]

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

Tribute to Dr. Walton McBride

LOCATION: CONV. CTR. ROOM 316 . . . 10:30 AM TO 10:40 AM

Presentation by **Linda J. Mullen**, Naval Air Systems Command (USA), **Weilin W. Hou**, U.S. Naval Research Lab. (USA), and **Robert Arnone**, Univ. of Southern Mississippi (USA).

SESSION 3

LOCATION: CONV. CTR. ROOM 316 . WED 10:40 AM TO 12:20 PM

Underwater Imaging: Special Session Dedicated to Walton McBride

Session Chairs: **Linda J. Mullen,** Naval Air Systems Command (USA); **Weilin W. Hou,** U.S. Naval Research Lab. (USA)

10:40 am: **Multistatic optical imaging system**, Derek M. Alley, Linda J. Mullen, Naval Air Systems Command (USA); Brandon Cochenour, Alan Laux, Naval Air Warfare Ctr. Aircraft Div. (USA) . . . . . [9111-21]

11:00 am: **Compressive sensing active serial imaging system for the underwater environment**, Bing Ouyang, Frank M. Caimi, Fraser R. Dalgleish, Gero Nootz, Walter Britton, Anni K. Vuorenkoski, Harbor Branch Oceanographic Institute (USA) . . . . . [9111-22]

11:20 am: **Underwater imaging of polarized targets**, Alexander Gilerson, Yalong Gu, Carlos Carrizo, Amir Ibrahim, Ahmed El-Habashi, Robert Foster, Samir Ahmed, The City College of New York (USA) . . . . . [9111-23]

11:40 am: **Overview of a hybrid underwater camera system**, Philip M. Church, Neptec Technologies Corp. (Canada); Weilin Hou, U.S. Naval Research Lab. (USA); Fraser R. Dalgleish, Harbor Branch Oceanographic Institute (USA); Georges R. Fournier, Defence Research and Development Canada, Valcartier (Canada) . . . . . [9111-24]

12:00 pm: **Waveform design considerations for modulated pulse lidar**, Shawn P. O'Connor, Linda J. Mullen, Naval Air Warfare Ctr. Aircraft Div. (USA) . . . . . [9111-25]

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

CONFERENCE 9111

LOCATION: CONV. CTR. ROOM 316

SESSION 4

LOCATION: CONV. CTR. ROOM 316 . . . WED 1:40 PM TO 3:20 PM

Laser Ocean Sensing

Session Chairs: **James H. Churnside,** National Oceanic and Atmospheric Administration (USA);
Weilin W. Hou, U.S. Naval Research Lab. (USA)

1:40 pm: **Underwater channel identification using a 532nm chaotic lidar transmitter and adaptive filtering**, Luke K. Rumbaugh, David W. Illig, Clarkson Univ. (USA); Todd A. Wey, Lafayette College (USA); William D. Jemison, Clarkson Univ. (USA) . . . . . [9111-27]

2:00 pm: **Optical ranging techniques in turbid waters**, David W. Illig, William D. Jemison, Clarkson Univ. (USA); Robert W. Lee, NAVAIR Training Systems Division (USA); Alan Laux, Linda J. Mullen, Naval Air Systems Command (USA) . . . . . [9111-28]

2:20 pm: **The impact of oceanic gravity waves on laser propagation**, Serdar Kizilkaya, Turkish Navy Research Ctr. (Turkey); Timothy Kane, The Pennsylvania State Univ. (USA) . . . . . [9111-29]

2:40 pm: **Optical remote sensing of sound in the ocean**, James H. Churnside, National Oceanic and Atmospheric Administration (USA); Konstantin Naugolnykh, Zel Technologies, LLC (USA); Richard D. Marchbanks, Univ. of Colorado at Boulder (USA) and National Oceanic and Atmospheric Administration (USA) . . . . . [9111-30]

3:00 pm: **Beyond bathymetry: probing the ocean subsurface using ship-based lidars**, Charles C. Trees, Ctr. for Maritime Research & Experimentation (USA) . . . . . [9111-31]

Coffee Break . . . . . .Wed 3:20 pm to 3:50 pm

SESSION 5

LOCATION: CONV. CTR. ROOM 316 . . . WED 3:50 PM TO 5:30 PM

Ocean Observation

Session Chairs: **Michael S. Twardowski,** WET Labs., Inc. (USA);
Richard L. Crout, U.S. Naval Research Lab. (USA)

3:50 pm: **Gliderpalooza 2013: so much more than gliders**, Michael F. Crowley, Oscar Schofield, Scott M. Glenn, Rutgers Coastal Ocean Observation Lab. (USA) . . . . . [9111-32]

4:10 pm: **The Chesapeake Bay interpretive buoy system: an estuarine observing partnership**, William D. Wilson, Caribbean Wind LLC (USA) [9111-33]

4:30 pm: **Airborne remote sensing investigation of shoaling internal waves, eddies, and rip currents on the inner shelf**, Geoffrey Smith, George O. Marmorino, W. David Miller, U.S. Naval Research Lab. (USA) . . . . . [9111-35]

4:50 pm: **The validation of ocean color sensors using a profiling hyperspectral radiometer**, Michael E. Ondrusek, NOAA Ctr. for Weather and Climate Prediction (USA); Eric Stengel, National Oceanic and Atmospheric Administration (USA) . . . . . [9111-36]

5:10 pm: **Remote real-time sensing technology for gaseous hydrocarbon concentration measurement in deep water layers from joint Russian-Ukraine R&D team**, Andrey Bashchenko, GeoSpex (Russian Federation); Sergiy Baschenko, Institute of Physics (Ukraine) . . . . . [9111-37]

CONFERENCE 9112

LOCATION: CONV. CTR. ROOM 318

Monday - Wednesday 5 - 7 May 2014 • Proceedings of SPIE Vol. 9112

Sensing Technologies for Global Health, Military Medicine, and Environmental Monitoring IV

Conference Chair: **Šárka O. Southern,** Gaia Medical Institute (USA)

Conference Co-Chairs: **Mark A. Mentzer,** Neuroscience Applications Group, LLC (USA); **Isaac Rodriguez-Chavez,** National Institute of Dental and Craniofacial Research (USA); **Virginia E. Wotring,** Universities Space Research Association/NASA JSC (USA)

Program Committee: **James Delehanty,** U.S. Naval Research Lab. (USA); **Theresa G. Evans-Nguyen,** Draper Lab. (USA); **Peter Kiesel,** Palo Alto Research Ctr., Inc. (USA); **Baochuan Lin,** U.S. Naval Research Lab. (USA); **Daniel Malamud,** New York Univ. (USA); **Igor Medintz,** U.S. Naval Research Lab. (USA); **Richard M. Ozanich,** Pacific Northwest National Lab. (USA); **Ava M. Puccio,** Univ. of Pittsburgh Medical Ctr. (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); **Shadrian B. Strong,** Johns Hopkins Univ. Applied Physics Lab. (USA); **David E. Wolf,** Radiation Monitoring Devices, Inc. (USA); **Aurel Ymeti,** Ostendum R&D BV (Netherlands)

MONDAY 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 318 . . MON 8:30 AM TO 12:40 PM

Non-invasive Disease Diagnostics for Global Health I

Session Chairs: **Šárka O. Southern,** Gaia Medical Institute (USA); **Isaac R. Rodriguez-Chavez,** National Institute of Dental and Craniofacial Research (USA); **Daniel Malamud,** New York Univ. (USA)

8:30 am: **NIH/NIDCR perspective on non-invasive disease diagnostics based on oral fluids** *(Invited Paper)*, Isaac R. Rodriguez-Chavez, Penny W. Burgoon, National Institute of Dental and Craniofacial Research (USA). . [9112-1]

9:30 am: **Rapid noninvasive tests for diagnostics of infectious disease**, Daniel Malamud, New York Univ. (USA) . . . . . [9112-71]

10:00 am: **Saliva-based molecular test for malaria**, Sungano Mharakurwa, Johns Hopkins Univ. (USA) . . . . . [9112-8]

10:20 am: **Rapid saliva test for HIV/AIDS screening and monitoring**, Sarka O. Southern, Gaia Medical Institute (USA). . . . . [9112-5]

Coffee Break . . . . . Mon 10:40 am to 11:00 am

11:00 am: **Programmable bio-nano-chip system for non-invasive disease diagnostics**, John McDevitt, Rice Univ. (USA) . . . . . [9112-7]

11:20 am: **Micro- and nano-scale medical technologies for global health applications**, Utkan Demirci, Harvard Medical School (USA) . . . . . [9112-72]

11:40 am: **Next-gen microblotting for confirmatory disease diagnostics**, Amy Herr, Univ. of California, Berkeley (USA). . . . . [9112-73]

12:00 pm: **KS-detect: solar-thermal PCR for smartphone assisted diagnosis of Kaposi's sarcoma in limited resource settings and its potential application to using oral fluids**, David Erickson, Li Jiang, Matthew Mancuso, Zhengda Lu, Cornell Univ. (USA); Gunkut Akar, Ethel Cesarman, Weill Cornell Medical College (USA). . . . . [9112-69]

12:20 pm: **Wireless, quantitative, and universal lateral flow test reader**, Sophie Gerrick, Ray C. Delcher, Onur Mudanyali, Neven Karlovac, Holomic LLC (USA) . . . . . [9112-6]

Lunch Break . . . . . Mon 12:40 pm to 2:00 pm

GREEN PHOTONICS

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

Watch for this icon next to conferences discussing innovative ways to help our planet.

SESSION 2

LOCATION: CONV. CTR. ROOM 318 . . . MON 2:00 PM TO 5:20 PM

Non-invasive Disease Diagnostics for Global Health II

Session Chairs: **Timothy J. Griffin,** Univ. of Minnesota (USA); **Charles F. Streckfus,** The Univ. of Texas at Houston (USA); **Šárka O. Southern,** Gaia Medical Institute (USA)

2:00 pm: **Human saliva proteome: an overview** *(Invited Paper)*, Timothy J. Griffin, Univ. of Minnesota (USA). . . . . [9112-11]

2:30 pm: **Top down protein analysis for characterizing health and disease**, Julian Whitelegge, Univ. of California, Los Angeles (USA) . . . . . [9112-17]

2:50 pm: **Oral microbiome: a role in dynamic proteomics of whole saliva**, Eva J. Helmerhorst, Boston Univ. (USA) . . . . . [9112-10]

3:10 pm: **The diagnostic potential of bacterial glycan recognition in saliva**, Stefan Ruhl, Univ. at Buffalo (USA) . . . . . [9112-15]

Coffee Break . . . . . Mon 3:30 pm to 4:00 pm

4:00 pm: **Salivary biomarkers for modeling breast cancer progression** *(Invited Paper)*, Charles F. Streckfus, The Univ. of Texas Health Science Ctr. at Houston (USA). . . . . [9112-14]

4:30 pm: **Saliva biomarkers in cardiovascular disease** *(Invited Paper)*, Craig S. Miller, Univ. of Kentucky (USA). . . . . [9112-13]

5:00 pm: **Nanosensor for saliva based glucose monitoring**, Jonathan C. Claussen, U.S. Naval Research Lab. (USA) . . . . . [9112-9]

TUESDAY 6 MAY

SESSION 3

LOCATION: CONV. CTR. ROOM 318 . . . TUE 8:30 AM TO 11:30 AM

Military Medicine I: Traumatic Brain Injury and PTSD

Session Chairs: **Mary E. Michel,** National Institutes of Health (USA); **Geoffrey Ling,** Uniformed Services Univ. of the Health Sciences (USA); **Barry D. Jordan,** Sports Concussion Institute (USA)

8:30 am: **Rehabilitation technologies for traumatic brain injury and stroke** *(Invited Paper)*, Mary E. Michel, National Institutes of Health (USA) . . . . [9112-18]

9:00 am: **The military's approach to TBI and PTSD** *(Invited Paper)*, Geoffrey Ling, Uniformed Services Univ. of the Health Sciences (USA). [9112-20]

9:30 am: **Sports-related traumatic brain injury: prevention and rehabilitation** *(Invited Paper)*, Barry D. Jordan, Sports Concussion Institute (USA) . . . [9112-21]

Coffee Break . . . . . Tue 10:00 am to 10:30 am

SENSING TECHNOLOGY + APPLICATIONS

CONFERENCE 9112
LOCATION: CONV. CTR. ROOM 318

10:30 am: **New approach to neurorehabilitation: cranial nerve noninvasive neuromodulation (CN-NINM technology)**, Y. Danilov, K. Kaczmarek, M. Tyler, Univ. of Wisconsin-Madison (USA) . . . . . [9112-23]

10:50 am: **Clinical detection of brain damage in TBI**, Ava M. Puccio, Univ. of Pittsburgh Medical Ctr. (USA) . . . . . [9112-22]

11:10 am: **Saliva-based biomarkers for TBI diagnostics**, Sarka O. Southern, Gaia Medical Institute (USA) . . . . . [9112-24]

Lunch/Exhibition Break . . . . . Tue 11:30 am to 1:00 pm

SESSION 4
LOCATION: CONV. CTR. ROOM 318 . . . . TUE 1:00 PM TO 5:20 PM

Military Medicine II: Physiology and Medicine of Extreme Environments and Spaceflight

Session Chairs: **Virginia E. Wotring,** Universities Space Research Association/NASA JSC (USA); **Jonathan D. Stallings,** U.S. Army Ctr. for Environmental Health Research (USA)

1:00 pm: **Monitoring physiology during spaceflight** *(Invited Paper)*, Virginia E. Wotring, Universities Space Research Association/NASA JSC (USA) . . [9112-25]

1:40 pm: **Rapid, high-sensitivity diagnostic assay for viral DNA in saliva: translation from space to patients on Earth**, Duane L. Pierson, Satish K. Mehta, NASA Johnson Space Ctr. (USA) . . . . . [9112-68]

2:10 pm: **NASA laboratory analysis for manned exploration missions**, Michael Krihak, Univ. of California, Santa Cruz (USA); Tianna Shaw, NASA Ames Research Ctr., Moffett Field (USA) . . . . . [9112-67]

2:40 pm: **Drug stability analyzer for long duration spaceflights**, Stuart R. Farquharson, Chetan S. Shende, Real-Time Analyzers, Inc. (USA) . . . . [9112-26]

Coffee Break . . . . . Tue 3:00 pm to 3:30 pm

3:30 pm: **Prioritizing military-relevant toxicants and future sensing needs for exposure assessment and adverse health effects** *(Invited Paper)*, Jonathan D. Stallings, U.S. Army Ctr. for Environmental Health Research (USA) . . . . . [9112-30]

4:00 pm: **Non-invasive monitoring of hydration status in warfighters**, Sarka O. Southern, Gaia Medical Institute (USA) . . . . . [9112-29]

4:20 pm: **Military target task performance after wavefront-guided (WFG) and wavefront-optimized (WFO) photorefractive keratectomy (PRK)**, Tana Maurer, Oanh Nguyen, Greg Mueller, Dawne Deaver, Christopher Howell, Steve Moyer, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Denise Ryan, Rose K. Sia, Richard Stutzman, Joseph Pasternak, Kraig Bower, Warfighter Refractive Surgery and Research Ctr. (USA) . . . . . [9112-34]

4:40 pm: **Raman spectroscopic analysis of whole sheep's blood acetylcholinesterase**, Phillip G. Wilcox, U.S. Army Edgewood Chemical Biological Ctr. (USA) and Johns Hopkins Univ. (USA); Jin U. Kang, Johns Hopkins Univ. (USA) . . . . . [9112-32]

5:00 pm: **The challenges of analysing blood stains with hyperspectral imaging**, Jaana R. Kuula, Heikki J. Rinta, Hannu-Heikki Puupponen, Ilkka Pölönen, Univ. of Jyväskylä (Finland) . . . . . [9112-35]

POSTERS-TUESDAY
LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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.

Environmental data and remote sensing as an early warning system for dengue and malaria, Md. Z. Rahman, Kadik Abdel Hamid, LaGuardia Community College (USA); Leonid Roytman, The City College of New York (USA) . . . . . [9112-31]

Simulation studies in biochemical signaling and enzyme reactions, Mary C. Vagula, Gannon Univ. (USA); Sudarshan R. Nelatury, Penn State Erie, The Behrend College (USA); Charles F. Nelatury, Drexel Univ. (USA) . . [9112-49]

Health hazards of radio wave frequency radiation on gene expression during early embryonic development using zebra fish, Mary C. Vagula, Ryan Harkless, Muntather Alquraishi, Gannon Univ. (USA) . . . . . [9112-50]

Remote laser spectroscopy of oil and gas deposits, Sergey V. Kascheev, National Research Univ. of Information Technologies, Mechanics and Optics (Russian Federation) . . . . . [9112-51]

Investigation of plasmonic enhancement of chlorophyll emission in optical waveguide for algae detection, Jimmy Wang, National Sun Yat-Sen Univ. (Taiwan) . . . . . [9112-52]

Analysis of a generalized model for influenza including differential susceptibility due to immunosuppression, Juan F. Ospina, Univ. EAFIT (Colombia) . . . . . [9112-53]

Using computer algebra and SMT-solvers to analyse a mathematical model of cholera transmission, Mariana Trujillo Arredondo, Univ. EAFIT (Colombia) . . . . . [9112-54]

Computational algebraic geometry of epidemic models, Martin Rodriguez, Univ. EAFIT (Colombia) . . . . . [9112-55]

Using Tutte polynomials to characterize sexual contact networks, Juan José Cadavid Muñoz, Univ. EAFIT (Colombia) . . . . . [9112-56]

Computing Ro in a population with heterogeneity in sexual activity and proportionate mixing using a STM-solver, Natalia A. Gutierrez, Univ. EAFIT (Colombia) . . . . . [9112-57]

Bessel filters applied in biomedical image processing, Juan P. Mesa Lopez, Univ. EAFIT (Colombia) . . . . . [9112-58]

Application of a Morse Filter in the Processing of Brain Angiograms, Santiago Venegas Bayona, Univ. EAFIT (Colombia) . . . . . [9112-59]

Using special functions to model the propagation of airborne diseases, Daniela D. B. M. Bolaños Marin, Univ. EAFIT (Colombia) . . . . . [9112-60]

Optimal control in a model of malaria with differential susceptibility, Juan F. Ospina, Univ. EAFIT (Colombia) . . . . . [9112-61]

Using quantum filters to process images of diffuse axonal injury, Mateo Pineda Osorio, Univ. EAFIT (Colombia) . . . . . [9112-62]

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

SESSION 5
LOCATION: CONV. CTR. ROOM 318 . WED 10:30 AM TO 12:10 PM

Sensing Technologies for Disease Diagnostics and Environmental Monitoring I

Session Chairs: **Stephen M. Hewitt,** National Cancer Institute (USA); **Richard Conroy,** National Institutes of Health (USA); **Šárka O. Southern,** Gaia Medical Institute (USA)

10:30 am: **Next generation disease diagnostics: advances in laboratory and field-expedient technologies** *(Invited Paper)*, Stephen M. Hewitt, National Cancer Institute (USA). . . . . [9112-36]

11:00 am: **Current NIH funding opportunities in optical imaging and spectroscopy** *(Invited Paper)*, Richard Conroy, National Institutes of Health (USA) . . . . . [9112-70]

11:30 am: **Quantification of cellular disease biomarkers using digital image analysis**, James Evans, Gaia Medical Institute (USA) . . . . . [9112-74]

11:50 am: **Saliva-based multiplex technology: applications for oral clinical diagnostics in HIV/AIDS**, Jennifer Webster-Cyriaque, The Univ. of North Carolina at Chapel Hill (USA). . . . . [9112-75]

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

SESSION 6
LOCATION: CONV. CTR. ROOM 318 . . . .WED 1:10 PM TO 5:40 PM

Sensing Technologies for Disease Diagnostics and Environmental Monitoring II

Session Chairs: **Stephen M. Hewitt,** National Cancer Institute (USA); **Claudia Gärtner,** microfluidic ChipShop GmbH (Germany)

1:10 pm: **Portable capillary electrophoresis-system for on-site food analysis with lab-on-a-chip based contactless conductivity detection** *(Invited Paper)*, Claudia Gärtner, René Sewart, Richard Klemm, Holger Becker, microfluidic ChipShop GmbH (Germany) . . . . . [9112-38]

1:40 pm: **Critical stages of a biodetection platform development from sensor chip fabrication to surface chemistry and assay development**, Yildiz Uludag, TUBITAK UME (Turkey) . . . . . [9112-39]

2:00 pm: **Chemoselective surface attachment of antimicrobial peptides and its effects on interfacial behavior**, Stella H. North, Christopher So, Kenan Fears, Chris R. Taitt, U.S. Naval Research Lab. (USA) . . . . . [9112-40]

2:20 pm: **Data-driven classification of HEp-2 immunofluorescence patterns for autoimmune disease diagnosis**, Victor V. Pomponiu, Harishwaran Hariharan, Univ. of Pittsburgh (USA). . . . . [9112-41]

2:40 pm: **Automated detection of pulmonary emphysema in CT images of the lungs**, Victor V. Pomponiu, Harishwaran Hariharan, Univ. of Pittsburgh (USA) . . . . . [9112-42]

3:00 pm: **Software system for computing material and structural properties of bone and muscle in the lower extremity from PQCT**, Sokratis Makrogiannis, Delaware State Univ. (USA) and National Institutes of Health (USA); Luigi Ferrucci, National Institutes of Health (USA) . . . . . [9112-43]

Coffee/Exhibition Break. . . . . .Wed 3:20 pm to 3:40 pm

3:40 pm: **Label-free single cancer marker protein detection using a nanoplasmonic-photonic hybrid whispering gallery mode biosensor**, Stephen Holler, Fordham Univ. (USA); Venkata R. Dantham, Curtis Barbre, David Keng, Polytechnic Institute of New York Univ. (USA); Vasily Kolchenko, New York City College of Technology (USA); Stephen Arnold, Polytechnic Institute of New York Univ. (USA) . . . . . [9112-44]

4:00 pm: **Miniature polymer Fabry-Perot sensor with dual optical cavities for simultaneous pressure and temperature measurements**, Hyungdae Bae, Miao Yu, Univ. of Maryland, College Park (USA) . . . . . [9112-45]

4:20 pm: **Prototype spectral analysis of water samples for monitoring and treatment of public water resources** *(Invited Paper)*, Samuel G. Lambrakos, Maria Lee, U.S. Naval Research Lab. (USA); Constantine Yapijakis, The Cooper Union for the Advancement of Science and Art (USA); Scott A. Ramsey, Lulu Huang, U.S. Naval Research Lab. (USA); Andrew Shabaev, George Mason Univ. (USA); Lou Massa, Hunter College (USA) . . . . . [9112-46]

4:50 pm: **Estimation of suspended sediment concentrations by spectral reflectance: a field survey on the Yellow River** *(Invited Paper)*, Liqin Qu, Xiusheng Yang, Daniel Civco, Univ. of Connecticut (USA) . . . . . [9112-47]

5:20 pm: **Antarctic sea ice temperature monitoring using passive microwave SSM/I data**, Liu Yanxia, Wuhan Univ. (China). . . . . [9112-48]

CONFERENCE 9113

LOCATION: CONV. CTR. ROOM 319

Wednesday - Thursday 7 - 8 May 2014 • Proceedings of SPIE Vol. 9113

Sensors for Extreme Harsh Environments

Conference Chairs: **Debbie G. Senesky,** Stanford Univ. (USA); **Sachin Dekate,** GE Global Research (USA)

Program Committee: **Fabian Goericke,** Univ. of California, Berkeley (USA); **Jr-Hau (J.H.) He,** National Taiwan Univ. (Taiwan); **Kevin S. C. Kuang,** National Univ. of Singapore (Singapore)

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

SESSION 1
LOCATION: CONV. CTR. ROOM 319 . WED 10:50 AM TO 11:50 AM

Radiation-Tolerant Devices

Session Chair: **Debbie G. Senesky,** Stanford Univ. (USA)

10:50 am: **The effects of gamma irradiation on micro-hotplates with integrated temperature sensing diodes** *(Invited Paper)*, Laurent A. Francis, Nicolas André, Pierre Gérard, Univ. Catholique de Louvain (Belgium); Zeeshan Ali, Florin Udrea, Cambridge CMOS Sensors (United Kingdom); Denis Flandre, Univ. Catholique de Louvain (Belgium) . . . . . [9113-1]

11:10 am: **AlN-based resistive random access memory for harsh environment**, Po-Kang Yang, National Taiwan Univ. (Taiwan) . . . . . [9113-2]

11:30 am: **Effects of radiation and temperature on gallium nitride (GaN) metal-semiconductor-metal ultraviolet photodetectors**, Heather Chiamori, Minmin Hou, Debbie G. Senesky, Stanford Univ. (USA) . . . . . [9113-3]

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

SESSION 2
LOCATION: CONV. CTR. ROOM 319 . . .WED 2:00 PM TO 3:00 PM

High-Temperature Sensing Technology

Session Chair: **Sachin Dekate,** GE Global Research (USA)

2:00 pm: **Silicon carbide solid-state photomultiplier for UV light detection**, Stanislav Soloviev, Peter Sandvik, Sabarni Palit, Sergei Dolinsky, GE Global Research (USA) . . . . . [9113-5]

2:20 pm: **4H-SiC PN diode for extreme environment temperature sensing applications**, Nuo Zhang, Chih-Ming Lin, Yi Rao, Univ. of California, Berkeley (USA); Debbie G. Senesky, Stanford Univ. (USA); Albert P. Pisano, Univ. of California, Berkeley (USA) . . . . . [9113-6]

2:40 pm: **Sensors for high temperature displacement, deformation and strain measurement: a review**, Jiuhong Jia, East China Univ. of Science and Technology (China) . . . . . [9113-7]

Coffee/Exhibition Break. . . . . .Wed 3:00 pm to 3:30 pm

SESSION 3
LOCATION: CONV. CTR. ROOM 319 . . . WED 3:30 PM TO 5:30 PM

MEMS for Harsh Environments

Session Chair: **Debbie G. Senesky,** Stanford Univ. (USA)

3:30 pm: **High temperature sic pressure sensors with low offset voltage shift** *(Invited Paper)*, Robert S. Okojie, NASA Glenn Research Ctr. (USA); Dorothy Lukco, Vantage Partners, LLC (USA) and NASA Glenn Research Ctr. (USA); Ender Savrun, Sienna Technologies, Inc. (USA) . . . . . [9113-9]

3:50 pm: **Mechanical properties of MEMS materials: reliability investigations by the combination of mechanical and HR-XRD characterizations with environmental testing** *(Invited Paper)*, Tobias Bandi, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland) and Ecole Polytechnique Fédérale de Lausanne (Switzerland); Herbert R. Shea, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Antonia Neels, Ctr. Suisse d'Electronique et de Microtechnique SA (Switzerland) . . . . . [9113-10]

4:10 pm: **Development of an aluminum nitride-silicon carbide material set for high-temperature sensor applications** *(Invited Paper)*, Benjamin A. Griffin, Scott Habermehl, Peggy J. Clews, Sandia National Labs. (USA) . . . . . [9113-11]

4:30 pm: **Characterization of gallium nitride surface acoustic wave resonators in radiation environments**, Ashwin Shankar, Debbie G. Senesky, Stanford Univ. (USA) . . . . . [9113-12]

4:50 pm: **High temperature energy harvesters utilizing ALN/3C-SiC composite diaphragms**, Yun-Ju Lai, Univ. of California, Berkeley (USA); Debbie G. Senesky, Stanford Univ. (USA); Albert P. Pisano, Univ. of California, San Diego (USA) . . . . . [9113-13]

5:10 pm: **Emerging GaN-based HEMTs for mechanical sensing within harsh environments**, Helmut Köck, Stanford Univ. (USA) and Kompetenzzentrum Automobil- und Industrieelektronik GmbH (Austria); Caitlin A. Chapin, Stanford Univ. (USA); Clemens Ostermaier, Oliver Haeberlen, Infineon Technologies Austria AG (Austria); Debbie G. Senesky, Stanford Univ. (USA) . . . . . [9113-14]

THURSDAY 8 MAY

SESSION 4
LOCATION: CONV. CTR. ROOM 319 . . .THU 8:50 AM TO 10:10 AM

Fiber Optic Systems

Session Chair: **Sachin Dekate,** GE Global Research (USA)

8:50 am: **Monitoring corrosion in reinforced concrete structures** *(Invited Paper)*, Peter Kung, QPS Photronics Inc. (Canada); Maria Cominici, McGill Univ. (Canada) . . . . . [9113-15]

9:10 am: **Rainfall compensation scheme in distributed optical-fiber vibration sensor engineering system**, Hui Zhu, Chao Pan, Xiaohan Sun, Southeast Univ. (China) . . . . . [9113-17]

9:30 am: **A miniaturized optical package for shear stress measurements in harsh environments**, Tai-An Chen, David A. Mills, Vijay Chandrasekharan, Mark Sheplak, Univ. of Florida (USA) . . . . . [9113-18]

9:50 am: **Development of a sapphire optical pressure sensor for high-temperature applications**, David A. Mills, Dylan Alexander, Ghatu Subhash, Mark Sheplak, Univ. of Florida (USA) . . . . . [9113-19]

Coffee/Exhibition Break. . . . . Thu 10:10 am to 10:40 am

SESSION 5
LOCATION: CONV. CTR. ROOM 319 . THU 10:40 AM TO 12:00 PM

Industrial Applications

Session Chair: **Debbie G. Senesky,** Stanford Univ. (USA)

10:40 am: **Robust MEMS gyroscope for oil and gas exploration** *(Invited Paper)*, David Lin, Todd Miller, GE Global Research (USA) . . . . . [9113-20]

11:00 am: **Development of a downhole tool for measuring real-time concentration of ionic tracers and pH in geothermal reservoirs**, Grzegorz G. Cieslewski, Ryan F. Hess, Scott Lindblom, Timothy J. Boyle, Sandia National Labs. (USA); Greg Stillman, U.S. Dept. of Energy (USA); William G. Yelton, Steven J. Limmer, Sandia National Labs. (USA) . . . . [9113-21]

11:20 am: **Modeling and fabrication of a low cost passive wireless temperature sensor using metamaterials**, Hasanul Karim, Diego Delfin, Mohammad Arif I. Shuvo, Raymond C. Rumpf, Ryan B. Wicker, Ahsan Choudhuri, Yirong Lin, The Univ. of Texas at El Paso (USA) . . . . [9113-22]

11:40 am: **Open architecture health monitoring and analysis for large structures and a distributed network of synchronized strain sensors**, James Morrison, Robert Klug, Jonathan Williams, McQ, Inc. (USA) . . . [9113-23]

Lunch/Exhibition Break . . . . . Thu 12:00 pm to 3:40 pm

SESSION 6
LOCATION: CONV. CTR. ROOM 319 . . . . THU 3:40 PM TO 5:20 PM

Space Environment and Exploration

Session Chair: **Jr-Hau He,** National Taiwan Univ. (Taiwan)

3:40 pm: **Magnetoresistive sensors for angle, position, and electrical current measurement in demanding environments**, Rolf Slatter, Ronald Lehndorff, Johannes Paul, Marco Doms, Sensitec GmbH (Germany) . . . . . [9113-24]

4:00 pm: **High-sensitivity trace gas sensor at 30-km altitude**, Douglas Maukonen, Andrey V. Muraviev, Christopher J. Fredricksen, Joshua Colwell, Ammar Alhasan, Robert E. Peale, Univ. of Central Florida (USA) . . . . . [9113-25]

4:20 pm: **Harsh electronics: materials and electronic device development**, Dung-Sheng Tsai, Jr-Hau He, National Taiwan Univ. (Taiwan) . . . . . [9113-26]

4:40 pm: **Remote optical detection of alpha particle sources from joint Russian-Ukrainian R&D team**, Andrey Bashchenko, GeoSpex Sciences (Russian Federation); Sergiy Baschenko, Institute of Physics (Ukraine) . [9113-27]

5:00 pm: **Qualification of quantum cascade lasers for space environments**, Tanya L. Myers, Bret D. Cannon, Carolyn S. Brauer, Pacific Northwest National Lab. (USA); Blake G. Crowther, Utah State Univ. Research Foundation (USA) and Space Dynamics Lab. (USA); Stewart Hansen, Utah State Univ. (USA) . . . . . [9113-29]

POSTERS-THURSDAY
LOCATION: CONV. CTR. HALL C . . . . . THU 6:00 PM 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 session. 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 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.

Thin film transistors based on hafnium indium zinc oxide (HIZO) with high radiation tolerance, Dung-Sheng Tsai, Shih-Guo Yang, Meng-Lin Tsai, Der-Hsien Lien, National Taiwan Univ. (Taiwan); Kuan-Ming Chen, Yueh-Chung Yu, Academia Sinica (Taiwan); Jr-Hau He, National Taiwan Univ. (Taiwan) . . . . . [9113-4]

A two laser noise estimation technique to reduce the effects of 1/f noise in open path tunable diode laser absorption spectrometry (OP-TDLAS), Israa L. Mohammad, Univ. of Arkansas at Little Rock (USA) and The Univ. of Mustansiriyah (Iraq); Gary Anderson, Youhua Chen, Univ. of Arkansas at Little Rock (USA) . . . . . [9113-41]

CONFERENCE 9114

LOCATION: CONV. CTR. ROOM 323

Wednesday - Thursday 7 - 8 May 2014 • Proceedings of SPIE Vol. 9114

Advanced Photon Counting Techniques VIII

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,** Univ. of Glasgow (United Kingdom); **Majeed Hayat,** The Univ. of New Mexico (USA); **Michael A. Krainak,** NASA Goddard Space Flight Ctr. (USA); **Robert A. Lamb,** SELEX Galileo Ltd. (United Kingdom); **K. Alex McIntosh,** MIT Lincoln Lab. (USA); **Alan L. Migdall,** National Institute of Standards and Technology (USA); **Michael Wahl,** PicoQuant GmbH (Germany); **Hugo Zbinden,** Univ. of Geneva (Switzerland)

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

SESSION 1

LOCATION: CONV. CTR. ROOM 323 . .WED 10:30 AM TO 12:15 PM

Superconducting SPDs I: Free Space Communications

Session Chair: **Mark A. Itzler,** Princeton Lightwave, Inc. (USA)

10:30 am: **Device physics to receiving photons from lunar orbit: an evolution of superconducting nanowire single photon detectors** *(Keynote Presentation)*, Eric A. Dauler, Andrew J. Kerman, Matthew E. Grein, Danna Rosenberg, Matthew M. Willis, Jan E. Kansky, Bryan S. Robinson, Daniel V. Murphy, Don M. Boroson, MIT Lincoln Lab. (USA). . . . . [9114-1]

11:15 am: **Tungsten silicide superconducting nanowire single photon detector arrays for deep space optical communication** *(Invited Paper)*, Matthew D. Shaw, Francesco Marsili, Andrew D. Beyer, William H. Farr, Jet Propulsion Lab. (USA); Giovanni Resta, Politecnico di Torino (Italy); Varun B. Verma, Robert D. Horansky, Adriana Lita, Richard P. Mirin, Sae Woo Nam, National Institute of Standards and Technology (USA). . . . . [9114-2]

11:45 am: **Cryogenic SiGe integrated circuits for superconducting nanowire single photon detector readout** *(Invited Paper)*, Joseph C. Bardin, Prasana Ravindran, Su-Wei Chang, Univ. of Massachusetts Amherst (USA); Charif Mohamed, The Univ. of New Hampshire (USA); Matthew D. Shaw, Francesco Marsili, Giovanni Resta, William H. Farr, Jet Propulsion Lab. (USA). . . . . [9114-3]

Lunch/Exhibition Break . . . . . .Wed 12:15 pm to 1:45 pm

SESSION 2

LOCATION: CONV. CTR. ROOM 323 . . . .WED 1:45 PM TO 3:05 PM

Superconducting SPDs II: Quantum Information Processing

Session Chair: **Robert H. Hadfield,** Univ. of Glasgow (United Kingdom)

1:45 pm: **Photon-number-resolving detectors for photonic on-chip quantum information** *(Invited Paper)*, Thomas Gerrits, National Institute of Standards and Technology (USA) . . . . . [9114-4]

2:15 pm: **Photon-number-resolving detectors for GaAs waveguide quantum circuits** *(Invited Paper)*, Dondu Sahin, Technische Univ. Eindhoven (Netherlands); Alessandro Gaggero, Istituto di Fotonica e Nanotecnologie (Italy); Zili Zhou, Saeedeh Jahanmirinejad, Technische Univ. Eindhoven (Netherlands); Francesco Mattioli, Roberto Leoni, Istituto di Fotonica e Nanotecnologie (Italy); Johannes Beetz, Matthias Lermer, Martin Kamp, Sven Höfling, Julius-Maximilians-Univ. Würzburg (Germany); Andrea Fiore, Technische Univ. Eindhoven (Netherlands) . . . . . [9114-5]

2:45 pm: **Characterization of superconducting nanowire single-photon detector with artificial constrictions**, Ling Zhang, Lixing You, Dengkuan Liu, Weijun Zhang, Xiaoyu Liu, Junjie Wu, Yuhao He, Chaolin Lv, Zhen Wang, Shanghai Institute of Microsystem and Information Technology (China) . [9114-6]

Coffee Break . . . . . .Wed 3:05 pm to 3:35 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 323 . . . WED 3:35 PM TO 4:55 PM

Quantum Communications

Session Chair: **Alan L. Migdall,**
National Institute of Standards and Technology (USA)

3:35 pm: **Progress towards implementation of a quantum communication receiver satellite** *(Invited Paper)*, Thomas D. Jennewein, Brendon L. Higgins, Jean-Philippe Bourgoin, Catherine Holloway, Christopher Pugh, Nick Gigov, Raymond Laflamme, Univ. of Waterloo (Canada) . . . . . [9114-7]

4:05 pm: **A compact high-performance gigahertz-gated SPAD in an actively stabilized RF-interferometer**, Alessandro Restelli, Joint Quantum Institute (USA); Joshua C. Bienfang, Alan L. Migdall, National Institute of Standards and Technology (USA) . . . . . [9114-8]

4:25 pm: **Detector-related security loopholes in quantum cryptography** *(Invited Paper)*, Vadim Makarov, Univ. of Waterloo (Canada) . . . . . [9114-9]

THURSDAY 8 MAY

SESSION 4
LOCATION: CONV. CTR. ROOM 323 . . THU 8:00 AM TO 10:00 AM

Single-Photon Imaging and Photon-Counting Arrays

Session Chair: **Gerald S. Buller,** Heriot-Watt Univ. (United Kingdom)

8:00 am: **Photon sparse imaging** *(Invited Paper)*, Miles J. Padgett, Univ. of Glasgow (United Kingdom) . . . . . [9114-10]

8:30 am: **Low-noise CMOS SPAD arrays with in-pixel time-to-digital converters** *(Invited Paper)*, Alberto Tosi, Federica A. Villa, Danilo Bronzi, Yu Zou, Davide Tamborini, Politecnico di Milano (Italy); Simone Tisa, Micro Photon Devices S.r.l. (Italy); Daniel Durini, Sascha Weyers, Uwe Paschen, Werner Brockherde, Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme (Germany); Franco Zappa, Politecnico di Milano (Italy) . . . . . [9114-11]

9:00 am: **Evaluation of GM-APD array devices for low-light-level imaging**, Kimberly E. Kolb, Brandon J. Hanold, Joong Y. Lee, Donald F. Figer, Rochester Institute of Technology (USA) . . . . . [9114-12]

9:20 am: **Near-infrared silicon photon-counting arrays**, Stefan A. Vasile, aPeak, Inc. (USA). . . . . [9114-13]

9:40 am: **SWIR Geiger-mode APD detectors and cameras for 3D imaging**, Mark A. Itzler, Princeton Lightwave, Inc. (USA). . . . . [9114-14]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

SESSION 5
LOCATION: CONV. CTR. ROOM 323 . . THU 10:30 AM TO 12:30 PM

Single-Photon Lidar

Session Chair: **K. Alex McIntosh,** MIT Lincoln Lab. (USA)

10:30 am: **Advanced 3D imaging lidar concepts for long range sensing** *(Invited Paper)*, Robert A. Lamb, Philip A. Hiskett, Gerald J. Wong, Karen J. Gordon, Agata M. Pawlikowska, Roger Pilkington, Peter Sinclair, SELEX ES Ltd. (United Kingdom). . . . . [9114-15]

11:00 am: **Moderate to high altitude, single photon sensitive, 3D imaging lidars**, John J. Degnan, Christopher T. Field, Sigma Space Corp. (USA) . . . . . [9114-16]

11:20 am: **Long range 3D imaging with a 32x32 Geiger mode InGaAs/InP camera**, Philip A. Hiskett, Karen J. Gordon, Jeremy W. Copley, Roger Pilkington, Agata M. Pawlikowska, Peter Sinclair, Iain A. Clark, Robert A. Lamb, SELEX ES Ltd. (United Kingdom) . . . . . [9114-17]

11:40 am: **Applications of depth imaging based on time-correlated single-photon counting** *(Invited Paper)*, Gerald S. Buller, Aongus McCarthy, Ximing Ren, Nathan R. Gemmell, Aurora Maccarone, Yvan R. Petillot, Andrew M. Wallace, Heriot-Watt Univ. (United Kingdom). . . . . [9114-18]

12:10 pm: **Using HgCdTe e-APD detector arrays with single photon sensitivity for space lidar**, Xiaoli Sun, James B. Abshire, NASA Goddard Space Flight Ctr. (USA); Jeffrey D. Beck, DRS RSTA, Inc. (USA). . . . . [9114-19]

Lunch/Exhibition Break . . . . . Thu 12:30 pm to 1:45 pm

SESSION 6
LOCATION: CONV. CTR. ROOM 323 . . . . THU 1:45 PM TO 3:35 PM

Solid-State Photomultipliers

Session Chair: **Joe C. Campbell,** Univ. of Virginia (USA)

1:45 pm: **New trends in silicon photomultiplier development** *(Invited Paper)*, Valeri Saveliev, M. V. Keldysh Institute of Applied Mathematics (Russian Federation) and National Research Nuclear Univ. MEPhI (Russian Federation) . . . . . [9114-20]

2:15 pm: **Silicon photomultipliers for high-performance high-volume applications** *(Invited Paper)*, Carlton Jackson, SensL (Ireland) . . . . . [9114-21]

2:45 pm: **Study of silicon photomultipliers and applications**, Nicola D'Ascenzo, Deutsches Elektronen-Synchrotron (Germany) . . . . [9114-22]

3:05 pm: **Free-running operation of InGaAs single photon avalanche photodiodes with extremely low noise** *(Invited Paper)*, Boris Korzh, Nino Walenta, Tommaso Lunghi, Raphael Houlmann, Claudio Barreiro, Hugo Zbinden, Univ. of Geneva (Switzerland) . . . . . [9114-23]

Coffee Break . . . . . Thu 3:35 pm to 4:05 pm

SESSION 7
LOCATION: CONV. CTR. ROOM 323 . . . . THU 4:05 PM TO 4:45 PM

Visible and UV Single-Photon Communications

Session Chair: **Mark A. Itzler,** Princeton Lightwave, Inc. (USA)

4:05 pm: **Underwater optical communications at single photon sensitivities**, Philip A. Hiskett, Robert Struthers, Roy Tatton, Robert A. Lamb, SELEX ES Ltd. (United Kingdom). . . . . [9114-24]

4:25 pm: **Receiver dead time in non-line-of-sight ultraviolet communications**, Robert J. Drost, Paul L. Yu, U.S. Army Research Lab. (USA); Gang Chen, Univ. of California, Riverside (USA); Brian M. Sadler, U.S. Army Research Lab. (USA) . . . . . [9114-26]

SESSION 8
LOCATION: CONV. CTR. ROOM 323 . . . . THU 4:45 PM TO 5:05 PM

Novel Photon-Counting Technologies

Session Chair: **Mark A. Itzler,** Princeton Lightwave, Inc. (USA)

4:45 pm: **Advances in photon arrival timing circuitry and time-resolved luminescence imaging**, Michael Wahl, Tino Roehlicke, Hans-Jürgen Rahn, Volker Buschmann, Uwe Ortmann, PicoQuant GmbH (Germany); Gerald Kell, Fachhochschule Brandenburg (Germany). . . . . [9114-27]

CONFERENCE 9115

LOCATION: CONV. CTR. ROOM 319

Monday - Tuesday 5 - 6 May 2014 • Proceedings of SPIE Vol. 9115

Energy Harvesting and Storage: Materials, Devices, and Applications V

Conference Chairs: **Nibir K. Dhar,** Defense Advanced Research Projects Agency, Microelectronics Technology Office (USA); **Palani Balaya,** National Univ. of Singapore (Singapore); **Achyut K. Dutta,** Banpil Photonics, Inc. (USA)

Program Committee: **Pulickel M. Ajayan,** Rice Univ. (USA); **Paul Boieriu,** EPISOLAR, Inc. (USA); **Deryn Chu,** U.S. Army Research Lab. (USA); **M. Saif Islam,** Univ. of California, Davis (USA); **Nobuhiko P. Kobayashi,** Univ. of California, Santa Cruz (USA); **Pooi See Lee,** Nanyang Technological Univ. (Singapore); **Pat McGrath,** Booz Allen Hamilton Inc. (USA); **Robert Olah,** Banpil Photonics, Inc. (USA); **Kimberly A. Sablon,** U.S. Army Research Lab. (USA); **A. Fred Semendy,** U.S. Army Research Lab. (USA); **Sivalingam Sivananthan,** EPIR Technologies (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); **Priyalal Wijewarnasuriya,** U.S. Army Research Lab. (USA)

MONDAY 5 MAY

OPENING REMARKS

LOCATION: CONV. CTR. ROOM 319 . . . . . 8:25 AM TO 8:30 AM

Session Chair: **Nibir K. Dhar,**
Defense Advanced Research Projects Agency (USA)

SESSION 1

LOCATION: CONV. CTR. ROOM 319 . . MON 8:30 AM TO 10:10 AM

Energy Harvesting and Related Technologies

Session Chairs: **Nibir K. Dhar,** Defense Advanced Research Projects Agency (USA); **Achyut K. Dutta,** Banpil Photonics, Inc. (USA)

8:30 am: **Embeddable solid state fuel cells as power sources for autonomous systems** *(Keynote Presentation)*, Shriram Ramanathan, Harvard School of Engineering and Applied Sciences (USA) . . . . . [9115-1]

9:00 am: **Development of irradiation methods and degradation modeling for state-of-the-art space solar cells** *(Invited Paper)*, Takeshi Ohshima, Shin-ichiro Sato, Japan Atomic Energy Agency (Japan); Taishi Sumita, Tetsuya Nakamura, Mitsuru Imaizumi, Japan Aerospace Exploration Agency (Japan). . . . . [9115-2]

9:25 am: **Tantalum tungsten alloy photonic crystals for high-temperature energy conversion**, Veronika Stelmakh, Veronika Rinnerbauer, Jay J. Senkevich, Massachusetts Institute of Technology (USA); John D. Joannopoulos, MIT Institute for Soldier Nanotechnologies (USA); Marin Soljacic, Ivan Celanovic, Massachusetts Institute of Technology (USA) . [9115-3]

9:40 am: **Doped semiconductor nanocrystals**, Latha Nataraj, Aaron Jackson, Lily Giri, Clifford Hubbard, Mark L. Bundy, U.S. Army Research Lab. (USA) . . . . . [9115-4]

9:55 am: **Nanocavity absorption enhancement towards atomically thin layers**, Haomin Song, Kai Liu, Xie Zeng, Dengxin Ji, Nan Zhang, Qiaoqiang Gan, Univ. at Buffalo (USA) . . . . . [9115-5]

Coffee Break . . . . . Mon 10:10 am to 10:40 am

GREEN PHOTONICS

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

Watch for this icon next to conferences discussing innovative ways to help our planet.

SESSION 2

LOCATION: CONV. CTR. ROOM 319 . MON 10:40 AM TO 11:50 AM

Novel Energy Harvester

Session Chairs: **Roger E. Welser,** Magnolia Solar, Inc. (USA); **Achyut K. Dutta,** Banpil Photonics, Inc. (USA)

10:40 am: **High-efficiency energy harvesting using TAGS-85/half-Heusler thermoelectric devices** *(Invited Paper)*, Gary E. Bulman, Bruce Cook, RTI International (USA). . . . . [9115-6]

11:05 am: **MEMS electromagnetic energy harvesters with multiple resonances**, Sudarshan R. Nelatury, Penn State Erie, The Behrend College (United States); Robert Gray, Penn State Harrisburg (USA) . . . . . [9115-7]

11:20 am: **Piezoelectric-based event sensing and energy-harvesting power sources for thermal battery initiation in gun-fired munitions**, Jahangir Rastegar, Omnitek Partners, LLC (USA); Carlos M. Pereira, U.S. Army Armament Research, Development and Engineering Ctr. (USA) . . . . . [9115-8]

11:35 am: **Large-scale lithography-free metasurface with spectrally tunable super absorption**, Kai Liu, Xie Zeng, Dengxin Ji, Nan Zhang, Qiaoqiang Gan, Univ. at Buffalo (USA) . . . . . [9115-9]

Lunch Break . . . . . Mon 11:50 am to 1:20 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 319 . . . . MON 1:20 PM TO 2:55 PM

Advanced Harvesting Device and Applications

Session Chairs: **Gary E. Bulman,** RTI International (USA); **Achyut K. Dutta,** Banpil Photonics, Inc. (USA)

1:20 pm: **PV power plants production maximization** *(Invited Paper)*, Andras Boross, SunEdison (USA) . . . . . [9115-10]

1:45 pm: **Printed vibration based energy scavenging and storage devices for mobile electronics**, Kate J. Duncan, Victoria Carey, Mark S. Mirotznik, Univ. of Delaware (USA) . . . . . [9115-11]

2:00 pm: **Integrated soldier power and data system (ISPDS)**, Roman P. Ostroumov, Mohamad Zahzah, Thomas C. Forrester, Robert Stevens, Anthony Lai, Physical Optics Corp. (USA). . . . . [9115-12]

2:15 pm: **Broadband absorption engineering of hyperbolic metafilm patterns**, Dengxin Ji, Haomin Song, Xie Zeng, Haifeng Hu, Kai Liu, Nan Zhang, Qiaoqiang Gan, Univ. at Buffalo (USA) . . . . . [9115-13]

2:30 pm: **High-voltage thin-absorber photovoltaic device structures for efficient energy harvesting** *(Invited Paper)*, Roger E. Welser, Gopal G. Pethuraja, John W. Zeller, Ashok K. Sood, Magnolia Optical Technologies, Inc. (USA) and Magnolia Solar, Inc. (USA); Kimberly A. Sablon, U.S. Army Research Lab. (USA); Nibir K. Dhar, Defense Advanced Research Projects Agency (USA) . . . . . [9115-14]

TUESDAY 6 MAY

SESSION 4
LOCATION: CONV. CTR. ROOM 319 . . TUE 8:00 AM TO 10:00 AM

Advanced Batteries and Storage Devices

Session Chairs: **Palani Balaya,** National Univ. of Singapore (Singapore); **Jie Xiao,** Pacific Northwest National Lab. (USA)

8:00 am: **Micro battery development: from fundamental research to manufacturing** *(Invited Paper)*, Jie Xiao, Honghao Chen, Samuel Cartmell, Qiang Wang, Terence Lozano, Thomas Carlson, Zhiqun Deng, Pacific Northwest National Lab. (USA) . . . . . [9115-15]

8:25 am: **Electrodics: mesoscale physicochemical interactions in lithium-ion batteries** *(Invited Paper)*, Partha P. Mukherjee, Texas A&M Univ. (USA) . . . . . [9115-16]

8:50 am: **Tritium power source for long-lived sensors**, M. Litz, U.S. Army Research Lab. (USA); D. C. Katsis, Athena Energy Corp. (USA); J. A. Russo, D. A. Burns, J. J. Carroll, U.S. Army Research Lab. (USA) . . . . . [9115-17]

9:10 am: **Measuring battery state of health through mechanical stress measurements** *(Invited Paper)*, John Cannarella, Craig B. Arnold, Princeton Univ. (USA) . . . . . [9115-18]

9:35 am: **Design and fabrication of Li-ion microbatteries** *(Invited Paper)*, Shen J. Dillon, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [9115-19]

Coffee/Exhibition Break. . . . . Tue 10:00 am to 10:40 am

SESSION 5
LOCATION: CONV. CTR. ROOM 319 . . TUE 10:40 AM TO 11:45 AM

Advanced Storages: Batteries and Capacitors

Session Chairs: **Shen J. Dillon,** Univ. of Illinois at Urbana-Champaign (USA); **Palani Balaya,** National Univ. of Singapore (Singapore)

10:40 am: **Flexible Li-ion battery electrodes prepared from nanostructured polymer-derived ceramic composites** *(Invited Paper)*, Gurpreet Singh, Kansas State Univ. (USA) . . . . . [9115-20]

11:05 am: **Nanoengineered capacitor materials with colossal dielectric constant**, Narsingh B. Singh, Samuel Opeka, Vishnu Razdan, Marcus Zupan, Carlos A. Romero-Talamas, Univ. of Maryland, Baltimore County (USA) . . . . . [9115-22]

11:25 am: **Nanostructured metal-oxides for use as high power and energy density storage electrodes**, Bilge Saruhan-Brings, G. C. Mondragón Rodríguez, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Yakup Goenuellue, Univ. zu Köln (Germany) . . . . . [9115-23]

POSTERS-TUESDAY
LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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.

Modeling of high-efficiency ITO/ZnO quantum wire photovoltaic, Fahad A. Althowibi, Eric Donkor, Univ. of Connecticut (USA) . . . . . [9115-28]

Junctionless thin-film ferroelectric oxides for photovoltaic energy production, Farnood K. Rezaie, Janardan Nath, Evan M. Smith, Univ. of Central Florida (USA); Isaiah O. Oladeji, SISOM Thin Films, LLC (USA); Robert E. Peale, Univ. of Central Florida (USA) . . . . . [9115-27]

Analysis of solar cell using the Lambert W function with Maple, Daniel Villegas, Univ. EAFIT (Colombia) . . . . . [9115-24]

Single stage AC-DC converter for Galfenol-based micro-power energy harvesters, Peyton Cavaroc, Chandra V. Curtis, Space and Naval Warfare Systems Ctr. Atlantic (USA); James P. Cooper, Middle Tennessee State Univ. (USA); Suketu Naik, Space and Naval Warfare Systems Command (USA) . . . . . [9115-26]

Magnetohydrodynamic-based devices for energy harvesting from motion and vibration, John Vetrovec, Aqwest, LLC (USA) . . . . . [9115-33]

Temperature influence on energy density of nanocomposite for dielectric capacitor, Mohammad Arif I. Shuvo, Md. Rajib, Hasanul Karim, Diego Delfin, Yirong Lin, The Univ. of Texas at El Paso (USA) . . . . . [9115-32]

Procedure to determine module distribution within a solar array to increase the net energy collection in a solar competition vehicle, Nicolás Suárez-Castañeda, Ana M. Gil-Herrera, Jorge A. Barrera-Velásquez, Gilberto Osorio-Gómez, Ricardo Mejía-Gutiérrez, Univ. EAFIT (Colombia) . . . . . [9115-31]

Designing a concentrating photovoltaic (CPV) system in adjunct with a silicon photovoltaic panel for a solar competition car, Andrés Arias-Rosales, Jorge A. Barrera-Velásquez, Gilberto Osorio-Gómez, Ricardo Mejía-Gutiérrez, Univ. EAFIT (Colombia) . . . . . [9115-29]

Can seismic (destructive) energy be stored after conversion into electrical or acoustic energy?, Umesh P. Verma, Madhurendra N. Sinha, Patna Science College (India) . . . . . [9115-30]

Pulsed wireless photonic power transfer at high irradiance, Harbans S. Dhadwal, Omnitek Partners, LLC (USA) . . . . . [9115-34]

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

SESSION 6
LOCATION: CONV. CTR. ROOM 336 . . WED 8:00 AM TO 9:50 AM

NOTE ROOM CHANGE

Advanced Micro/Nanotechnologies for Solar Energy Generation

Joint session with Conferences 9083 and 9115

Session Chair: **Siva Sivananthan,** EPIR Technologies, Inc. (USA)

8:00 am: **Novel solar cells using II-VI semiconductors** *(Keynote Presentation)*, Sivalingam Sivananthan, James W. Garland, Christoph H. Grein, Robert F. Klie, Univ. of Illinois at Chicago (USA); Ramesh G. Dhere, Episolar Inc. (USA) . . . . . [9083-36]

8:30 am: **Flexible, lightweight CdTe solar cells on thin glass** *(Invited Paper)*, Teresa M. Barnes, Matthew O. Reese, James Burst, William L. Rance, Timothy A. Gessert, Wyatt K. Metzger, National Renewable Energy Lab. (USA); Daniel Meysing, Colin A. Wolden, Colorado School of Mines (USA); Xinghua Li, Pat Cimo, Sean Garner, Corning Incorporated (USA) . . . . . [9083-37]

8:50 am: **Fundamentals and recent results of super-high-efficiency solar cells** *(Invited Paper)*, Masafumi Yamaguchi, Kazuma Ikeda, Yoshio Ohshita, Toyota Technological Institute (Japan) . . . . . [9083-38]

9:10 am: **Nanoscale optimization of quantum dot media for effective photovoltaic conversion** *(Invited Paper)*, Kimberly A. Sablon, U.S. Army Research Lab. (USA) . . . . . [9083-39]

9:30 am: **Using soft x-rays to look into (buried) interfaces of energy conversion devices** *(Invited Paper)*, Clemens Heske, Univ. of Nevada, Las Vegas (USA) and Karlsruher Institut für Technologie (Germany) . . . . . [9083-40]

CONFERENCE 9116

LOCATION: CONV. CTR. ROOM 320

Thursday 8 May 2014 • Proceedings of SPIE Vol. 9116

Sensors for Next-Generation Robotics

Conference Chairs: **Dan Popa,** The Univ. of Texas at Arlington (USA); **Muthu B. J. Wijesundara,** The Univ. of Texas at Arlington Research Institute (USA)

Program Committee: **Rakesh Murthy,** Jet Propulsion Lab. (USA); **Andrew J. Tickle,** Coventry Univ. (United Kingdom)

THURSDAY 8 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 320 . . . THU 8:30 AM TO 10:10 AM

Sensors for Next-Generation Robotics I

Session Chairs: **Dan Popa, Muthu B. J. Wijesundara,** The Univ. of Texas at Arlington (USA)

8:30 am: **A haptic sensing upgrade for the current EOD robotic fleet** *(Invited Paper)*, Patrick S. Rowe, RE2, Inc. (USA) . . . . . [9116-1]

9:10 am: **Tactile MEMS-based sensor for delicate microsurgery**, Young Soo Park, Argonne National Lab. (USA); Woo Ho Lee, The Univ. of Texas at Arlington (USA); Nachappa Gopalsami, Argonne National Lab. (USA); Mohan S. Gundeti, The Univ. of Chicago Medical Ctr. (USA) . . . . . [9116-2]

9:30 am: **Tactile sensing and compliance in microstressbot assemblies**, Vahid Faroutan, Ratul Majumdar, Igor Paprotny, Univ. of Illinois at Chicago (USA) . . . . . [9116-3]

9:50 am: **Haptic exploration of fingertip-sized geometric features using a multimodal tactile sensor**, Ruben D. Ponce Wong, Randall B. Hellman, Veronica J. Santos, Arizona State Univ. (USA) . . . . . [9116-4]

Coffee Break . . . . . Thu 10:10 am to 10:40 am

SESSION 2

LOCATION: CONV. CTR. ROOM 320 . THU 10:40 AM TO 12:00 PM

Sensors for Next-Generation Robotics II

Session Chairs: **Dan Popa, Muthu B. J. Wijesundara,** The Univ. of Texas at Arlington (USA)

10:40 am: **Experimental testbed for robotic skin characterization and interaction control**, Kyle Shook, Woo Ho Lee, Kamesh Subbarao, Dan Popa, The Univ. of Texas at Arlington (USA) . . . . . [9116-5]

11:00 am: **Conformal grasping using feedback controlled bubble actuator array**, Wei Carrigan, Manoj Mittal, Richard E. Stein, Muthu B. J. Wijesundara, The Univ. of Texas at Arlington (USA) . . . . . [9116-6]

11:20 am: **Development and characterization of a new silicone/platine-based 2-DoF sensorized end-effector for micromanipulators**, Xin Xu, Joel Agnus, Micky Rakotondrabe, FEMTO-ST (France) . . . . . [9116-7]

11:40 am: **A multidirectional capacitive proximity sensor array**, Jiang Long, Mitsubishi Electric Research Labs. (USA) and Univ. of California, San Diego (USA); Bingnan Wang, Mitsubishi Electric Research Labs. (USA) . . . . . [9116-8]

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

SESSION 3

LOCATION: CONV. CTR. ROOM 320 . . . . .THU 1:30 PM TO 3:10 PM

Sensors for Next-Generation Robotics III

Session Chairs: **Dan Popa, Muthu B. J. Wijesundara,** The Univ. of Texas at Arlington (USA)

1:30 pm: **Need and emerging trends in remote sensing**, Michael McNair, Jeongsik Shin, The Univ. of Texas at Arlington (USA). . . . . [9116-9]

1:50 pm: **Toward controlling perturbations in robotic sensor networks**, Ashis G. Banerjee, Saikat Ray-Majumder, GE Global Research (USA) . [9116-10]

2:10 pm: **Advanced THz sensor array for precise position and material properties recognition**, Aleksander Sešek, Janez Trontelj, Univ. of Ljubljana (Slovenia); Andrej Švigelj, Letrika Lab. d.o.o (Slovenia) . . . . . [9116-11]

2:30 pm: **Micro-sensor selection for outdoor air quality monitoring**, Kristen L. Dorsey, John Herr, Univ. of California, Berkeley (USA); F. S. Alleyne, U.S. Dept. of Agriculture (USA); Albert P. Pisano, Univ. of California, San Diego (USA) . . . . . [9116-12]

2:50 pm: **Radiation detection based on luminescence ratio method**, Wei Chen, Lun Ma, Rasool Kenarangui, Andrew Brandt, Erick Jones, Alex Weiss, The Univ. of Texas at Arlington (USA) . . . . . [9116-13]

Coffee Break . . . . . Thu 3:10 pm to 3:40 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 320 . . . THU 3:40 PM TO 4:40 PM

Sensors for Next-Generation Robotics IV

Session Chairs: **Dan Popa, Muthu B. J. Wijesundara,** The Univ. of Texas at Arlington (USA)

3:40 pm: **EHD printing as sensor fabrication technology for robotic skins**, Jeongsik Shin, Woo Ho Lee, Caleb Nothnagle, Muthu B. J. Wijesundara, The Univ. of Texas at Arlington (USA) . . . . . [9116-14]

4:00 pm: **Microassembly and packaging of carbon nanotube-based field emission devices for high temperature electronics applications**, Rakesh Murthy, Jet Propulsion Lab. (USA) . . . . . [9116-16]

4:20 pm: **Force and joint angle measurements during activities of daily life**, Joe Sanford, Nicoleta Bugnariu, Rita M. Patterson, The Univ. of Texas at Arlington (USA) . . . . . [9116-20]

CONFERENCE 9117

LOCATION: CONV. CTR. ROOM 350

Monday - Wednesday 5 - 7 May 2014 • Proceedings of SPIE Vol. 9117

Three-Dimensional Imaging, Visualization, and Display 2014

Conference Chairs: **Bahram Javidi,** Univ. of Connecticut (USA); **Jung-Young Son,** Konyang Univ. (Korea, Republic of)

Conference Co-Chairs: **Osamu Matoba,** Kobe Univ. (Japan); **Manuel Martínez-Corral,** Univ. de València (Spain); **Adrian Stern,** Ben-Gurion Univ. of the Negev (Israel)

Program Committee: **Arun Anand,** Maharaja Sayajirao Univ. of Baroda (India); **V. Michael Bove Jr.,** MIT Media Lab. (USA); **Michael T. Eismann,** Air Force Research Lab. (USA); **Pietro Ferraro,** Istituto Nazionale di Ottica (Italy); **Toshiaki Fujii,** Nagoya Univ. (Japan); **Hong Hua,** College of Optical Sciences, The Univ. of Arizona (USA); **Yi-Pai Huang,** National Chiao Tung Univ. (Taiwan); **Naomi Inoue,** National Institute of Information and Communications Technology (Japan); **Dae-Sik Kim,** SAMSUNG Electronics Co., Ltd. (Korea, Republic of); **Jinwoong Kim,** Electronics and Telecommunications Research Institute (Korea, Republic of); **Thomas J. Naughton,** National Univ. of Ireland, Maynooth (Ireland); **Fumio Okano,** NHK Engineering Services, Inc. (Japan); **Wolfgang Osten,** Univ. Stuttgart (Germany); **Min-Chul Park,** Korea Institute of Science and Technology (Korea, Republic of); **Sumio Yano,** NHK Science & Technical Research Labs. (Japan); **Zeev Zalevsky,** Bar-Ilan Univ. (Israel)

MONDAY 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 350 . . . MON 1:40 PM TO 5:20 PM

Holographic Imaging Technologies I

Session Chair: **Jung-Young Son,** Konyang Univ. (Korea, Republic of)

1:40 pm: **Study on the digital hologram recording system with extra-large field of view** *(Invited Paper)*, Jaisoon Kim, Myongji Univ. (Korea, Republic of); Jisoo Lee, Myongji Univ. (Korea, Republic of); Sanghee Lee, Myongji Univ. (Korea, Republic of); Jinoh Han, Myongji Univ. (Korea, Republic of); Jung-Young Son, Konyang Univ. (Korea, Republic of); Bong Ho Lee, Kyungae Moon, Jin-Woong Kim, Electronics and Telecommunications Research Institute (Korea, Republic of) . . . . . [9117-1]

2:10 pm: **Experimental evaluation of reconstructed image quality in electronic holography using rectangular-shaped 1D SLM**, Osamu Matoba, Kobe Univ. (Japan); Ayaka Ueno, Kobe Univ. (Japan); Kouichi Nitta, Kobe Univ. (Japan) . . . . . [9117-2]

2:30 pm: **Holographic stereogram printing under the non-vibration environment**, Bong Ho Lee, Electronics and Telecommunications Research Institute (Korea, Republic of) . . . . . [9117-3]

2:50 pm: **Accurate quantitative phase imaging through telecentric digital holographic microscopy**, Manuel Martínez-Corral, Ana I. Doblas, Emilio Sánchez-Ortiga, Genaro Saavedra, Univ. de València (Spain); Jorge I. Garcia-Sucerquia, Univ. Nacional de Colombia Sede Medellín (Colombia) . . . . . [9117-4]

Coffee Break . . . . . .Mon 3:10 pm to 3:40 pm

3:40 pm: **Measurement of depth representation using integral imaging for quality evaluation of computer-generated hologram**, Soohyun Lee, Jeho Nam, Eun-Young Chang, Kyungae Moon, Jin-Woong Kim, Electronics and Telecommunications Research Institute (Korea, Republic of) . . . . . [9117-5]

4:00 pm: **Generation of three-dimensional color images by a horizontally scanning holographic display** *(Invited Paper)*, Yasuhiro Takaki, Tokyo Univ. of Agriculture and Technology (Japan) . . . . . [9117-6]

4:30 pm: **Fluctuations in the intensity read out of CCD arrays in digital holographic setups: an experimental investigation**, Yang Wu, Damien P. Kelly, Stefan Sinzinger, Technische Univ. Ilmenau (Germany); Adrian Stern, Ben-Gurion Univ. of the Negev (Israel) . . . . . [9117-7]

4:50 pm: **Portable low-coherence interferometry for quantitatively imaging fast dynamics with extended field of view** *(Invited Paper)*, Natan T. Shaked, Tel Aviv Univ. (Israel) . . . . . [9117-13]

TUESDAY 6 MAY

SESSION 2

LOCATION: CONV. CTR. ROOM 350 . . .TUE 8:30 AM TO 10:20 AM

Holographic Imaging Technologies II

Session Chair: **Adrian Stern,** Ben-Gurion Univ. of the Negev (Israel)

8:30 am: **Speckle suppression in computational hologram generated using ray-sampling plane** *(Invited Paper)*, Masahiro Yamaguchi, Takeru Utsugi, Tokyo Institute of Technology (Japan) . . . . . [9117-8]

9:00 am: **Acceleration of color computer-generated hologram from three-dimensional scenes with texture and depth information** *(Invited Paper)*, Tomoyoshi Shimobaba, Takashi Kakue, Tomoyoshi Ito, Chiba Univ. (Japan) . . . . . [9117-9]

9:30 am: **Digital speckle reduction: a comparison between methods**, Adrian Stern, Vladimir Farber, Ben-Gurion Univ. of the Negev (Israel) . . [9117-10]

9:50 am: **Multi-parameter motion-picture recording with wide space-bandwidth by parallel phase-shifting digital holography** *(Invited Paper)*, Tatsuki Tahara, Kansai Univ. (Japan); Peng Xia, Yasuhiro Awatsuji, Kenzo Nishio, Shogo Ura, Kyoto Institute of Technology (Japan); Toshihiro Kubota, Kubota Holography Lab. Corp. (Japan); Osamu Matoba, Kobe Univ. (Japan) . . . . . [9117-11]

Coffee Break . . . . . Tue 10:20 am to 10:50 am

SESSION 3

LOCATION: CONV. CTR. ROOM 350 . . TUE 10:50 AM TO 12:40 PM

Related Technologies of 3D Imaging

Session Chair: **Bahram Javidi,** Univ. of Connecticut (USA)

10:50 am: **Liquid crystal lens array for 3D endoscope application** *(Invited Paper)*, Amir Hassan Firoozi, Tai-Hsiang Jen, National Chiao Tung Univ. (Taiwan); Yi-Pai Huang, National Chiao Tung Univ. (Taiwan); Han-Ping D. Shieh, National Chiao Tung Univ. (Taiwan) . . . . . [9117-12]

11:20 am: **High dynamic depth range for 3D image capturing system**, Yi-Pai Huang, National Chiao Tung Univ. (Taiwan); Po-Yuan Hsieh, National Chiao Tung Univ. (Taiwan); Yong-Ren Su, Han-Ping D. Shieh, National Chiao Tung Univ. (Taiwan) . . . . . [9117-14]

11:40 am: **Scattering super lens: subwavelength light focusing and imaging via holographic control in complex media** *(Invited Paper)*, YongKeun Park, KAIST (Korea, Republic of) . . . . . [9117-15]

12:10 pm: **From the plenoptic camera to the flat integral-imaging display** *(Invited Paper)*, Manuel Martínez-Corral, Adrián Dorado, Hector Navarro, Anabel Llavador, Genaro Saavedra, Univ. de València (Spain); Bahram Javidi, Univ. of Connecticut (USA) . . . . . [9117-16]

Lunch/Exhibition Break . . . . . Tue 12:40 pm to 2:10 pm

CONFERENCE 9117

LOCATION: CONV. CTR. ROOM 350

SESSION 4

LOCATION: CONV. CTR. ROOM 350 . . . . TUE 2:10 PM TO 3:00 PM

3D Displays

Session Chair: **Manuel Martínez-Corral,** Univ. de València (Spain)

2:10 pm: **Principle and recent developments on depth-fused 3D (DFD) display** *(Invited Paper)*, Hirotsugu Yamamoto, Atsuhiro Tsunakawa, Univ. of Tokushima (Japan); Junnosuke Kawakami, Univ. of Tokushima (Japan); Shiro Suyama, Univ. of Tokushima (Japan) . . . . . [9117-17]

2:40 pm: **Novel measurement method of multiview 3D display for determining an optimum viewing distance (OVD)**, Ki Hyuk Yoon, Korea Institute of Science and Technology (Korea, Republic of) and Univ. of Seoul (Korea, Republic of); Hyunwoo Kim, Seon Kyu Yoon, Korea Institute of Science and Technology (Korea, Republic of) and Korea Univ. (Korea, Republic of); Sung Kyu Kim, Korea Institute of Science and Technology (Korea, Republic of) . . . . . [9117-18]

SESSION 5

LOCATION: CONV. CTR. ROOM 350 . . . . TUE 3:00 PM TO 5:20 PM

3D Imaging and Display

Session Chair: **Manuel Martínez-Corral,** Univ. de València (Spain)

3:00 pm: **In memoriam: Fumio Okano, innovator of 3D displays** *(Invited Paper)*, Jun Arai, NHK Japan Broadcasting Corp. (Japan) . . . . . [9117-19]

Coffee/Exhibition Break. . . . . Tue 3:30 pm to 4:00 pm

4:00 pm: **3D reconstruction method based on time-division multiplexing using multiple depth cameras**, Ji-Hoon Kang, Dong-Su Lee, Min-Chul Park, Korea Institute of Science and Technology (Korea, Republic of); Kwang-Hoon Lee, Korea Photonics Technology Institute (Korea, Republic of) . . . . . [9117-21]

4:20 pm: **Noninterferometric tomographic reconstruction of 3D static and dynamic phase and amplitude objects** *(Invited Paper)*, Sarvenaz Memarzadeh, Univ. of Dayton (USA); Georges T. Nehmetallah, Catholic Univ. of America (USA); Partha P. Banerjee, Univ. of Dayton (USA) . . . . . [9117-22]

4:50 pm: **High-precision microscopic phase imaging without phase unwrapping for cellular function evaluation** *(Invited Paper)*, Eriko Watanabe, The Univ. of Electro-Communications (Japan) . . . . . [9117-52]

POSTERS-TUESDAY

LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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.

Digital holographic visualization of thermally induced optical parameter changes in micro-obejcts, Janak Rathod, Jignesh Pandya, Nimit R. Patel, Swapnil Mahajan, Vismay Trivedi, Vani Chhaniwal, The Maharaja Sayajirao Univ. of Baroda (India); Bahram Javidi, Univ. of Connecticut (USA); Arun Anand, The Maharaja Sayajirao Univ. of Baroda (India) . . . . . [9117-20]

Photorealistic image synthesis and camera validation from 2D images, Juan C. Santos Ferrer, David M. González Chévere, Vidya B. Manian, Univ. de Puerto Rico Mayagüez (USA) . . . . . [9117-23]

Spatial distortion elimination in integral Fourier holography with intermediate projection views generation method, Chen Yang, Xidian Univ. (China) and Univ. of Connecticut (USA); Xiaorui Wang, Xidian Univ. (China); Bahram Javidi, Univ. of Connecticut (USA). . . . . [9117-36]

Bayesian estimation of depth information in three-dimensional integral imaging, Xiao Xiao, Bahram Javidi, Dipak K. Dey, Univ. of Connecticut (USA) . . . . . [9117-37]

Three-dimensional object recognition via integral imaging and scale invariant feature transform, Faliu Yi, Inkyu Moon, Chosun Univ. (Korea, Republic of) . . . . . [9117-38]

Optimized NURBS skinning surface using a gravitational search algorithm, Siti Mariyam H. Shamsuddin, Univ. Teknologi Malaysia (Malaysia) . . . . [9117-39]

Volumetric display containing multiple two-dimensional color motion pictures, Ryuji Hirayama, Chiba Univ. (Japan); Atsushi Shiraki, Kisarazu National College of Technology (Japan); Hirotaka Nakayama, Takashi Kakue, Tomoyoshi Shimobaba, Tomoyoshi Ito, Chiba Univ. (Japan) . . . . . [9117-40]

Extended viewing-angle holographic display with optical fiber arrays backlight, Hyun-Eui Kim, Minsik Park, Kyungae Moon, Jin-Woong Kim, Electronics and Telecommunications Research Institute (Korea, Republic of) . . . . . [9117-42]

High-resolution TFT-LCD for spatial light modulator from ETRI, Chi-Sun Hwang, Yong Hae Kim, Gi Heon Kim, Chunwon Byun, Himchan Oh, Hye Yong Chu, Electronics and Telecommunications Research Institute (Korea, Republic of) . . . . . [9117-43]

Optical fiber trap and digital holographic microscope integrated setup, Samira Ebrahimi, Ali-Reza Moradi, Univ. of Zanjan (Iran, Islamic Republic of); Arun Anand, The Maharaja Sayajirao Univ. of Baroda (India); Bahram Javidi, Univ. of Connecticut (USA) . . . . . [9117-44]

Nondestructive analysis of advanced materials nonlinear behavior using digital projection moiré, Yousef Pourvais, Pegah Asgari, Ali-Reza Moradi, Omid Rahmani, Univ. of Zanjan (Iran, Islamic Republic of) . . . . . [9117-45]

Controlled phagocytosis by multiple optical traps, Adel Nasehi, Fatemeh Rezaei, Univ. of Zanjan (Iran, Islamic Republic of); Ali-Reza Moradi, Univ. of Zanjan (Iran, Islamic Republic of) and Institute for Advanced Studies in Basic Sciences (Iran, Islamic Republic of); elnaz nasehi, Univ of Zanjan (Iran, Islamic Republic of) . . . . . [9117-46]

Multispectral photon counting integral imaging system for color visualization of photon limited 3D scenes, Inkyu Moon, Chosun Univ. (Korea, Republic of) . . . . . [9117-47]

Curve-based representation and analysis of 3D facial expressions, Manar D. Samad, Khan M. Iftekharuddin, Old Dominion Univ. (USA) . . . . . [9117-48]

Comparative analysis of a technique to pick-up 3D hologram data from real object, Dong-Su Lee, Min-Chul Park, Korea Institute of Science and Technology (Korea, Republic of); Jung-Young Son, Konyang Univ. (Korea, Republic of); Kwang-Hoon Lee, Korea Photonics Technology Institute (Korea, Republic of) . . . . . [9117-49]

Partially occluded object reconstruction using multiple Kinect sensors, Tabassum Nasrin, Faliu Yi, Samarjit Das, Inkyu Moon, Chosun Univ. (Korea, Republic of) . . . . . [9117-50]

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

SESSION 6
LOCATION: CONV. CTR. ROOM 350 . WED 10:30 AM TO 12:20 PM

Holographic Displays

Session Chair: **Osamu Matoba,** Kobe Univ. (Japan)

10:30 am: **Interactive holographic display** *(Invited Paper)*, Jung-Young Son, Konyang Univ. (Korea, Republic of); Beom-Ryeol Lee, Electronics and Telecommunications Research Institute (Korea, Republic of); Oleksii O. Chernyshov, Volodymyr Gushchyn, Konyang Univ. (Korea, Republic of); Jin-Woong Kim, Electronics and Telecommunications Research Institute (Korea, Republic of). . . . . [9117-24]

11:00 am: **Integral photography capture and electronic holography display** *(Invited Paper)*, Yasuyuki Ichihashi, Kenji Yamamoto, National Institute of Information and Communications Technology (Japan). . . . . [9117-25]

11:30 am: **Electronic holography using binary phase modulation** *(Invited Paper)*, Osamu Matoba, Kobe Univ. (Japan) . . . . . [9117-26]

12:00 pm: **Three-dimensional holographic display using ray sampling and integral imaging**, Xiao Xiao, Univ. of Connecticut (USA); Koki Wakunami, National Institute of Information and Communications Technology (Japan); Jeho Nam, Jin Soo Kim, Electronics and Telecommunications Research Institute (Korea, Republic of); Bahram Javidi, Univ. of Connecticut (USA). . . . . [9117-27]

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

SESSION 7
LOCATION: CONV. CTR. ROOM 350 . . . WED 1:40 PM TO 3:40 PM

3D Images and Displays I

Session Chair: **Hong Hua,** College of Optical Sciences, The Univ. of Arizona (USA)

1:40 pm: **Depth perception due to captured horizontal motion natural images** *(Invited Paper)*, Sumio Yano, Shimane Univ. (Japan). . . . . [9117-28]

2:10 pm: **Eyetracked optical see-through head-mounted display as an assistive and augmentative communication device** *(Invited Paper)*, Hong Hua, Xinda Hu, College of Optical Sciences, The Univ. of Arizona (USA); Chunyu Gao, Augmented Vision, Inc. (USA). . . . . [9117-29]

2:40 pm: **Affective SSVEP BCI to effectively control 3D objects by using a prism array based display**, Sungchul Mun, Min-Chul Park, Korea Institute of Science and Technology (Korea, Republic of) . . . . . [9117-30]

3:00 pm: **Full resolution stereoscopic television using flicker-free active beam displacement glasses**, Sergey Chestak, Dae-Sik Kim, Samsung Electronics Co., Ltd. (Korea, Republic of). . . . . [9117-31]

3:20 pm: **Computer simulation of moiré waves in autostereoscopic displays basing on spectral trajectories**, Vladimir V. Saveljev, Sung Kyu Kim, Korea Institute of Science and Technology (Korea, Republic of) . . . . . [9117-32]

Coffee/Exhibition Break. . . . . .Wed 3:40 pm to 4:10 pm

SESSION 8
LOCATION: CONV. CTR. ROOM 350 . . . WED 4:10 PM TO 5:50 PM

3D Images and Displays II

Session Chair: **Yasuhiro Takaki,** Tokyo Univ. of Agriculture and Technology (Japan)

4:10 pm: **Self-referencing digital holographic microscope for dynamic imaging of living cells** *(Invited Paper)*, Arun Anand, Vani Chhaniwal, Swapnil Mahajan, Vismay Trivedi, The Maharaja Sayajirao Univ. of Baroda (India); Amardeep S. S. Singh, Rainer A. Leitgeb, Medizinische Univ. Wien (Austria); Bahram Javidi, Univ. of Connecticut (USA) . . . . . [9117-33]

4:40 pm: **Autostereoscopic 3D display system on the properties of both the expanded depth directional viewing zone and the removed structural crosstalk**, Kwang-Hoon Lee, Anjin Park, Dong-Kil Lee, Yang-Gyu Kim, Won-Gun Jang, Youngsik Park, Korea Photonics Technology Institute (Korea, Republic of) . . . . . [9117-34]

5:00 pm: **Properties of a super-multiview image**, Beom-Ryeol Lee, Ilkwon Jeong, Electronics and Telecommunications Research Institute (Korea, Republic of); Jung-Young Son, Konyang Univ. (Korea, Republic of) . . . . . [9117-35]

5:20 pm: **Display-specific light-field analysis** *(Invited Paper)*, Robert Bregovic, Tampere Univ. of Technology (Finland); Péter Kovács, Tibor Balogh, Holografika Kft. (Hungary); Atanas Gotchev, Tampere Univ. of Technology (Finland)[9117-85]

CONFERENCE 9118

LOCATION: CONV. CTR. ROOM 333

Wednesday - Friday 7 - 9 May 2014 • Proceedings of SPIE Vol. 9118

Independent Component Analyses, Compressive Sampling, Wavelets, Neural Net, Biosystems, and Nanoengineering XII

Conference Chair: **Harold H. Szu,** U.S. Army Research Office (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); **Henry Chu,** Univ. of Louisiana at Lafayette (USA); **Ronald R. Coifman,** Yale Univ. (USA); **John Daugman,** Univ. of Cambridge (United Kingdom); **David Donohoe,** Stanford Univ. (USA); **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); **Marc W. Kirschner,** Harvard Medical School (USA); **Keith A. Krapels,** U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Horacio Lamela,** Univ. Carlos III de Madrid (Spain); **Joseph S. Landa,** BriarTek, Inc. (USA); **Douglas A. Lauffenburger,** Massachusetts Institute of Technology (USA); **Soo-Young Lee,** KAIST (Korea, Republic of); **Kevin W. Lyons,** National Institute of Standards and Technology (USA); **Anke D. Meyer-Bäse,** 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); **Hyung-Min Park,** Sogang Univ. (Korea, Republic of); **Kitt C. Reinhardt,** Air Force Office of Scientific Research (USA); **Zuowei Shen,** National Univ. of Singapore (Singapore); **Metin Sitti,** Carnegie Mellon Univ. (USA); **Jan-Olov Stromberg,** Royal Institute of Technology (Sweden); **John Tangney,** Office of Naval Research (USA); **Emmanuel Vincent,** IRISA / INRIA Rennes (France); **Nadarajen A. Vydelingum,** National Institutes of Health (USA); **Lipo Wang,** Nanyang Technological Univ. (Singapore); **Olaf Wolkenhauer,** Univ. Rostock (Germany); **Donald C. Wunsch II,** Missouri Univ. of Science and Technology (USA); **Ning Xi,** Michigan State Univ. (USA); **Takeshi Yamakawa,** Fuzzy Logic Systems Institute (Japan); **Yiping Zhao,** The Univ. of Georgia (USA); **Yufeng Zheng,** Alcorn State Univ. (USA); **Xiaowei Zhuang,** Harvard Univ. (USA)

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

SESSION 1

LOCATION: CONV. CTR. ROOM 333 . .WED 10:30 AM TO 11:10 AM

Large Data Analyses Pioneer Award

Session Chairs: **Keith A. Krapels,** U.S. Army RDECOM CERDEC NVESD (USA); **Harold Szu,** The Catholic Univ. of America (USA)

2014 RECIPIENT OF THE LARGE DATA ANALYSIS PIONEER AWARD

Presented to **Prof. John Daugman,** Univ. of Cambridge (United Kingdom)

10:30 am: **Large Data Analysis: automatic visual personal identification in demography of 1.2 billion persons** *(Invited Paper)*, John Daugman, Univ. of Cambridge (United Kingdom) and Morpho (France) . . . . . [9118-1]

PANEL DISCUSSION

LOCATION: CONV. CTR. ROOM 333 . WED 11:10 AM TO 11:30 AM

LDA Challenges in 6 W, Mixed Signals Biometrics

Panel Moderators: **John Daugman** Univ. of Cambridge (United Kingdom); **Keith A. Krapels,** U.S. Army RDECOM CERDEC NVESD (USA); **Harold Szu,** The Catholic Univ. of America (USA)

SESSION 2

LOCATION: CONV. CTR. ROOM 333 . . WED 11:30 AM TO 12:10 PM

Large Data Analyses

Session Chairs: **Keith A. Krapels,** U.S. Army RDECOM CERDEC NVESD (USA); **Harold Szu,** The Catholic Univ. of America (USA)

11:30 am: **Manifolds of large data from different sensory modalities**, Ming-Kai Hsu, The George Washington Univ. (USA); Harold Szu, U.S. Army Night Vision & Electronic Sensors Directorate (USA) . . . . . [9118-2]

11:50 am: **Econometric source LDA discovery by unsupervised learning**, Jeffrey C. Jenkins, Rutger van Bergem, George Mason Univ. (USA); Dalila Benachenhou, George Washington Univ. (USA); Harold Szu, The Catholic Univ. of America (USA) . . . . . [9118-3]

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

SESSION 2A

LOCATION: CONV. CTR. ROOM 333 . . WED 1:10 PM TO 1:50 PM

Leadership Award for Optical Engineering

2014 LEADERSHIP AWARD FOR OPTICAL ENGINEERING

Presented to **Dr. Ronald G. Driggers,** U.S. Naval Research Lab. (USA)

1:10 pm: **TBD** *(Invited Paper)*, Ronald G. Driggers, U.S. Naval Research Lab. (USA) . . . . . [9118-43]

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 333 . .WED 1:50 PM TO 2:10 PM

Challenges of EOIR and RF in Modeling and Simulation

Panel Moderators: **Ronald G. Driggers,** U.S. Naval Research Lab. (USA); **Keith Krapels,** Univ. of Cambridge (United Kingdom)

SESSION 3
LOCATION: CONV. CTR. ROOM 333 . WED 2:10 PM TO 2:50 PM

Nano-engineering Pioneer Award

Session Chairs: **David H. Gracias,** Johns Hopkins Univ. (USA); **Yiping Zhao,** The Univ. of Georgia (USA)

2014 RECIPIENT OF THE NANO-ENGINEERING PIONEER AWARD

Presented to **Prof. Ritesh, Agarwal,** Univ. of Pennsylvania (USA)

2:10 pm: **Phase change nanowire memory** *(Invited Paper)*, Ritesh Agarwal, Univ. of Pennsylvania (USA); Yiping Zhao, The Univ. of Georgia (USA) . . . . . [9118-4]

2:30 pm: **Recent progresses on nanowires** *(Invited Paper)*, Agarwal Ritesh, Univ. of Pennsylvania (USA). . . . . [9118-5]

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 333 . WED 2:50 PM TO 3:10 PM

Recent progresses on Nano-engineering

Panel Moderators: **David H. Gracias,**, Johns Hopkins Univ. (USA); **Ritesh Agarwal,** Univ. of Pennsylvania (USA)

Panel Members: **Ning Xi,** Michigan State Univ. (USA); **Harold H. Szu,** The Catholic Univ. of America (USA)

Coffee Break . . . . . .Wed 3:10 pm to 3:30 pm

SESSION 4
LOCATION: CONV. CTR. ROOM 333 . . . WED 3:30 PM TO 5:50 PM

Nano-engineering

Session Chairs: **Ritesh Agarwal,** Univ. of Pennsylvania (USA); **Kai-Dee Chu,** U.S. Dept. of Homeland Security (USA)

3:30 pm: **Probing size-dependent light-matter interactions and structural phase change properties with nanowires**, Ritesh Agarwal, Univ. of Pennsylvania (USA) . . . . . [9118-6]

3:50 pm: **Neuromorphic Implementation of a camera to enhance imaging through fire and smoke** *(Invited Paper)*, Jae Cha, A. Lynn Abbott, VPI (USA); Harold Szu, The Catholic Univ. of America (USA); Keith A. Krapels, The Univ. of Memphis (USA); Joseph Landa, BriarTek, Inc. (USA) . . . . . [9118-7]

4:10 pm: **Enhancing thermal imaging through large scale fire**, Jae H. Cha, A. Lynn Abbott, VPI (USA); Keith A Krapels, The Univ. of Memphis (USA); Harold H Szu, The Catholic Univ. of America (USA). . . . . [9118-8]

4:30 pm: **3D printed rapid disaster response** *(Invited Paper)*, Edward A. Mottern, Robotic Research LLC (USA) . . . . . [9118-9]

4:50 pm: **3D printing nanotech enhanced by quantum mechanics** *(Invited Paper)*, Harold Szu, The Catholic Univ. of America (USA); Jeffery C. Jenkins, George Mason Univ. (USA); Jerry Wu, The Catholic Univ. of America (USA) . . . . . [9118-10]

5:10 pm: **Wavelet techniques for the detection of silicone on rough aluminum substrates by machine analysis of mid-infrared spectra**, Richard Fauconier, Block Engineering, LLC (USA) . . . . . [9118-11]

5:30 pm: **Highway 3D model from image and lidar data** *(Invited Paper)*, Henry Chu, Jinfeng Chen, Xiaoduan Sun, Univ. of Louisiana at Lafayette (USA) . . . . . [9118-12]

THURSDAY 8 MAY

SESSION 5
LOCATION: CONV. CTR. ROOM 333 . THU 8:00 AM TO 8:40 AM

Compressive Sampling Pioneer Award

Session Chairs: **Justin K. Romberg,** Georgia Institute of Technology (USA); **Ning Xi,** Michigan State Univ. (USA)

2014 COMPRESSIVE SAMPLING PIONEER AWARD

Presented to **Prof. Michael Lustig,** Univ. of California, Berkeley (USA)

8:00 am: **Sparse MRI: the application of compressed sensing for rapid MRI** *(Invited Paper)*, Michael Lustig, Univ. of California, Berkeley (USA) . . . . . [9118-13]

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 333 . THU 8:40 AM TO 9:00 AM

Challenge in Pre-CS vs. Post-CS Image Processing

Panel Moderator: **Michael Lustig,** Univ. of California, Berkeley (USA)

SESSION 6
LOCATION: CONV. CTR. ROOM 333 . . . THU 9:00 AM TO 11:50 AM

Pre-CS vs Post-CS Image Processing

Session Chairs: **Francois Lalonde,** National Institutes of Health (USA); **Nitin Gogtay,** National Institutes of Health (USA)

9:00 am: **Split Bregman's optimization method for image construction in compressive sensing** *(Invited Paper)*, Anke Meyer-Bäse, Simon Foo, Dana Skinner, Florida State Univ. (USA). . . . . [9118-26]

9:40 am: **Compressive imaging: quantization and rate-allocation** *(Invited Paper)*, Amit Ashok, College of Optical Sciences, The Univ. of Arizona (USA); Yuzhang Lin, The Univ. of Arizona (USA) . . . . . [9118-15]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

10:30 am: **Optimal filter design for compressive sensing in electrogastrogram (EGG)** *(Invited Paper)*, Ning Xi, Michigan State Univ. (USA) . . . . . [9118-16]

11:10 am: **Noninvasive scalp pair correlation functions electroencephalogram (EEG)** *(Invited Paper)*, Francois Lalonde, Nitin Gogtay, National Institutes of Health (USA); Binh Q. Tran, Charles C. Hsu, Jefferson Willey, Jerry Wu, Gyu Moon, Joseph S. Landa, François Carlo Morabito, Yuh-Show Tsai, The Catholic Univ. of America (USA); T.-P. Jung, C. T. Lin, Univ. of California, San Diego (USA); Harold H. Szu, Alan T. Krzywicki, Babajide O. Familoni, Keith A. Krapels, U.S. Army RDECOM, NVESD (USA) . . . . . [9118-17]

11:30 am: **Overcoming shadowing occlusion by compressive sensing** *(Invited Paper)*, Harold Szu, The Catholic Univ. of America (USA); Charles C. Hsu, The George Washington Univ. (USA); Todd W. DuBosq, Univ. of Central Florida (USA); Steven K. Moyer, The Catholic Univ. of America (USA); Bavinder Kaur, George Mason Univ. (USA); Kelvin R. Leonard, Christopher M. May, The Catholic Univ. of America (USA); Keith A. Krapels, The Univ. of Tennessee Health Science Ctr. (USA); Joseph S. Landa, BriarTek, Inc. (USA). . . . . [9118-18]

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

SESSION 7
LOCATION: CONV. CTR. ROOM 333 . . THU 1:30 PM TO 2:10 PM

Unsupervised Learning ICA Pioneer Award

Session Chairs: **Soo-Young Lee,** KAIST (Korea, Republic of); **Hiroshi Sawada,** Nippon Telegraph and Telephone Corp. (Japan)

2014 RECIPIENT OF THE UNSUPERVISED LEARNING ICA PIONEER AWARD

Presented to **Prof. Jong-Hwan Lee,** Korea Univ. (Korea, Republic of)

1:30 pm: **Unsupervised learning toward brain imaging data analysis** *(Invited Paper)*, Jong-Hwan Lee, Korea Univ. (Korea, Republic of) . [9118-19]

CONFERENCE 9118

LOCATION: CONV. CTR. ROOM 333

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 333 . . THU 2:10 PM TO 2:30 PM

Why Unsupervised Brain Imaging?

Panel Moderators: **Soo-Young Lee,** KAIST (Korea, Republic of); **Harold H. Szu,** The Catholic Univ. of America (USA)

SESSION 8
LOCATION: CONV. CTR. ROOM 333 . . . .THU 2:30 PM TO 5:00 PM

Unsupervised Brain Imaging

Session Chairs: **Soo-Young Lee,** KAIST (Korea, Republic of); **Harold H. Szu,** The Catholic Univ. of America (USA)

2:30 pm: **User authentication systems based on brain finger-prints** *(Invited Paper)*, Soo-Young Lee, Eunsoo Jung, KAIST (Korea, Republic of) . . . . [9118-20]

2:50 pm: **Fixing basis mismatch via alternating convex search**, Jonathan M. Nichols, U.S. Naval Research Lab. (USA); Albert Oh, Duke Univ. (USA); Rebecca Willett, Univ. of Wisconsin-Madison (USA) . . . . . [9118-21]

Coffee Break . . . . . Thu 3:10 pm to 3:40 pm

3:40 pm: **Detecting directional and spectral characteristics of anomalous radiation sources**, Benjamin Manning, Wojciech Czaja, Thomas McCullough, Univ. of Maryland, College Park (USA); Lance McLean, National Security Technologies, LLC (USA) . . . . . [9118-22]

4:00 pm: **Low-discrepancy sampling of parametric surface using adaptive space-filling curves**, Charles C. Hsu, Trident Systems Inc. (USA); Harold Szu, The Catholic Univ. of America (USA). . . . . [9118-23]

4:20 pm: **SAR GMTI technologies and their applications**, Charles C. Hsu, Trident Systems Inc. (USA); Harold Szu, The Catholic Univ. of America (USA) . . . . . [9118-24]

4:40 pm: **Probabilistic inequalities with applications to machine learning**, Xinjia Chen, Southern Univ. and A&M College (USA) . . . . . [9118-42]

FRIDAY 9 MAY

SESSION 9
LOCATION: CONV. CTR. ROOM 333 . .FRI 8:00 AM TO 8:40 AM

Biomedical Wellness Pioneer Award

Session Chairs: **Weichuan Yu,** Hong Kong Univ. of Science and Technology (Hong Kong, China); **Soo-Young Lee,** KAIST (Korea, Republic of)

2014 RECIPIENT OF THE BIOMEDICAL WELLNESS PIONEER AWARD

Presented to **Prof. Elisa Konofagou,** Columbia Univ. (USA)

8:00 am: **Intrinsic cardiovascular wave imaging in vivo** *(Invited Paper)*, Elisa E. Konofagou, Columbia Univ. (USA) . . . . . [9118-44]

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 333 . .FRI 8:40 AM TO 9:00 AM

Biomedical Wellness and S&T Approaches

Panel Moderators: **Weichuan Yu,** Hong Kong Univ. of Science and Technology (Hong Kong, China); **Soo-Young Lee,** KAIST (Korea, Republic of)

SESSION 10
LOCATION: CONV. CTR. ROOM 333 . . . FRI 9:00 AM TO 11:50 AM

Biomedical Concerns and S&T Approaches

Session Chairs: **Weichuan Yu,** Hong Kong Univ. of Science and Technology (Hong Kong, China); **Soo-Young Lee,** KAIST (Korea, Republic of)

9:00 am: **A minimum invasive and maximum specific neo-Angiogenesis biomarker of a time-reversal spectral image tracking toward malignant breast/skin cancer** *(Invited Paper)*, Harold H. Szu, The Catholic Univ. of America (USA); Nadarajen A. Vydelingum, National Cancer Institute (USA); Philip P. Hoekstra III, Therma-Scan, Inc. (USA); Joseph S. Landa, BriarTek, Inc. (USA); Charles C. Hsu, George Washington Univ. (USA); Liyi Dai, Harvard Univ. (USA); David G. Brown, U.S. Food and Drug Administration (USA). . . . . [9118-14]

9:40 am: **Authentication, privacy and security can exploit brainwaves by smartphone** *(Invited Paper)*, Jeffrey C. Jenkins, Charles Sweet, Loft Mind, Inc. (USA); James Sweet, Loft Mind, Inc. (Germany); Harold Szu, The Catholic Univ. of America (USA) . . . . . [9118-27]

Coffee Break . . . . . Fri 10:00 am to 10:30 am

10:30 am: **Heart rate variability (HRV): an indicator of stress**, Balvinder Kaur, Joseph J. Durek, Barbara L. O'Kane, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Vasiliki N. Ikonomidou, George Mason Univ. (USA) . . . . . [9118-28]

10:50 am: **Impact of human emotions on physiological characteristics**, Pavol Partila, VŠB-Technical Univ. of Ostrava (Czech Republic); Miroslav Voznak, Technical Univ of Ostrava (Czech Republic); Tomas Peterek, Marek Penhaker, Vilem Novak, Jaromir Tovarek, Miralem Mehic, Lukas Vojtech, VŠB-Technical Univ. of Ostrava (Czech Republic) . . . . . [9118-29]

11:10 am: **Neural network classifier of attacks in IP telephony**, Jakub Safarik, Miroslav Voznak, Miralem Mehic, Pavol Partila, Martin Mikulec, VŠB-Technical Univ. of Ostrava (Czech Republic) . . . . . [9118-30]

11:30 am: **Predictive model for determining the quality of a call**, Miroslav Voznak, Technical Univ of Ostrava (Czech Republic); Jan Rozhon, Pavol Partila, Jakub Safarik, Martin Mikulec, Miralem Mehic, VŠB-Technical Univ. of Ostrava (Czech Republic) . . . . . [9118-31]

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

SESSION 11
LOCATION: CONV. CTR. ROOM 333 . . . FRI 1:00 PM TO 1:40 PM

Systems Biology Pioneer Award

Session Chairs: **Nadarajen A. Vydelingum,** National Institutes of Health (USA); **Anke Meyer-Bäse,** The Florida State Univ. (USA)

2014 RECIPIENT OF THE SYSTEMS BIOLOGY PIONEER AWARD

Presented to **Prof. Scott E. Fraser,** Univ. of Southern California (USA)

1:00 pm: **Next-gen systems biology: imaging the molecular dynamics of embodied cells** *(Invited Paper)*, Scott Fraser, Univ. of Southern California (USA) . . . . . [9118-45]

PANEL DISCUSSION
LOCATION: CONV. CTR. ROOM 333 . . FRI 1:40 PM TO 2:00 PM

Systems Biology

Panel Moderators: **Nadarajen A. Vydelingum,** National Institutes of Health (USA); **Sudhir Srivastava,** National Institutes of Health (USA)

Panel Members: **Uwe Meyer-Bäse,** The Florida State Univ. (USA); **Simon Foo,** The Florida State Univ. (USA)

SESSION 12
LOCATION: CONV. CTR. ROOM 333 .... FRI 2:00 PM TO 5:50 PM

Lessons Learned from Nonlinear Life System of Systems

Session Chairs: **Nadarajen A. Vydelingum,** National Institutes of Health (USA); **Scott Fraser,** Univ. of Southern California (USA)

2:00 pm: **Using Computer Algebra and SMT Solvers in Algebraic Biology**, Mateo Pineda Osorio, Univ. EAFIT (Colombia) . . . . . [9118-32]

2:20 pm: **Telescopic augmented reality at nanoscale**, Jeffrey C. Jenkins, George Mason Univ. (USA); Harold Szu, The Catholic Univ. of America (USA) . . . . . [9118-33]

2:40 pm: **Experimental verification of the performance of artificial neural networks (ANNs) versus partial least squares (PLS) for spectral interference correction in optical emission spectrometry** *(Invited Paper)*, Z. Li, X. Zhang, Vassili Karanassios, Univ. of Waterloo (Canada) . . . . . [9118-34]

Coffee Break . . . . . Fri 3:00 pm to 3:30 pm

3:30 pm: **Analyzing toys models of Arabidopsis and Drosphila using Z3 SMT-LIB**, Martin Rodriguez, Univ. EAFIT (Colombia). . . . . [9118-35]

3:50 pm: **Solving a discrete model of the lac operon using Z3**, Natalia A. Gutierrez, Univ. EAFIT (Colombia) . . . . . [9118-36]

4:10 pm: **Using Tutte polynomials to analyze the structure of the benzodiazepines**, Juan José Cadavid Muñoz, Univ. EAFIT (Colombia) [9118-37]

4:30 pm: **Analytical resolution of the reactive diffusion equation for transient electronics including materials whose porosity value changes in terms of their thickness**, Agustín Vargas Toro, Univ. EAFIT (Colombia) . . . . . [9118-38]

4:50 pm: **A model of the immune-compatibility using the install problem in computer science**, Felipe Diaz Jaramillo, Univ. EAFIT (Colombia) . . . . [9118-39]

5:10 pm: **Improving the efficiency of nonparametric entropy estimation**, Alexei Kaltchenko, Wilfrid Laurier Univ. (Canada); Evgeniy A. Timofeev, Yaroslavl State Univ. (Russian Federation) . . . . . [9118-41]

5:30 pm: **Efficiency of nearest neighbor entropy estimators for Bernoulli measures**, Alexei Kaltchenko, Wilfrid Laurier Univ. (Canada); Evgeniy A. Timofeev, Yaroslavl State Univ. (Russian Federation). . . . . [9118-40]

CONFERENCE 9119

LOCATION: CONV. CTR. ROOM 340

Thursday - Friday 8 - 9 May 2014 • Proceedings of SPIE Vol. 9119

Machine Intelligence and Bio-inspired Computation: Theory and Applications VIII

Conference Chairs: **Misty Blowers,** Air Force Research Lab. (USA); **Jonathan Williams,** Air Force Research Lab. (USA)

Program Committee: **Gus Anderson,** MacAulay-Brown, Inc. (USA); **Georgiy M. Levchuk,** Aptima, Inc. (USA); **John A. Marsh,** State Univ. of New York Institute of Technology (USA); **Daniel Stambovsky,** Air Force Research Lab. (USA); **Clare D. Thiem,** Air Force Research Lab. (USA); **Robinson Pino,** ICF International (USA); **Bryant T. Wysocki,** Air Force Research Lab. (USA)

THURSDAY 8 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 340 . . . .THU 8:30 AM TO 9:10 AM

Machine Learning and Bio-Inspired Computation

8:30 am: **A tale of three bio-inspired computational approaches** *(Keynote Presentation),* J. David Schaffer, Binghamton Univ. (USA) . . . . . [9119-1]

SESSION 2

LOCATION: CONV. CTR. ROOM 340 . . . .THU 9:10 AM TO 9:50 AM

Fundamental Research

Session Chair: **Robinson Pino,** ICF International (USA)

9:10 am: **Probabilistic graphs using coupled random variable**, Kenric P. Nelson, Raytheon Co. (USA) . . . . . [9119-2]

9:30 am: **Evaluating data distribution and drift vulnerabilities of machine learning algorithms in secure and adversarial environments**, Kevin M. Nelson, BAE Systems (USA); George E. Corbin, Air Force Research Lab. (USA); Christopher W. Banas, BAE Systems (USA); Misty Blowers, Air Force Research Lab. (USA) . . . . . [9119-3]

SESSION 3

LOCATION: CONV. CTR. ROOM 340 . . THU 9:50 AM TO 10:30 AM

Advancements in Memristor Architecture I

Session Chair: **Bryant T. Wysocki,** Air Force Research Lab. (USA)

9:50 am: **AHaH computing with thermodynamic RAM**, Alex Nugent, M. Alexander Nugent Consulting (USA) . . . . . [9119-4]

10:10 am: **Energy-efficient STDP-based learning circuits with memristor synapses**, Xinyu Wu, Vishal Saxena, Kristy A. Campbell, Boise State Univ. (USA) . . . . . [9119-5]

Coffee Break . . . . . Thu 10:30 am to 11:00 am

SESSION 4

LOCATION: CONV. CTR. ROOM 340 . . THU 11:00 AM TO 11:40 AM

Advancements in Memristor Architecture II

Session Chair: **Clare D. Thiem,** Air Force Research Lab. (USA)

11:00 am: **Towards leakage resiliency: memristor-based AES design for differential power attack mitigation**, Dhireesha Kudithipudi, Rochester Institute of Technology (USA); Ganesh Khedkar, Qualcomm Inc. (USA) . [9119-6]

11:20 am: **Heterogeneous CMOS/memristor hardware neural networks for real-time target classification**, Cory Merkel, Dhireesha Kudithipudi, Rochester Institute of Technology (USA) . . . . . [9119-8]

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

PANEL DISCUSSION

LOCATION: CONV. CTR. ROOM 340 . THU 1:00 PM TO 1:30 PM

Strategic Vision Security and Defense

Moderator: **Daniel Stambovsky,** Air Force Research Lab. (USA)

Panelists: **David Schaffer,** Binghamton Univ. (USA); **Bryant Wysocki,** Air Force Research Lab. (USA); **David Aha,** U.S. Naval Research Lab. (USA); **Misty Blowers,** Air Force Research Lab. (USA)

SESSION 5

LOCATION: CONV. CTR. ROOM 340 . . . . THU 1:30 PM TO 2:30 PM

Optimization of Advanced Systems

Session Chair: **Daniel Stambovsky,** Air Force Research Lab. (USA)

1:30 pm: **Hardware-based artificial neural networks for size, weight, and power constrained platforms**, Bryant T. Wysocki, Nathan R. McDonald, Clare D. Thiem, Air Force Research Lab. (USA) . . . . . [9119-9]

1:50 pm: **A reinforcement learning trained fuzzy neural network controller for maintaining wireless communication connections in multi-robot systems**, Xu Zhong, Stony Brook Univ. (USA); Yu Zhou, State Univ. of New York Institute of Technology (USA) . . . . . [9119-10]

2:10 pm: **A novel pipeline based FPGA implementation of a genetic algorithm**, Nonel S. Thirer, Holon Institute of Technology (Israel) . . . . . [9119-11]

SESSION 6

LOCATION: CONV. CTR. ROOM 340 . . . .THU 2:30 PM TO 3:30 PM

Cyber Operations I

Session Chair: **Jonathan Williams,** Air Force Research Lab. (USA)

2:30 pm: **Hardware machine learning for cybersecurity virus detection**, Bruce McCormick, CogniMem Technologies, Inc. (USA); Robinson E. Pino, ICF International (USA). . . . . [9119-12]

2:50 pm: **The application of top-down abstraction learning using prediction as a supervisory signal to cyber security**, Jonathan Mugan, Aram E. Khalili, 21st Century Technologies, Inc. (USA). . . . . [9119-13]

3:10 pm: **Index of cyber integrity**, Gustave W. Anderson, MacAulay-Brown, Inc. (USA). . . . . [9119-14]

Coffee Break . . . . . Thu 3:30 pm to 3:50 pm

SESSION 7
LOCATION: CONV. CTR. ROOM 340 . . . . THU 3:50 PM TO 5:20 PM

Cyber Operations II

Session Chair: **Gustave W. Anderson,** MacAulay-Brown, Inc. (USA)

3:50 pm: **Neuromorphic computing applications for network intrusion detection systems**, Robinson E. Pino, ICF International (USA) . . . . . [9119-15]

4:10 pm: **A tool for TDM time slot grouping**, Christopher P. Kaiser, Clinton E. Park, Michael A. Pittarelli, North Point Defense, Inc. (USA) . . . . . [9119-17]

4:30 pm: **Machine learning for cyber operations**, Misty Blowers, Jonathan Williams, Air Force Research Lab (USA) . . . . . [9119-18]

5:00 pm: **Bio-inspired diversity for increasing attacker workload**, Stephen Kuhn, Thayer School of Engineering at Dartmouth (USA) . . . . [9119-19]

FRIDAY 9 MAY

SESSION 8
LOCATION: CONV. CTR. ROOM 340 . . . . FRI 8:50 AM TO 9:50 AM

Information Fusion

Session Chair: **Georgiy M. Levchuk,** Aptima, Inc. (USA)

8:50 am: **Patterns of life in temporal data: indexing and hashing for fast and relevant data retrieval**, Georgiy M. Levchuk, Matthew Jacobsen, Mark Weston, Aptima, Inc. (USA) . . . . . [9119-20]

9:10 am: **Analysis of large-scale distributed knowledge sources via autonomous cooperative graph mining**, Georgiy M. Levchuk, Andres Ortiz, Aptima, Inc. (USA); Xifeng Yan, Univ. of California, Santa Barbara (USA) . . . . . [9119-22]

9:30 am: **Trust metrics in information fusion**, Erik Blasch, Air Force Research Lab. (USA) . . . . . [9119-23]

SESSION 9
LOCATION: CONV. CTR. ROOM 340 . . . . FRI 9:50 AM TO 11:10 AM

Remote Sensing

Session Chair: **Erik P. Blasch,** Air Force Research Lab. (USA)

9:50 am: **Quick data evaluation inspired by human vision**, Dieter Meinert, ROSEN Technology and Research Ctr. GmbH (Germany) . . . . . [9119-24]

10:10 am: **Use of neural computing architecture for radio frequency image and target detection**, Daniel Stambovsky, Air Force Research Lab. (USA) . . . . . [9119-25]

10:30 am: **Intelligent water drops for aerospace and defense applications**, Jeremy Straub, The Univ. of North Dakota (USA) . . . . . [9119-26]

10:50 am: **Autonomous target tracking of UAVs based on low-power neural network hardware**, Wei Yang, Zhanpeng Jin, Binghamton Univ. (USA); Clare Thiem, Bryant Wysocki, Air Force Research Lab. (USA); Dan Shen, Genshe Chen, Intelligent Fusion Technology, Inc. (USA) . . . . . [9119-31]

CONFERENCE 9120

LOCATION: CONV. CTR. ROOM 330

Monday - Tuesday 5 - 6 May 2014 • Proceedings of SPIE Vol. 9120

Mobile Multimedia/Image Processing, Security, and Applications 2014

Conference Chairs: **Sos S. Agaian,** The Univ. of Texas at San Antonio (USA); **Sabah A. Jassim,** The Univ. of Buckingham (United Kingdom); **Eliza Yingzi Du,** Qualcomm Inc. (USA)

Program Committee: **David Akopian,** The Univ. of Texas at San Antonio (USA); **Salim Alsharif,** Univ. of South Alabama (USA); **Vijayan K. Asari,** Univ. of Dayton (USA); **Cesar Bandera,** BanDeMar Networks (USA); **Chang Wen Chen,** Univ. at Buffalo (USA); **Reiner Creutzburg,** Fachhochschule Brandenburg (Germany); **Stephen P. DelMarco,** BAE Systems (USA); **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); **Cheryl L. Resch,** Johns Hopkins Univ. Applied Physics Lab. (USA); **Haleh Safavi,** NASA Goddard Space Flight Ctr. (USA); **Harin Sellahewa,** The Univ. of Buckingham (United Kingdom); **Yuri Shukuryan,** National Academy of Sciences of Armenia (Armenia); **Yue Wu,** Tufts Univ. (USA); **Yicong Zhou,** Univ. of Macau (Macao, China)

MONDAY 5 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 330 . . . MON 1:20 PM TO 3:00 PM

Steganography and Data Hiding

Session Chair: **Sabah A. Jassim,**
The Univ. of Buckingham (United Kingdom)

1:20 pm: **An enhancement technique for stereoscopic image using salient shape and wavelet transform**, Yimin Qiu, Wuhan Univ. of Science and Technology (China); Jinshan Tang, Michigan Technological Univ. (USA). [9120-1]

1:40 pm: **Detecting 2-LSB steganography using extended pairs of values analysis**, Omed S. Khalind, Benjamin Aziz, Univ. of Portsmouth (United Kingdom) . . . . . [9120-2]

2:00 pm: **SS-SVD: spread spectrum data hiding scheme based on singular value decomposition**, Victor V. Pomponiu, Univ. of Pittsburgh (USA); Davide Cavagnino, Marco Botta, Univ. degli Studi di Torino (Italy); Harishwaran Hariharan, Univ. of Pittsburgh (USA) . . . . . [9120-3]

2:20 pm: **Steganography based on pixel intensity value decomposition**, Alan A. Abdulla, Harin Sellahewa, Sabah A. Jassim, The Univ. of Buckingham (United Kingdom) . . . . . [9120-4]

2:40 pm: **Taxonomy of LSB steganographic techniques**, James C. Collins, Sos S. Agaian, The Univ. of Texas at San Antonio (USA) . . . . . [9120-5]

Coffee Break . . . . . .Mon 3:00 pm to 3:30 pm

SESSION 2

LOCATION: CONV. CTR. ROOM 330 . . . MON 3:30 PM TO 5:30 PM

Imaging Techniques, Requirements, and Emerging Applications

Session Chair: **Sos S. Agaian,** The Univ. of Texas at San Antonio (USA)

3:30 pm: **Power centroid radar** *(Invited Paper)*, Erlan H. Feria, College of Staten Island (USA). . . . . [9120-6]

4:00 pm: **Effectiveness of image features and similarity measures in cluster-based approaches for content-based image retrieval** *(Invited Paper)*, Hongbo Du, Harin Sellahewa, The Univ. of Buckingham (United Kingdom). . . . . [9120-7]

4:30 pm: **A mobile system for skin cancer detection and monitoring**, Yanliang Gu, Michigan Technological University (USA); Jinshan Tang, Michigan Technological Univ. (USA). . . . . [9120-8]

4:50 pm: **Automatic identification of early miscarriage based on multiple features quantification from ultrasound images**, Shan Khazendar, The Univ. of Buckingham (United Kingdom); Jessica Farren, Imperial College Healthcare NHS Trust (United Kingdom); Hisham Al-Assam, The Univ. of Buckingham (United Kingdom); Ahmed Sayasneh, Imperial College Healthcare NHS Trust (United Kingdom); Hongbo Du, The Univ. of Buckingham (United Kingdom); Tom Bourne, Imperial College Healthcare NHS Trust (United Kingdom); Sabah A. Jassim, The Univ. of Buckingham (United Kingdom) . . . . . [9120-10]

5:10 pm: **A colour and texture based multi-level fusion scheme for ethnicity identification**, Hongbo Du, The Univ. of Buckingham (United Kingdom); Sheerko HMA Salah, Koya Univ. (Iraq); Hawkar Omar Ahmed, Univ. of the Sulaimani (Iraq) . . . . . [9120-11]

TUESDAY 6 MAY

SESSION 3

LOCATION: CONV. CTR. ROOM 330 . . .TUE 8:00 AM TO 10:10 AM

Pattern Detection and Recognition

Session Chair: **Eliza Yingzi Du,** Qualcomm Inc. (USA)

8:00 am: **Search algorithm complexity modeling with application to image alignment and matching** *(Invited Paper)*, Stephen P. DelMarco, BAE Systems (USA) . . . . . [9120-12]

8:30 am: **A novel RANSAC-based Kalman filter algorithm for object characterization and tracking**, Sumit Chakravarty, New York Institute of Technology (USA) . . . . . [9120-13]

8:50 am: **The iris recognition algorithm under the condition of visible light on portable devices**, Siyuan Wang, Yuqing He, Yuan Zeng, Jiaqi Li, Mingqi Liu, Beijing Institute of Technology (China) . . . . . [9120-14]

9:10 am: **Degraded iris image localization and recognition in mobile devices**, Yuqing He, Siyuan Wang, Jing Pan, Kun Huang, Jiaqi Li, Beijing Institute of Technology (China) . . . . . [9120-15]

9:30 am: **Long distance face detection and tracking with probabilistic data association**, Seokwon Yeom, Daegu Univ. (Korea, Republic of) . . . . . [9120-16]

9:50 am: **Markov prediction using geometric mixing of weighted count partitions**, Richard E. L. Metzler, Sos S. Agaian, The Univ. of Texas at San Antonio (USA) . . . . . [9120-17]

Coffee/Exhibition Break. . . . . Tue 10:10 am to 10:50 am

SESSION 4
LOCATION: CONV. CTR. ROOM 330 . . TUE 10:50 AM TO 12:30 PM

Security and Privacy for Media Transmission

Session Chair: **Hongbo Du,** The Univ. of Buckingham (United Kingdom)

10:50 am: **Analytic sequential methods for detecting network intrusions**, Xinjia Chen, Ernest L. Walker, Southern Univ. and A&M College (USA) . [9120-18]

11:10 am: **Simultaneous compression and encryption for secure real-time secure transmission of sensitive video transmission**, Nazar Al-Hayani, Naseer Al-Jawad, Sabah A. Jassim, The Univ. of Buckingham (United Kingdom) . . . . . [9120-19]

11:30 am: **Develop a solution for protecting and securing enterprise networks from malicious attacks**, Harshitha Kamuru, Texas A&M Univ., Kingsville (USA); Mais Nijim, Texas A&M Univ.-Kingsville (USA) . . . . . [9120-20]

11:50 am: **Number system for encryption based privacy preserving speaker verification**, Lei Xu, Tao Feng, Xi Zhao, Weidong Shi, Univ. of Houston (USA) . . . . . [9120-21]

12:10 pm: **Image encryption using 2D sine-logistic chaotic map**, Zhongyun Hua, Yicong Zhou, Chi-Man Pun, C. L. Philip Chen, Univ. of Macau (Macao, China) . . . . . [9120-22]

Lunch/Exhibition Break . . . . . Tue 12:30 pm to 1:40 pm

SESSION 5
LOCATION: CONV. CTR. ROOM 330 . . . . TUE 1:40 PM TO 4:10 PM

Innovative Image Enhancements Techniques

Session Chair: **Sabah A. Jassim,**
The Univ. of Buckingham (United Kingdom)

1:40 pm: **A new omnidirectional multicamera system for high resolution surveillance**, Ömer Cogal, Abdulkadir Akin, Kerem Seyid, Vladan Popovic, Alexandre Schmid, Ecole Polytechnique Fédérale de Lausanne (Switzerland); Beat Ott, Peter Wellig, Armasuisse (Switzerland); Yusuf Leblebici, Ecole Polytechnique Fédérale de Lausanne (Switzerland) . . . . . [9120-23]

2:00 pm: **Robust digital image inpainting algorithm in the wireless environment**, Gevorg Karapetyan, Hakob G. Sarukhanyan, Institute for Informatics and Automation Problems (Armenia); Sos S. Agaian, The Univ. of Texas at San Antonio (USA) . . . . . [9120-24]

2:20 pm: **Implementation of wireless 3D stereo image capture system and synthesizing the depth of region of interest**, Woonchul Ham, Chulgyu Song, Hyeokjae Kwon, Luubaatar Badarch, Chonbuk National Univ. (Korea, Republic of) . . . . . [9120-26]

2:40 pm: **Color image enhancement of low-resolution images captured in extreme lighting conditions**, Evan Krieger, Saibabu Arigela, Vijayan K. Asari, Univ. of Dayton (USA) . . . . . [9120-27]

Coffee/Exhibition Break. . . . . Tue 3:00 pm to 3:30 pm

3:30 pm: **Using DNS amplification DDoS attack for hiding data**, Miralem Mehic, VŠB-Technical Univ. of Ostrava (Czech Republic); Miroslav Voznak, Technical Univ of Ostrava (Czech Republic); Jakub Safarik, Pavol Partila, Martin Mikulec, VŠB-Technical Univ. of Ostrava (Czech Republic) . . . . . [9120-29]

3:50 pm: **Machine learning approach for objective inpainting quality assessment**, V. A. Frantc, V. V. Voronin, V. I. Marchuk, A. I. Sherstobitov, Don State Technical Univ. (Russian Federation); S. Agaian, The Univ. of Texas at San Antonio (USA); K. Egiazarian, Tampere Univ. of Technology (Finland) . . . . . [9120-33]

POSTERS-TUESDAY
LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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.

Color image attribute and quality measurements, Chen Gao, Karen Panetta, Tufts Univ. (USA); Sos S. Agaian, The Univ. of Texas at San Antonio (USA) . . . . . [9120-25]

Interactive video audio system: communication server for INDECT portal, Martin Mikulec, VŠB-Technical Univ. of Ostrava (Czech Republic); Miroslav Voznak, Technical Univ of Ostrava (Czech Republic); Jakub Safarik, Pavol Partila, Jan Rozhon, Miralem Mehic, VŠB-Technical Univ. of Ostrava (Czech Republic) . . . . . [9120-30]

Texture descriptor based on local polynomial approximation, A. I. Sherstobitov, V. I. Marchuk, D. V. Timofeev, V. V. Voronin, Don State Technical Univ. (Russian Federation); K. O. Egiazarian, Tampere Univ. of Technology (Finland); Sos S. Agaian, The Univ. of Texas at San Antonio (USA) . . . . . [9120-34]

Image extrapolation for photo stitching using nonlocal patch-based inpainting, V. V. Voronin, V. I. Marchuk, A. I. Sherstobitov, E. A. Semenischev, Don State Technical Univ. (Russian Federation); S. Agaian, The Univ. of Texas at San Antonio (United States); K. Egiazarian, Tampere Univ. of Technology (Finland) . . . . . [9120-35]

CONFERENCE 9121

LOCATION: CONV. CTR. ROOM 332

Tuesday - Wednesday 6 - 7 May 2014 • Proceedings of SPIE Vol. 9121

Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications 2014

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

Program Committee: **Sheela V. Belur,** The Van Dyke Technology Group, Inc. (USA); **David P. 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,** Chemring Detection Systems, Inc. (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)

TUESDAY 6 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 332 . . TUE 10:40 AM TO 12:20 PM

Information Fusion Approaches and Algorithms I

Session Chairs: **Jerome J. Braun,** MIT Lincoln Lab. (USA); **Damian M. Lyons,** Fordham Univ. (USA)

10:40 am: **MTS in false positive reduction for multi-sensor fusion**, Robert Woodley, 21st Century Systems, Inc. (USA) . . . . . [9121-1]

11:00 am: **Embedding the results of focused Bayesian fusion into a global context**, Jennifer Sander, Michael Heizmann, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [9121-2]

11:20 am: **New results in semi-supervised learning using adaptive classifier fusion**, Robert S. Lynch, Analytic Information Fusion Systems, LLC (USA) . . . . . [9121-3]

11:40 am: **Process of probabilistic multisource multi-INT fusion benefit analysis**, David J. Wisniewski, Paul C. Hershey, Raytheon Co. (USA). . . [9121-4]

12:00 pm: **Multisensor fusion with non-optimal decision rules: the challenges of open world sensing**, Christian P. Minor, Nova Research, Inc. (USA); Kevin J. Johnson, U.S. Naval Research Lab. (USA) . . . . . [9121-5]

Lunch/Exhibition Break . . . . . Tue 12:20 pm to 1:50 pm

SESSION 2

LOCATION: CONV. CTR. ROOM 332 . . . . .TUE 1:50 PM TO 3:10 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)

1:50 pm: **Data mining to identify out-of-the-box findings in data that cannot be reviewed by a human**, Jeremy Straub, The Univ. of North Dakota (USA) . . . . . [9121-6]

2:10 pm: **Characterization of computer network events through simultaneous feature selection and clustering of intrusion alerts**, Siyue Chen, Henry Leung, Univ. of Calgary (Canada); Maxwell Dondo, Defence Research and Development Canada (Canada) . . . . . [9121-7]

2:30 pm: **Space-based detection of spoofing AIS signals using Doppler frequency**, Shanzeng Guo, Defence Research and Development Canada (Canada) . . . . . [9121-8]

2:50 pm: **A metamaterial-inspired combined inductive-capacitive sensor**, Jiang Long, Mitsubishi Electric Research Labs. (USA) and Univ. of California, San Diego (USA); Bingnan Wang, Mitsubishi Electric Research Labs. (USA) . . . . . [9121-9]

Coffee/Exhibition Break. . . . . Tue 3:10 pm to 3:40 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 332 . . . .TUE 3:40 PM TO 5:00 PM

Information Fusion Approaches and Algorithms III

Session Chairs: **David P. Benjamin,** Pace Univ. (USA); **Mirela Popa,** Chemring Detection Systems, Inc. (USA)

3:40 pm: **Synchronous radiation sensing and 3D urban mapping for improved source identification**, Kevin Kochersberger, Kenneth Kroeger, Gordon Christie, Virginia Polytechnic Institute and State Univ. (USA); Morgan McLean, Remote Sensing Lab. (USA); Wojciech Czaja, Univ. of Maryland, College Park (USA) . . . . . [9121-10]

4:00 pm: **On and efficient and effective intelligent transportation system (ITS) using field and simulation data**, Nnanna N. Ekedebe, Wei Yu, Towson Univ. (USA). . . . . [9121-11]

4:20 pm: **Hyperspectral data recovery by incorporating heterogeneous imaging modalities**, Alexander Cloninger, Wojciech Czaja, Univ. of Maryland, College Park (USA) . . . . . [9121-12]

4:40 pm: **Detecting and mapping oil pollution along pipeline routes in tropical ecosystems from multispectral data**, Bashir Adamu, Kevin Tansey, Booker Ogutu, Univ. of Leicester (United Kingdom) . . . . . [9121-14]

WEDNESDAY 7 MAY

Sensing Technology + Applications Plenary Presentations

WED 8:30 AM TO 10:00 AM
LOCATION: CONV. CTR. BALLROOM 1-2

8:30 am to 9:15 am

Planar Optronic Systems

Prof. Dr.-Ing. Ludger Overmeyer, Head of Institute of Transport and Automation Technology

9:15 am to 10:00 am:

The Emerging Industrial Internet

Mr. William Ruh, Vice President and Corporate Officer, GE Global Software Headquarters

Coffee/Exhibition Break. . . . . 10:00 to 10:30 am

SESSION 4
LOCATION: CONV. CTR. ROOM 332 . WED 10:30 AM TO 12:10 PM

Image Fusion

Session Chairs: **Charles F. Hester,** U.S. Army Research, Development and Engineering Command (USA); **Mirela Popa,** Chemring Detection Systems, Inc. (USA)

10:30 am: **Enhancing thermal video using a public database of images**, Hemin Qadir, Ehsan Ali, Samuel Kozaitis, Florida Institute of Technology (USA) . . . . . [9121-15]

10:50 am: **Low-cost, high-performance and efficiency computational photometer design**, Sam B. Siewert, Univ. of Alaska Anchorage (USA) and Univ. of Colorado at Boulder (USA); Jeries Shihadeh, Univ. of Colorado at Boulder (USA); Randall Myers, Mentor Graphics, Inc. (USA); Vitaly Ivanov, Univ. of Alaska Anchorage (USA) . . . . . [9121-16]

11:10 am: **Forensic prescreening system using coded aperture snapshot spectral imager**, Sehoon Lim, David C. Berends, Aveek K. Das, Michael Isnardi, Sek M. Chai, SRI International Sarnoff (USA) . . . . . [9121-17]

11:30 am: **True and false symmetries in the classification of optical scatterers**, Giovanni F. Crosta, Univ. degli Studi di Milano-Bicocca (Italy); Gorden Videen, U.S. Army Research Lab. (USA) . . . . . [9121-18]

11:50 am: **Hybrid fusion and demosaicing algorithm with near-infrared image**, Xiaoyan Luo, Jun Zhang, BeiHang Univ. (China); Qionghai Dai, Tsinghua Univ. (China). . . . . [9121-19]

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

SESSION 5
LOCATION: CONV. CTR. ROOM 332 . . . WED 1:40 PM TO 3:00 PM

Information Fusion and Robotics I

Session Chairs: **Damian M. Lyons,** Fordham Univ. (USA); **David P. Benjamin,** Pace Univ. (USA)

1:40 pm: **Improving object detection in 2D images using a 3D world model**, Herbert Viggh, Peter Cho, Nicholas Armstrong-Crews, Danelle C. Shah, Myra Nam, MIT Lincoln Lab. (USA). . . . . [9121-20]

2:00 pm: **Fusion of ranging and RGB-D data from robot teams operating in confined areas**, Damian M. Lyons, Michael Yu, Fordham Univ. (USA) . [9121-21]

2:20 pm: **Building animats: neurobiomimetic approach for cognitive systems**, Jerome J. Braun, Marianne A. DeAngelus, Kate D. Fischl, Austin R. Hess, Danelle C. Shah, MIT Lincoln Lab. (USA) . . . . . [9121-22]

2:40 pm: **Voice and gesture control of a robotic reconnaissance unmanned unit (R2-U2)**, Adrian Stoica, Jet Propulsion Lab (USA) . . . . . [9121-23]

Coffee/Exhibition Break. . . . . .Wed 3:00 pm to 3:30 pm

SESSION 6
LOCATION: CONV. CTR. ROOM 332 . . . WED 3:30 PM TO 4:50 PM

Information Fusion and Robotics II

Session Chairs: **Damian M. Lyons,** Fordham Univ. (USA); **Jerome J. Braun,** MIT Lincoln Lab. (USA)

3:30 pm: **Integrated multisensor fusion for mapping and localization in outdoor environments for mobile robots**, Thomas Emter, Janko Petereit, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) . . . . . [9121-24]

3:50 pm: **Control fusion for safe multi-robot coordination**, Roger V. Bostelman, Jeremy A. Marvel, National Institute of Standards and Technology (USA) . . . . . [9121-25]

4:10 pm: **Camera-laser projector stereo system based anti-collision system for robotic wheelchair users with cognitive impairment**, Ashutosh Natraj, Sonia Waharte, Daniel Kroening, Univ. of Oxford (United Kingdom) . . . [9121-26]

4:30 pm: **A generic multisensor fusions framework for robust odometry in mobile robots**, Davide A. Cucci, Matteo Matteucci, Politecnico di Milano (Italy) . . . . . [9121-27]

CONFERENCE 9122

LOCATION: CONV. CTR. ROOM 323

Tuesday 6 May 2014 • Proceedings of SPIE Vol. 9122

Next-Generation Analyst II

Conference Chairs: **Barbara D. Broome,** U.S. Army Research Lab. (USA); **David L. Hall,** The Pennsylvania State Univ. (USA); **James Llinas,** Univ. at Buffalo (USA)

Program Committee: **Nina M. Berry,** Sandia National Labs., California (USA); **John S. Eicke,** U.S. Army Research Lab. (USA); **James Fink,** U. S. Army Intelligence Ctr. of Excellence (USA); **Timothy P. Hanratty,** U.S. Army Research Lab. (USA); **James Hendler,** Rensselaer Polytechnic Institute (USA); **John E. Lavery,** U.S. Army Research Lab. (USA); **Bob Madahar,** Defence Science and Technology Lab. (United Kingdom); **Paul Sajda,** Columbia Univ. (USA); **Alan Steinberg,** Georgia Tech Research Institute (USA); **Edward L. Waltz,** BAE Systems (USA)

TUESDAY 6 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 323 . . TUE 8:20 AM TO 10:00 AM

Information Fusion and Analysis

Session Chair: **David L. Hall,** The Pennsylvania State Univ. (USA)

8:20 am: **Automatic theory generation from analyst text files using coherence networks**, Steven C. Shaffer, The Pennsylvania State Univ. (USA) . . . . . [9122-1]

8:40 am: **Using complex event processing (CEP) and vocal synthesis techniques to improve comprehension of sonified human-centric data**, Jeffrey C. Rimland, Mark Ballora, The Pennsylvania State Univ. (USA) . . [9122-2]

9:00 am: **A JDL fusion approach to I&W of terrorist attacks**, David M. McDaniel, Silver Bullet Solutions, Inc. (USA). . . . . [9122-3]

9:20 am: **Warfighter information services: lessons learned in the intelligence domain**, Simon E. Bray, Defence Science and Technology Lab. (United Kingdom). . . . . [9122-4]

9:40 am: **A survey of automated methods for sensemaking support**, James Llinas, Univ. at Buffalo (USA). . . . . [9122-5]

Coffee/Exhibition Break. . . . . Tue 10:00 am to 10:40 am

SESSION 2

LOCATION: CONV. CTR. ROOM 323 . . TUE 10:40 AM TO 12:20 PM

Information Visualization

Session Chair: **James Llinas,** Univ. at Buffalo (USA)

10:40 am: **Neural network based visualization of collaborations in a citizen science project**, Alessandra M. M. Morais, Instituto Nacional de Pesquisas Espaciais (Brazil); Jordan M. Raddick, Johns Hopkins Univ. (USA); Rafael D. Coelho dos Santos, Instituto Nacional de Pesquisas Espaciais (Brazil) . . [9122-6]

11:00 am: **Visualizing common operating picture of critical infrastructure**, Lauri Rummukainen, Lauri Oksama, Jussi Timonen, Jouko Vankka, National Defence Univ. (Finland) . . . . . [9122-7]

11:20 am: **Visualization for multi-INT fusion using JVIEW**, Erik Blasch, Alex Aved, James Nagy, Steve Scott, Air Force Research Lab. (USA). . . [9122-8]

11:40 am: **A visual analytic framework for sense-making in investigative intelligence**, Guoray Cai, The Pennsylvania State Univ. (USA); Geoff A. Gross, Univ. at Buffalo (USA); Dong Chen, The Pennsylvania State Univ. (USA); James Llinas, Univ. at Buffalo (USA) . . . . . [9122-9]

12:00 pm: **Human terrain exploitation suite: applying visual analytics to open source information to improve tactical human terrain understanding**, Timothy P. Hanratty, John Dumer, John T. Richardson, Mark Mittrick, Sue E. Kase, Heather Roy, U.S. Army Research Lab. (USA) . . . . . [9122-10]

Lunch/Exhibition Break . . . . . Tue 12:20 pm to 1:50 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 323 . . . . TUE 1:50 PM TO 3:30 PM

Big Data and Information Management

Session Chair: **Barbara D. Broome,** U.S. Army Research Lab. (USA)

1:50 pm: **Profile-based autonomous data feeding: an approach to the information retrieval problem in a high communications latency environment**, Jeremy Straub, The Univ. of North Dakota (USA) . . . . . [9122-11]

2:10 pm: **Exploiting social media in future army operations: a chemical attack case study**, Sue E. Kase, Kirk Ogaard, U.S. Army Research Lab. (USA); Tanvir Al Amin, Tarek Abdelzaher, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [9122-12]

2:30 pm: **A qualitative model for quantifying organizational data-sharing and integration readiness across enterprise warehouses**, Mohammed M. Olama, Allen W. McNair, Sreenivas R. Sukumar, James Nutaro, Oak Ridge National Lab. (USA) . . . . . [9122-13]

2:50 pm: **Virtual information exchange: enabling secure, dynamic, and policy-controlled interoperation**, Geeth de Mel, David Wood, Seraphin Calo, Keith Grueneberg, IBM Thomas J. Watson Research Ctr. (USA); David Braines, IBM United Kingdom Ltd. (United Kingdom); Paul Sullivan, Intelpoint Inc. (USA); Tien Pham, U.S. Army Research Lab. (USA); Dinesh Verma, IBM Thomas J. Watson Research Ctr. (USA) . . . . . [9122-14]

3:10 pm: **Utilizing semantic wiki technology for intelligence analysis at the tactical edge**, Eric G. Little, Modus Operandi, Inc. (USA) . . . . . [9122-16]

Coffee Break . . . . . Tue 3:30 pm to 4:00 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 323 . . . . TUE 4:00 PM TO 5:20 PM

Participatory Sensing & Cognition

Session Chair: **David L. Hall,** The Pennsylvania State Univ. (USA)

4:00 pm: **User-centric incentive design for participatory mobile phone sensing**, Wei Gao, Haoyang Lu, The Univ. of Tennessee Knoxville (USA) . . . . . [9122-17]

4:20 pm: **Conversational sensing**, Alun D. Preece, Christopher Gwilliams, Christos Parizas, Diego Pizzocaro, Cardiff Univ. (United Kingdom); David Braines, IBM United Kingdom Ltd. (United Kingdom) . . . . . [9122-18]

4:40 pm: **Technology and the analyst: using ACT-R models to understand collective sensemaking and the role of technology in mediating cognition**, Darren P. Richardson, Paul R. Smart, Univ. of Southampton (United Kingdom); Katia Sycara, Carnegie Mellon Univ. (USA). . . . . [9122-19]

5:00 pm: **Language and dialect identification in social media analysis**, Stephen Tratz, Douglas Briesch, Jamal Laoudi, Clare Voss, Melissa Holland, U.S. Army Research Lab. (USA) . . . . . [9122-21]

POSTERS-TUESDAY

LOCATION: CONV. CTR. HALL C . . . . . TUE 6:00 PM 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 session. 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 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 the JDL data fusion process model for the condition monitoring of aircraft, Joseph T. Bernardo, The Pennsylvania State Univ. (USA) . . . . . [9122-22]

Predicting student success using analytics in course learning management systems, Mohammed M. Olama, Gautam Thakur, Allen W. McNair, Sreenivas R. Sukumar, Oak Ridge National Lab. (USA). . . . . [9122-23]

CONFERENCE 9123

LOCATION: CONV. CTR. ROOM 331

Thursday - Friday 8 - 9 May 2014 • Proceedings of SPIE Vol. 9123

Quantum Information and Computation XII

Conference Chairs: **Eric Donkor,** Univ. of Connecticut (USA); **Andrew R. Pirich,** ACP Consulting (USA); **Howard E. Brandt,** U.S. Army Research Lab. (USA)

Conference Co-Chairs: **Michael R. Frey,** Bucknell Univ. (USA); **Samuel J. Lomonaco Jr.,** Univ. of Maryland, Baltimore County (USA); **John M. Myers,** Harvard Univ. (USA)

Program Committee: **Paul M. Alsing,** Air Force Research Lab. (USA); **Chip Brig Elliott,** Raytheon BBN Technologies (USA); **Reinhard K. Erdmann,** Air Force Research Lab. (USA); **Michael L. Fanto,** Air Force Research Lab. (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); **Alexander V. Sergienko,** Boston Univ. (USA); **Tai Tsun Wu,** Harvard Univ. (USA)

THURSDAY 8 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 331 . . . THU 8:20 AM TO 10:00 AM

QKD, Cryptography I

Session Chairs: **Howard E. Brandt,** U.S. Army Research Lab. (USA); **Louis H. Kauffman,** Univ. of Illinois at Chicago (USA)

8:20 am: **Superdense teleportation for space applications**, Trent M. Graham, Univ. of Illinois at Urbana-Champaign (USA); Herbert J. Bernstein, Hampshire College (USA); Hamid Javadi, Jet Propulsion Lab. (USA); Barry J. Geldzahler, NASA Headquarters (USA); Paul Kwiat, Univ. of Illinois at Urbana-Champaign (USA) . . . . . [9123-1]

8:40 am: **Quantum state regeneration in entanglement based QKD**, Reinhard Erdmann, Advanced Automation Corp. (USA); David H. Hughes, Richard J. Michalak, John Malowicki, Paul Cook, Air Force Research Lab. (USA) . . [9123-2]

9:00 am: **LDPC error correction for Gb/s QKD**, Alan Mink, Anastase Nakassis, National Institute of Standards and Technology (USA). . . . . [9123-3]

9:20 am: **Polar codes in a QKD environment**, Anastase Nakassis, Alan Mink, National Institute of Standards and Technology (USA). . . . . [9123-4]

9:40 am: **Spectral-temporal-polarization encoding of photons for multi-user secure quantum communication.**, Eric Donkor, Univ. of Connecticut (USA) . . . . . [9123-5]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

SESSION 2

LOCATION: CONV. CTR. ROOM 331 . . . THU 10:30 AM TO 11:30 AM

QKD, Cryptography II

Session Chairs: **Michael R. Frey,** Bucknell Univ. (USA); **Paul M. Alsing,** Air Force Research Lab. (USA)

10:30 am: **Adaptive multicarrier quadrature division modulation for continuous-variable quantum key distribution**, Laszlo Gyongyosi, Budapest Univ. of Technology and Economics (Hungary) and Hungarian Academy of Sciences (Hungary); Sandor Imre, Budapest Univ. of Technology and Economics (Hungary) . . . . . [9123-6]

10:50 am: **The braided single-stage protocol for quantum-secure communication**, Bhagyashri A. Darunkar, Pramode K. Verma, The Univ. of Oklahoma, Tulsa (USA) . . . . . [9123-7]

11:10 am: **Dual compressible hybrid quantum secret sharing schemes based on extended unitary operations**, Hong Lai, Mehmet Orgun, Macquarie Univ. (Australia); Liyin Xue, Australian Taxation Office (Australia); Jinghua Xiao, Beijing Univ. of Posts and Telecommunications (China); Josef Pieprzyk, Macquarie Univ. (Australia) . . . . . [9123-8]

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

SESSION 3

LOCATION: CONV. CTR. ROOM 331 . . . . . THU 1:20 PM TO 3:00 PM

Quantum Gates, Circuits, and Memories

Session Chairs: **John M. Myers,** Harvard Univ. (USA); **Michael J. Hayduk,** Air Force Research Lab. (USA)

1:20 pm: **Example of lumped parameter modeling of a quantum optics circuit**, Paul J. Werbos, National Science Foundation (USA) . . . . . [9123-10]

1:40 pm: **Implications of the Landauer limit for quantum logic**, Fabian M. Mihelic, The Univ. of Tennessee Graduate School of Medicine (USA) . . [9123-11]

2:00 pm: **Building two-photon qubit from incoherent thermal fields**, Tao Peng, Hui Chen, Jane Sprigg, Yanhua Shih, Univ. of Maryland, Baltimore County (USA) . . . . . [9123-12]

2:20 pm: **Progress towards a quantum memory with telecom-wavelength conversion**, Daniel T. Stack, Qudsia Quraishi, Patricia J. Lee, U.S. Army Research Lab. (USA) . . . . . [9123-13]

2:40 pm: **A 3D topological insulator quantum dot for optically controlled quantum memory and quantum computing**, Hari P. Paudel, Michael N. Leuenberger, Univ. of Central Florida (USA) . . . . . [9123-14]

Coffee Break . . . . . Thu 3:00 pm to 3:30 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 331 . . . . . THU 3:30 PM TO 5:50 PM

Quantum Imaging, Sensing, and Networks

Session Chairs: **Samuel J. Lomonaco Jr.,** Univ. of Maryland, Baltimore County (USA); **Reinhard Erdmann,** Advanced Automation Corp. (USA)

3:30 pm: **New results in remote quantum sensing**, Gerald N. Gilbert, The MITRE Corp. (USA) . . . . . [9123-15]

3:50 pm: **Characterization of photons generated in spontaneous parametric down-conversion**, Mark Bashkansky, Igor Vurgaftman, U.S. Naval Research Lab. (USA); J. Reintjes, Sotera Defense Solutions (USA) . . . . . [9123-16]

4:10 pm: **Phase manipulation in fluctuation-fluctuation correlation of thermal light**, Hui Chen, Tao Peng, Jane Sprigg, Yanhua Shih, Univ. of Maryland, Baltimore County (USA) . . . . . [9123-17]

4:30 pm: **Deterministic generation of many-photon GHZ states using quantum dots in a cavity**, Michael N. Leuenberger, Mikhail Erementchouk, Univ. of Central Florida (USA); Ahmed Elhalawany, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). . . . . [9123-18]

4:50 pm: **Quantum walk search factors in the regime of weak measurement**, Debabrata Ghoshal, George Mason Univ. (USA). . . . . [9123-19]

5:10 pm: **Analysis of quantum dot superlattice of quantum information theory**, Subhamoy Singha Roy, JIS College of Engineering (India) . . . . [9123-20]

5:30 pm: **Hyper-entanglement based sensor with reduced measurement time and enhanced signal to interference ratio**, James F. Smith III, U.S. Naval Research Lab. (USA) . . . . . [9123-21]

CONFERENCE 9123

LOCATION: CONV. CTR. ROOM 331

FRIDAY 9 MAY

SESSION 5

LOCATION: CONV. CTR. ROOM 331 . . . . FRI 8:00 AM TO 10:40 AM

Quantum Computing and Information Science I

Session Chairs: **Michael L. Fanto,** Air Force Research Lab. (USA); **Eric Donkor,** Univ. of Connecticut (USA)

8:00 am: **Absence of local energy in elementary spin systems at low temperature**, Michael R. Frey, Bucknell Univ. (USA); Masahiro Hotta, Tohoku Univ. (Japan) . . . . . [9123-22]

8:20 am: **Maximal proper acceleration and the quantum-classical boundary**, Howard E. Brandt, U.S. Army Research Lab. (USA) . . . . . [9123-23]

8:40 am: **A quantum benchmark for the D-Wave computer**, Samuel J. Lomonaco Jr., Univ. of Maryland, Baltimore County (USA); Louis H. Kauffman, Univ. of Illinois at Chicago (USA); Omar Shehab, Univ. of Maryland, Baltimore County (USA). . . . . [9123-24]

9:00 am: **Graphical calculi for quantum information and quantum topology**, Louis H. Kauffman, Univ. of Illinois at Chicago (USA); Samuel J. Lomonaco Jr., Univ. of Maryland, Baltimore County (USA) . . . . . [9123-25]

9:20 am: **Global effects of mathematical locality and number scaling on physical systems and on space time**, Paul Benioff, Argonne National Lab. (USA) . . . . . [9123-26]

9:40 am: **Topological quantum computation of the Dold-Thom functor**, Juan F. Ospina, Univ. EAFIT (Colombia) . . . . . [9123-27]

10:00 am: **Quantum walk in optical quantum device**, Nan Wu, Haixing Hu, Ping Xu, Fangmin Song, Nanjing Univ. (China); Xiangdong Li, New York City College of Technology (USA) and City Univ. of New York (USA) . . . . . [9123-28]

10:20 am: **Logical synchronization: how evidence and hypotheses steer atomic clocks**, John M. Myers, Harvard Univ. (USA) . . . . . [9123-29]

CONFERENCE 9124

LOCATION: CONV. CTR. ROOM 337

Thursday - Friday 8 - 9 May 2014 • Proceedings of SPIE Vol. 9124

Satellite Data Compression, Communications, and Processing X

Conference Chairs: **Bormin Huang,** Univ. of Wisconsin-Madison (USA); **Chein-I Chang,** Univ. of Maryland, Baltimore County (USA); **José Fco. López,** Univ. de Las Palmas de Gran Canaria (Spain)

Conference Co-Chairs: **Chulhee Lee,** Yonsei Univ. (Korea, Republic of); **Yunsong Li,** Xidian Univ. (China); **Qian Du,** Mississippi State Univ. (USA)

Program Committee: **Philip E. Ardanuy,** Raytheon Intelligence & Information Systems (USA); **Roberto Camarero,** Ctr. National d'Études Spatiales (France); **Lena Chang,** National Taiwan Ocean Univ. (Taiwan); **Ni-Bin Chang,** Univ. of Central Florida (USA); **Yang-Lang Chang,** National Taipei Univ. of Technology (Taiwan); **David J. Crain,** GeoMetWatch Corp. (USA); **Mitchell D. Goldberg,** National Oceanic and Atmospheric Administration (USA); **Lingjia Gu,** Jilin Univ. (China); **Li-xin Guo,** Xidian Univ. (China); **Tung-Ju Hsieh,** National Taipei Univ. of Technology (Taiwan); **Allen H.-L. Huang,** Univ. of Wisconsin-Madison (USA); **Felix Huber,** Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Roger L. King,** Mississippi State Univ. (USA); **Sebastian Lopez Suarez,** Univ. de Las Palmas de Gran Canaria (Spain); **Enrico Magli,** Politecnico di Torino (Italy); **Jarno Mielikainen,** Univ. of Eastern Finland (USA); **Daniela I. Moody,** Los Alamos National Lab. (USA); **Antonio J. Plaza,** Univ. de Extremadura (Spain); **Jordi Portell de Mora,** Univ. de Barcelona (Spain); **Jeffery J. Puschell,** Raytheon Space & Airborne Systems (USA); **Shen-En Qian,** Canadian Space Agency (Canada); **Joan Serra-Sagrista,** Univ. Autònoma de Barcelona (Spain); **Xiaopeng Shao,** Xidian Univ. (China); **Carole Thiebaut,** Ctr. National d'Études Spatiales (France); **Pierre V. Villeneuve,** Space Computer Corp. (USA); **Raffaele Vitulli,** European Space Research and Technology Ctr. (Netherlands); **Maria F. von Schoenermark,** Univ. Stuttgart (Germany); **Jiaji Wu,** Xidian Univ. (China); **Zhensen Wu,** Xidian Univ. (China); **Zhang Ye,** Harbin Institute of Technology (China)

THURSDAY 8 MAY

SESSION 1

LOCATION: CONV. CTR. ROOM 337 . . THU 8:00 AM TO 10:00 AM

Data Processing I

Session Chair: **Bormin Huang,** Univ. of Wisconsin-Madison (USA)

8:00 am: **A theory of least squares target-specified virtual dimensionality in hyperspectral imagery**, Drew Paylor, Chein-I Chang, Univ. of Maryland, Baltimore County (USA) . . . . . [9124-1]

8:20 am: **Investigation on the GPS single scattering from a 2D largescale sea surface**, Yiwen Wei, Li-Xin Guo, Xidian Univ. (China) . . . . . [9124-2]

8:40 am: **Applying the hyperspectral region growing algorithm to oil segmentation**, Meiping Song, Wei Xu, Dalian Maritime Univ. (China); Haimo Bao, Dalian Nationalities Univ. (China) . . . . . [9124-3]

9:00 am: **High-resolution remote sensing image restoration based on double-knife-edge method**, Shaohui Zhang, Lin Wang, Qiuhua Luo, Xiaopeng Shao, Xidian Univ. (China) . . . . . [9124-4]

9:20 am: **Scattering characteristics of Gaussian beam from two dimensional dielectric rough surfaces based on the two-scale method**, Longxiang Linghu, Zhensen Wu, Yuanyuan Zhang, Xidian Univ. (China) . [9124-5]

9:40 am: **Multidimensional edge detection operators**, Sungwook Youn, Chulhee Lee, Yonsei Univ. (Korea, Republic of) . . . . . [9124-6]

Coffee Break . . . . . Thu 10:00 am to 10:30 am

SESSION 2

LOCATION: CONV. CTR. ROOM 337 . . THU 10:30 AM TO 11:50 AM

Data Compression I

Session Chair: **Chein-I Chang,**
Univ. of Maryland, Baltimore County (USA)

10:30 am: **Efficient lossy compression implementations of hyperspectral images: tools, hardware platforms, and comparisons**, Jose F. Lopez, Univ. de Las Palmas de Gran Canaria (Spain) . . . . . [9124-7]

10:50 am: **Lossy hyperspectral image compression using improved classified DCT and 3DSPIHT**, Keyan Wang, Zifan Hu, Ran Han, Jing Zhang, Yunsong Li, Xidian Univ. (China) . . . . . [9124-8]

11:10 am: **Hyperspectral data compression using lasso algorithm for spectral decorrelation**, Amedeton Simplice Alissou, Ye Zhang, Harbin Institute of Technology (China) . . . . . [9124-9]

11:30 am: **Wavelet-based compression of multichannel climate data**, Ershad Sharifahmadian, Yoonsuk Choi, Shahram Latifi, Univ. of Nevada, Las Vegas (USA). . . . . [9124-10]

Lunch Break . . . . . Thu 11:50 am to 1:20 pm

SESSION 3

LOCATION: CONV. CTR. ROOM 337 . . . . THU 1:20 PM TO 3:00 PM

Data Processing II

Session Chair: **José Fco. López,**
Univ. de Las Palmas de Gran Canaria (Spain)

1:20 pm: **Anomaly discrimination in hyperspectral imagery**, Shih-Yu Chen, Drew Paylor, Chein-I Chang, Univ. of Maryland, Baltimore County (USA). . . . . [9124-11]

1:40 pm: **MTF compensation method utilizing the curved edge for high-resolution satellite image recovery**, Qiuhua Luo, Lin Wang, Hong Yang, Shaohui Zhang, Xiaopeng Shao, Xidian Univ. (China). . . . . [9124-12]

2:00 pm: **Adaptive sparse signal processing of satellite-based radiofrequency (RF) recordings of lightning events**, Daniela I. Moody, David A. Smith, Los Alamos National Lab. (USA) . . . . . [9124-13]

2:20 pm: **A compressed coded aperture imaging warning system**, Xiaopeng Shao, Juan Du, Lin Wang, Xidian Univ. (China) . . . . . [9124-14]

2:40 pm: **An adaptive filtering based on generalized sidelobe cancellation for target detection of hyperspectral images**, Lena Chang, Zay-Shing Tang, National Taiwan Ocean Univ. (Taiwan); Yang-Lang Chang, National Taipei Univ. of Technology (Taiwan) . . . . . [9124-15]

Coffee Break . . . . . Thu 3:00 pm to 3:30 pm

SESSION 4

LOCATION: CONV. CTR. ROOM 337 . . . . THU 3:30 PM TO 5:50 PM

Spectral Unmixing

Session Chair: **Chulhee Lee,** Yonsei Univ. (Korea, Republic of)

3:30 pm: **On the acceleration of the NFINDR algorithm for hyperspectral endmember extraction**, Raul Guerra, Sebastian López, Gustavo M. Callico, Jose F. Lopez, Roberto Sarmiento, Univ. de Las Palmas de Gran Canaria (Spain) . . . . . [9124-16]

3:50 pm: **Endmember variability resolved by pixel purity index in hyperspectral imagery**, Yao Li, Cheng Gao, Shih-Yu Chen, Chein-I Chang, Univ. of Maryland, Baltimore County (USA) . . . . . [9124-17]

4:10 pm: **On performance improvement of vertex component analysis-based endmember extraction from hyperspectral imagery**, Qian Du, Mississippi State Univ. (USA); Nareenart Raksuntorn, Suan Sunandha Rajabhat Univ. (Thailand); Nick Younan, Mississippi State Univ. (USA). . . . . [9124-18]

4:30 pm: **Fisher's ratio-based criterion for finding endmembers in hyperspectral imagery**, Cheng Gao, Shih-Yu Chen, Chein-I Chang, Univ. of Maryland, Baltimore County (USA) . . . . . [9124-19]

4:50 pm: **Progressive band processing of simplex growing algorithm for finding endmembers in hyperspectral imagery**, Robert C. Schultz, Marissa Hobbs, U.S. Naval Academy (USA); Chein-I Chang, Univ. of Maryland, Baltimore County (USA). . . . . [9124-20]

CONFERENCE 9124
LOCATION: CONV. CTR. ROOM 337

5:10 pm: **Relationship between linear spectral unmixing and endmember finding**, Hsiao-Chi Li, Shih-Yu Chen, Cheng Gao, Chein-I Chang, Univ. of Maryland, Baltimore County (USA) . . . . . [9124-21]

5:30 pm: **Nonlinear hyperspectral unmixing based on multiple kernel constrained NMF**, Jiantao Cui, Xiaorun Li, Zhejiang Univ. (China); Liaoying Zhao, Junpeng Zheng, Hangzhou Dianzi Univ. (China). . . . . [9124-22]

POSTERS-THURSDAY
LOCATION: CONV. CTR. HALL C . . . . . .THU 6:00 PM 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 session. 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 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 novel IR polarization staring imaging system designed by a four-camera array, Xiaopeng Shao, Fei Liu, Pingli Han, Xidian Univ. (China) . . . . . [9124-44]

Imaging characteristics of ball lens, Qinghui Li, Xiaopeng Shao, Xidian Univ. (China) . . . . . [9124-45]

Spherical aberration and modulation transfer function, Qinghui Li, Xiaopeng Shao, Xidian Univ. (China) . . . . . [9124-46]

Focusing through a turbid medium by amplitude modulation with genetic algorithm, Xiaopeng Shao, Wei Jia Dai, Li Gen Peng, Xidian Univ. (China) . . . . . [9124-47]

Particle swarm optimization for focusing by phase modulation through scattering media, Xiaopeng Shao, Li Gen Peng, Wei Jia Dai, Xidian Univ. (China) . . . . . [9124-48]

Pixel-level image registration method of polarization images acquired by a four-camera array, Xiaopeng Shao, Pingli Han, Fei Liu, Xidian Univ. (China) . . . . . [9124-49]

Online visual tracking based on updating with smoothing, Jin Zhang, Kai Liu, Fei Cheng, Yunsong Li, Xidian Univ. (China) . . . . . [9124-50]

Random grid ferns for visual tracking, Fei Cheng, Kai Liu, Jin Zhang, Yunsong Li, Xidian Univ. (China) . . . . . [9124-51]

FRIDAY 9 MAY

SESSION 5
LOCATION: CONV. CTR. ROOM 337 . . . FRI 8:00 AM TO 10:00 AM

High-Performance Computing

Session Chair: **Yunsong Li,** Xidian Univ. (China)

8:00 am: **Above the cloud computing orbital services distributed data model**, Jeremy Straub, The Univ. of North Dakota (USA) . . . . . [9124-23]

8:20 am: **Parallelized physical optics computations for the RCS prediction of rough surface by CUDA**, Xiao Meng, Li-Xin Guo, Xidian Univ. (China) . . . . . [9124-24]

8:40 am: **Optimizing weather and research forecast (WRF) Thompson cloud microphysics on Intel Many Integrated Core (MIC)**, Jarno Mielikainen, Melin Huang, Bormin Huang, HungLung Allen Huang, Univ. of Wisconsin-Madison (USA). . . . . [9124-25]

9:00 am: **Computational design of miniaturized microstrip antenna for satellite communications in the bands S and C**, Damian A. Campo, Jose I. Marulanda, Univ. EAFIT (Colombia). . . . . [9124-26]

9:20 am: **Massive parallel implementation of JPEG2000 decoding algorithm with multi-GPUs**, Xianyun Wu, Yunsong Li, Kai Liu, Li Wang, Xidian Univ. (China); Keyan Wang, Xidian Univ (China). . . . . [9124-27]

9:40 am: **Using Intel Xeon Phi to accelerate the WRF TEMF planetary boundary layer scheme**, Melin Huang, Jarno Mielikainen, Bormin Huang, HungLung Allen Huang, Univ. of Wisconsin-Madison (USA) . . . . . [9124-28]

Coffee Break . . . . . Fri 10:00 am to 10:30 am

SESSION 6
LOCATION: CONV. CTR. ROOM 337 . . . FRI 10:30 AM TO 11:50 AM

Data Compression II

Session Chair: **Qian Du,** Mississippi State Univ. (USA)

10:30 am: **Texture based adaptive lifting wavelet transform for hyperspectral image compression**, Yan Yan, Zifan Hu, Xidian Univ. (China) . . . . . [9124-29]

10:50 am: **FPGA based JPEG-LS encoder for lossless and lossy onboard image compression**, Yakup Murat Mert, TÜBITAK UZAY (Turkey). . . . [9124-30]

11:10 am: **Lossless compression of hyperspectral images using edge-based multi-order predictor**, Keyan Wang, Huilin Liao, Yunsong Li, Liping Wang, Xianyun Wu, Xidian Univ. (China) . . . . . [9124-31]

11:30 am: **Remote sensing image real-time progressive transmission based on multi-threads with retry broken downloads**, Haicheng Qu, Yu Meng, Xiaochen Shan, Wanjun Liu, Jie Yu, Liaoning Technical Univ. (China) . . [9124-32]

Lunch Break . . . . . Fri 11:50 am to 1:20 pm

SESSION 7
LOCATION: CONV. CTR. ROOM 337 . . . . . FRI 1:20 PM TO 3:00 PM

Image Classification

Session Chair: **Daniela I. Moody,** Los Alamos National Lab. (USA)

1:20 pm: **Land cover classification in multispectral satellite imagery using sparse approximations on learned dictionaries**, Daniela I. Moody, Steven P. Brumby, Joel C. Rowland, Chadana Gangodagamage, Los Alamos National Lab. (USA) . . . . . [9124-33]

1:40 pm: **Sparse classification of hyperspectral image based on first-order neighborhood system weighted constraint**, Jiahui Liu, Xidian Univ. (China); Hui Guan, Beijing Institute of Space Mechanics & Electricity (China); Jiaojiao Li, Yunsong Li, Xidian Univ. (China) . . . . . [9124-34]

2:00 pm: **An efficient spatial-spectral classification method for hyperspectral imagery**, Wei Li, Beijing Univ. of Chemical Technology (China); Qian Du, Mississippi State Univ. (USA) . . . . . [9124-35]

2:20 pm: **A stereo remote sensing feature selection method based on artificial bee colony algorithm**, Yiming Yan, Pigang Liu, Ye Zhang, Nan Su, Shu Tian, Harbin Institute of Technology (China); Fengjiao Gao, Institute of Automation (China) and Heilongjiang Academy of Sciences (China) . . . [9124-36]

2:40 pm: **Fisher criterion based nearest feature line approach to land cover classification using multisource data fusion**, Yang-Lang Chang, Yi-Shiang Fu, Tung-Ju Hsieh, National Taipei Univ. of Technology (Taiwan); Lena Chang, National Taiwan Ocean Univ. (Taiwan); Chin-Chuan Han, National United Univ. (Taiwan); Bormin Huang, Univ. of Wisconsin-Madison (USA) . . . . . [9124-37]

Coffee Break . . . . . Fri 3:00 pm to 3:30 pm

SESSION 8
LOCATION: CONV. CTR. ROOM 337 . . . . . FRI 3:30 PM TO 5:30 PM

Data Processing III

Session Chair: **Meiping Song,** Dalian Maritime Univ. (China)

3:30 pm: **Background suppression issues in anomaly detection for hyperspectral imagery**, Yu-lei Wang, Harbin Engineering Univ. (China); Shih-Yu Chen, Univ. of Maryland, Baltimore County (USA); Chunhong Liu, South China Agricultural Univ. (China); Chein-I Chang, Univ. of Maryland, Baltimore County (USA) . . . . . [9124-38]

3:50 pm: **No-reference remote sensing image quality assessment using a comprehensive evaluation factor**, Lin Wang, Wang Xu, Xiao Li, Xiaopeng Shao, Xidian Univ. (China) . . . . . [9124-39]

4:10 pm: **Impact of a revised standard for best practices for academic, governmental and industrial ground station scheduling and communications design**, Scott Kerlin, Jeremey Straub, The Univ. of North Dakota (USA); Christoffer Korvald, Univ. of North Dakota (USA) . . . . . [9124-40]

4:30 pm: **An equivalent model for the electromagnetic scattering coefficient of the typical land surface in the microwave band**, Yuanyuan Zhang, Zhensen Wu, Kaiyuan Fu, Xidian Univ. (China) . . . . . [9124-41]

4:50 pm: **Unfolding hurricane volume data using focus-plus-context technique**, Tung-Ju Hsieh, Chun-Jhun Wu, Yang-Lang Chang, National Taipei Univ. of Technology (Taiwan); Bormin Huang, Univ. of Wisconsin-Madison (USA) . . . . . [9124-42]

5:10 pm: **Manifold regularized sparsity model for hyperspectral target detection**, Jing Li, Zhejiang Univ. (China); Liaoying Zhao, Hangzhou Dianzi Univ. (China); Xiaorun Li, Zhejiang Univ. (China) . . . . . [9124-43]

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9114	**Advanced Photon Counting Techniques VIII** *(Itzler, Campbell)*	$ 53
9115	**Energy Harvesting and Storage: Materials, Devices, and Applications V** *(Dhar, Dutta, Balaya)*	$ 60
9116	**Next-Generation Robots and Systems** *(Wijesundara, Popa)*	$ 45
9117	**Three-Dimensional Imaging, Visualization, and Display 2014** *(Son, Javidi)*	$ 80
9118	**Independent Component Analyses, Compressive Sampling, Wavelets, Neural Net, Biosystems, and Nanoengineering XII** *(Szu)*	$ 70
9119	**Machine Intelligence and Bio-inspired Computation: Theory and Applications VIII** *(Blowers, Williams)*	$ 53

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All proceedings from this event will be published in the SPIE Digital Library, promoting breakthrough results, ideas, and organizations to millions of key researchers from around the world.

VOL#	TITLE (EDITOR)	PRICE
9120	**Mobile Multimedia/Image Processing, Security, and Applications 2014** *(Du, Agaian, Jassim)*	$ 53
9121	**Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications 2014** *(Braun)*	$ 60
9122	**Next-Generation Analyst II** *(Llinas, Hall, Broome)*	$ 53
9123	**Quantum Information and Computation XII** *(Brandt, Donkor, Pirich)*	$ 53
9124	**Satellite Data Compression, Communications, and Processing X** (López, Huang, Chang)	$ 80

**Indicates volumes that will be available at the meeting. Other Proceedings will be available an average of 6 weeks after the meeting.

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Sensing Technology and Applications 2014: Imaging and Sensing Technologies
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Meeting attendee: $155
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Nonattendee nonmember price: $445

Sensing Technology and Applications 2014: Sensing for Industry, Environment, and Health; and Emerging Technologies
(Includes Vols. 9105-9108, and 9110-9116)
Order No. CDS547
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Nonattendee member price: $475
Nonattendee nonmember price: $630

Sensing Technology and Applications 2014: Information Systems and Networks: Processing, Fusion, and Knowledge Generation; and Data Visualization
(Includes Vols. 9117-9124)
Order No. CDS548
Est. pub. July 2014
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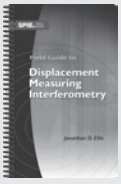

Optical Satellite Signal Processing and Enhancement
Shen-En Qian
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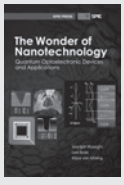
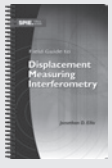


The Wonder of Nanotechnology: Quantum Optoelectronic Devices and Applications
Manijeh Razeghi, Leo Esaki, and **Klaus von Klitzing**
Vol. PM238
SPIE Member $123 / Nonmember $145



Field Guide to Displacement Measuring Interferometry
Jonathan D. Ellis
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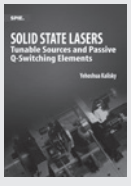
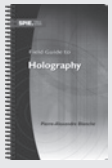
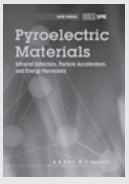


Solid State Lasers: Tunable Sources and Passive Q-Switching Elements
Yehoshua Y. Kalisky
Vol. PM243
SPIE Member $47 / Nonmember $55



Field Guide to Holography
Pierre-Alexandre J. Blanche
Vol. FG31
SPIE Member $36 / Nonmember $42

Ocean Sensing and Monitoring: Optics and Other Methods
Weilin Hou
Vol. TT98
SPIE Member $62 / Nonmember $73



Pyroelectric Materials: Infrared Detectors, Particle Accelerators, and Energy Harvesters
Ashok K. Batra and **Mohan D. Aggarwal**
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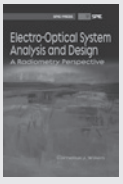
SPIE Member $56 / Nonmember $66



Electro-Optical System Analysis and Design: A Radiometry Perspective
Cornelius J. Willers
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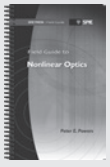

Field Guide to Nonlinear Optics
Peter E. Powers
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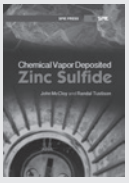
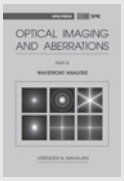
SPIE Member $36 / Nonmember $42



Chemical Vapor Deposited Zinc Sulfide
John S. McCloy and **Randal W. Tustison**
Vol. PM237
SPIE Member $56 / Nonmember $66



Optical Imaging and Aberrations, Part III: Wavefront Analysis
Virendra N. Mahajan
Vol. PM221
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Windowed Fringe Pattern Analysis
Qian Kemao
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SPIE provided over $3.2 million in support of education and outreach programs in 2013.

GIVING.

SPIE supports tomorrow's leaders through a wide array of scholarships, grants, educational materials, and networking opportunities.

SPIE Scholarships

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Education and Training in Optics and Photonics Conference (ETOP)

Hands on Optics (HOO): K-12 outreach

Science Fairs

Optics Education Directory

Free SPIE Journal Access in developing nations

Active Learning in Optics and Photonics (ALOP): Teacher Training

International Centre for Theoretical Physics (ICTP) Winter College

Visiting Lecturer Program

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SPIE Conference App
Search topics, people, papers, courses, networking events. Print your schedule and go!

SPIE Exhibition Directory
Search exhibitors, technology areas, applications, demonstrations, new products. Build and print your exhibition schedule.

Courtesy of **SPIE.**

REGISTRATION

Onsite Registration and Badge Pick-Up Hours
Pratt St. Lobby (Level 300)

Sunday 4 May. . . . . 4:00 pm to 7:00 pm
Monday 5 May . . . . . 7:00 am to 5:00 pm
Tuesday 6 May . . . . . 7:30 am to 5:00 pm
Wednesday 7 May. . . . . 7:30 am to 5:00 pm
Thursday 8 May . . . . . 7:30 am to 5:00 pm
Friday 9 May. . . . . 7:30 am to 12:00 pm

CONFERENCE REGISTRATION

Includes admission to all conference sessions, plenaries, panels, and poster sessions, admission to the Exhibition, Welcome Reception, coffee breaks, and a choice of proceedings. Student pricing does not include proceedings.

COURSE AND WORKSHOP REGISTRATION

Courses and workshops are priced separately. Course-only registration includes your selected course(s), course notes, coffee breaks, and admittance to the exhibition. Course prices include applicable taxes. Onsite, please go to Course Materials Pickup after you pick up your badge.

Multiple facilities may be used for courses; allow yourself enough time to register, pick up your materials and possibly walk to a nearby facility before your course begins.

EXHIBITION REGISTRATION

Exhibition-Only visitor registration is complimentary.

EARLY REGISTRATION PRICING AND DATES

Conference registration prices increase by $150 USD after 18 April 2014. Course prices increase $75 after 18 April 2014. The online form will automatically display the increased prices.

SPIE MEMBER, SPIE STUDENT MEMBER, AND STUDENT PRICING

- SPIE Members receive conference and course registration discounts. Discounts are applied at the time of registration.
- SPIE Student Members receive a 50% discount on all courses.
- Student registration rates are available only to undergraduate and graduate students who are enrolled full time and have not yet received their Ph.D. Post-docs may not register as students. A student ID number or proof of student status is required with your registration.

PRESS REGISTRATION

For credentialed press and media representatives only. Please email contact information, title, and organization to media@spie.org.

SPIE Cashier

Registration Area
Open during registration hours

REGISTRATION PAYMENTS

If you are paying by cash or check as part of your onsite registration, wish to add a course, workshop, or special event requiring payment, or have questions regarding your registration, visit the SPIE Cashier.

RECEIPTS AND CERTIFICATE OF ATTENDANCE

Preregistered attendees who did not receive a receipt or attendees who need a Certificate of Attendance may obtain those from the SPIE Cashier at Badge Corrections and Receipts.

BADGE CORRECTIONS

Badge corrections can be made by the SPIE Cashier at the Badge Corrections station. Please have your badge removed from the badge holder and marked with your changes before approaching the counter.

REFUND INFORMATION

There is a $50 USD service charge for processing refunds. Requests for refunds must be received by 24 April 2014; all registration fees will be forfeited after this date. Membership dues, SPIE Digital Library subscriptions or Special Events purchased are not refundable.

GENERAL INFORMATION

ONSITE SERVICES

Internet Access

WIRED
Pratt St. Lobby (Level 300) – near SPIE Bookstore

Complimentary wired internet access is available; attendees can hook up their laptops or use provided workstations.

WIRELESS
Pratt St. Lobby (Level 300)
Camden Lobby (Level 300)
Hall D (Level 100)

Complimentary wireless access; instructions will be posted onsite.

SPIE Conference App

Pratt St. Lobby (Level 300)

Search and browse the program, special events, participants, exhibitors, courses, and more. Free Conference Apps available for iPhone and Android smart phones.

SPIE Exhibitor Directory

Pratt St. Lower Lobby (Level 100)
Camden Lobby (Level 300)

Search exhibitors by name or booth numbers, browse products, and search technologies.

SPIE Bookstore

Pratt St. Lobby (Level 300)

The SPIE Bookstore is your source for the latest SPIE Press Books, Proceedings, and Education and Professional Development materials. Become an SPIE member, explore the Digital Library, take home a free SPIE poster, or buy a souvenir (tie, t-shirt, educational toys, and more).

SPIE Education Services

Pratt St. Lobby (Level 300)

Browse course offerings and the other education services available: SPIE courses, videos, and CDs as well as customized in-company courses.

SPIE Press Room

Pratt St. East Show Office (Level 200)
Open during Registration hours

For Registered Press only. The Press Room provides meeting space, refreshments, access to exhibitor press releases, and Internet connections. Press are urged to register before the meeting by emailing name, contact information, and name of publication to media@spie.org. Preregistration closes approximately 10 days before the start of the event.

SPIE Luggage + Coat Check

Pratt St. Lobby (Level 300) – Room 338
Monday through Friday

Complimentary luggage, package, and coat storage are available. Please note hours; no late pickup available.

Baltimore Convention Center Business Center

Pratt St. Lobby (Level 300)
Monday through Friday

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 for more details.

Restaurant & City Information

Pratt St. Lobby (Level 300)
Monday through Thursday

The information table, near the escalators, will have printed material for those that would like to know more restaurants and city information.

Child Care Services:

- Elizabeth Cooney Agency Inc., Toll Free: 888-353-1700, Phone: 410-323-1700, Fax: 410-377-4722

NOTE: SPIE does not imply an endorsement nor recommendation of these services. They are provided on an "information only" basis for your further analysis and decision. Other services may be available.

Urgent Message Line

An urgent message line is available during registration hours: 410.649.6102.

Lost and Found

Pratt St. Lobby – Cashier
Open during Registration hours

Found items will be kept at Cashier until registration closes each day and then turned over to Simmons Security. At the end of the meeting, all found items will be turned over to Baltimore Convention Center's Public Safety Office, 410.649.7055.

AUTHOR / PRESENTER INFORMATION

Speaker Check-In and Preview Station
Pratt St. Lobby West (Level 300)

Monday through Friday . . . . . 7:30 am to 5:00 pm

All conference rooms have a computer workstation, projector, screen, lapel microphone, and laser pointer. All presenters are requested to come to Speaker Check-In with their memory devices or laptops to confirm their presentation display settings.

Authors must upload their oral presentation slides to the computer in their conference room. Presentations should be uploaded during the break times on the day of presentation.

Poster Setup Instructions

Hall C (Level 100)

Tuesday 6 May
Thursday 8 May

Poster presenters must set up their posters between 10:00 am and 5:00 pm on the day of their poster session.

- Paper numbers will be posted in the poster boards in numerical order; please find your poster number and set up your poster in the designated space.
- Presenters who have not set up their poster by 5:00 pm on the day of their presentation will be considered a "no show' and their manuscript will not be published.
- A poster author or coauthor is required to stand by the poster during the scheduled poster session to answer questions from attendees
- It is your responsibility to remove your poster at the end of the session.
- Posters and all other material not removed will be considered unwanted and will be discarded.

CAR RENTAL

Hertz

Hertz Car Rental has been selected as the official car rental agency for this Symposium. To reserve a car, identify yourself as a Defense, Security & Sensing Symposium attendee using the Hertz Meeting Code CV# 029B0018. Discount rates apply for rentals up to one week prior through one week after the conference dates. Note: When booking from International Hertz locations, the CV # must be quoted with the letters CV before the number, i.e. CV029B0018. To book online below, please note that the CV# is already incorporated into the link. Book Hertz Online

- In the United States call 1 800.654.2240.
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FOOD AND BEVERAGE SERVICES

Coffee Breaks

Mezzanine (Level 200) & Camden Lobby (Level 300)
Monday, Thursday afternoon, and Friday

Two locations in the Exhibition Hall (Level 100)
Tuesday through Thursday morning

Near Speaker Check-in on Friday

Complimentary coffee will be served twice daily, at 10:00 am and 3:00 pm. Check individual conference listings for exact times and locations.

Food & Refreshments for Purchase

MARKET FRESH CAFÉ - Main Terrace (Level 300)

STARBUCKS - Pratt St Lobby (Level 300)
Monday through Friday - hours posted

EXHIBITION HALLS - (Level 100)
Tuesday through Thursday during exhibition hours

Hot and cold snacks, hot entrees, deli sandwiches, salads, and pastries are available for purchase including espresso & beverages. Cash and credit cards accepted.

DESSERTS

Complimentary tickets for dessert snacks are included in course and conference attendee registration packets.

Acceptance of Policies and Registration Conditions

The following Policies and Conditions apply to all SPIE Events. As a condition of registration, you will be required to acknowledge and accept the SPIE Registration Policies and Conditions contained herein.

Granting Attendee Registration and Admission

SPIE, or their officially designated event management, in their sole discretion, reserves the right to accept or decline an individual's registration for an event. Further, SPIE, or event management, reserves the right to prohibit entry or remove any individual whether registered or not, be they attendees, exhibitors, representatives, or vendors, who in their sole opinion are not, or whose conduct is not, in keeping with the character and purpose of the event. Without limiting the foregoing, SPIE and event management reserve the right to remove or refuse entry to any attendee, exhibitor, representative, or vendor who has registered or gained access under false pretenses, provided false information, or for any other reason whatsoever that they deem is cause under the circumstances.

Misconduct Policy

SPIE is a professional, not-for-profit society committed to providing valuable conference and exhibition experiences. SPIE is dedicated to equal opportunity and treatment for all its members and meeting attendees. Attendees are expected to be respectful to other attendees, SPIE staff, and contractors. Harassment and other misconduct will not be tolerated; violators will be asked to leave the event.

Identification

To verify registered participants and provide a measure of security, SPIE will ask attendees to present a government-issued Photo ID at registration to collect registration materials.

Individuals are not allowed to pick up badges for attendees other than themselves. Further, attendees may not have some other person participate in their place at any conference-related activity. Such other individuals will be required to register on their own behalf to participate.

Capture and Use of a Person's Image

By registering for this event, I grant full permission to SPIE to capture, store, use, and/or reproduce my image or likeness by any audio and/or visual recording technique (including electronic/digital photographs or videos), and create derivative works of these images and recordings in any SPIE media now known or later developed, for any legitimate SPIE marketing or promotional purpose.

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Payment Method

Registrants for paid elements of the event, who do not provide a method of payment, will not be able to complete their registration. Individuals with incomplete registrations will not be able to attend the conference until payment has been made. SPIE accepts VISA, MasterCard, American Express, Discover, Diner's Club, checks and wire transfers. Onsite registrations can also pay with Cash.

Authors/Coauthors

By submitting an abstract, you agree to the following conditions:

- An author or coauthor (including keynote, invited, and solicited speakers) will register at the author registration rate, attend the meeting, and make the presentation as scheduled.
- A full-length manuscript (6-page minimum) for any accepted oral or poster presentation will be submitted for publication in the SPIE Digital Library, printed conference Proceedings, and CD. (Some SPIE events have other requirements that the author is made aware of at the time of submission.)
- Only papers presented at the conference and received according to publication guidelines and timelines will be published in the conference Proceedings and SPIE Digital Library (or via the requirements of that event).

Audio, Video, Digital Recording Policy

Conferences, courses, and poster sessions: For copyright reasons, recordings of any kind are prohibited without prior written consent of the presenter or instructor. Attendees may not capture or use the materials presented in any meeting/course room, or in course notes on display without written permission. Consent forms for material presented in meeting rooms are available at Speaker Check-In. Individuals not complying with this policy will be asked to leave a given session and/or asked to surrender their recording media.

Exhibition Hall: For security and courtesy reasons, recordings of any kind are prohibited unless one has explicit permission from on-site company representatives. Individuals not complying with this policy will be asked to surrender their recording media and to leave the exhibition hall.

Your registration signifies your agreement to be photographed or videotaped by SPIE in the course of normal business. Such photos and video may be used in SPIE marketing materials or other SPIE promotional items.

Laser Pointer Safety Information/Policy

SPIE supplies tested and safety-approved laser pointers for all conference meeting rooms. For safety reasons, SPIE requests that presenters use provided laser pointers.

Use of a personal laser pointer represents user's acceptance of liability for use of a non-SPIE-supplied laser pointer. If you choose to use your own laser pointer, it must be tested to ensure <5 mW power output. Laser pointers in Class II and IIIa (<5 mW) are eye safe if power output is correct, but output must be verified because manufacturer labeling may not match actual output. Come to Speaker Check-In and test your laser pointer on our power meter. You are required to sign a waiver releasing SPIE of any liability for use of potentially non-safe, personal laser pointers. Misuse of any laser pointer can lead to eye damage.

Access to Technical and Networking Events

Persons under the age of 18 including babies, carried or in strollers, and toddlers are not allowed in technical or networking events. Anyone 18 or older must register as an attendee. All technical and networking events require a valid conference badge for admission.

Underage Persons on Exhibition Floor Policy

For safety and insurance reasons:

- No persons under the age of 18 will be allowed in the exhibition area during move-in and move-out.
- Children 14 and older, accompanied by an adult, will be allowed in the exhibition area during open exhibition hours only
- All children younger than 14, including babies in strollers and toddlers, are not allowed in the exhibition area at any time.

Unauthorized Solicitation Policy

Unauthorized solicitation in the Exhibition Hall is prohibited. Any non-exhibiting manufacturer or supplier observed to be distributing information or soliciting business in the aisles, or in another company's booth, will be asked to leave immediately.

Unsecured Items Policy

Personal belongings should not be left unattended in meeting rooms or public areas. Unattended items are subject to removal by security. SPIE is not responsible for items left unattended.

Wireless Internet Service Policy

At SPIE events where wireless is included with your registration, SPIE provides wireless access for attendees during the conference and exhibition but cannot guarantee full coverage in all locations, all of the time. Please be respectful of your time and usage so that all attendees are able to access the internet.

Excessive usage (e.g., streaming video, gaming, multiple devices) reduces bandwidth and increases cost for all attendees. No routers may be attached to the network. Properly secure your computer before accessing the public wireless network. Failure to do so may allow unauthorized access to your laptop as well as potentially introduce viruses to your computer and/or presentation. SPIE is not responsible for computer viruses or other computer damage.

Mobile Phones and Related Devices Policy

Mobile phones, tablets, laptops, pagers, and any similar electronic devices should be silenced during conference sessions. Please exit the conference room before answering or beginning a phone conversation.

Smoking

For the health and consideration of all attendees, smoking is not permitted at any event elements, such as but not limited to: plenaries, conferences, workshops, courses, poster sessions, hosted meal functions, receptions, and in the exhibit hall. Most facilities also prohibit smoking in all or specific areas. Attendees should obey any signs preventing or authorizing smoking in specified locations.

Hold Harmless

Attendee agrees to release and hold harmless SPIE from any and all claims, demands, and causes of action arising out of or relating to your participation in the event you are registering to participate in and use of any associated facilities or hotels.

Event Cancellation

If for some unforeseen reason SPIE should have to cancel the event, registration fees processed will be refunded to registrants. Registrants will be responsible for cancellation of travel arrangements or housing reservations and the applicable fees.

Confidential Reporting of Unethical or Inappropriate Behavior

SPIE is an organization with strong values of responsibility and integrity. Our Ethics Statement and Code of Professional Conduct contain general guidelines for conducting business with the highest standards of ethics. SPIE has established a confidential reporting system for staff & other stakeholders to raise concerns about possible unethical or inappropriate behavior within our community. Complaints may be filed by phone or through the website, and, if preferred, may be made anonymously. The web address is www.SPIE.ethicspoint.com and the toll free hotline number is 1-888-818-6898.

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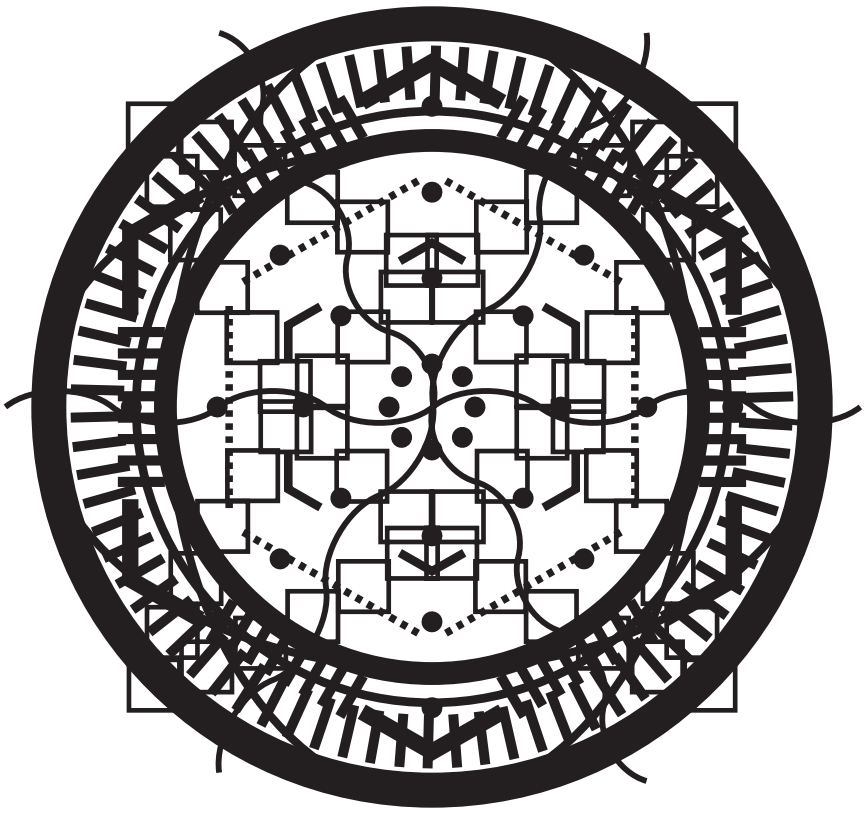

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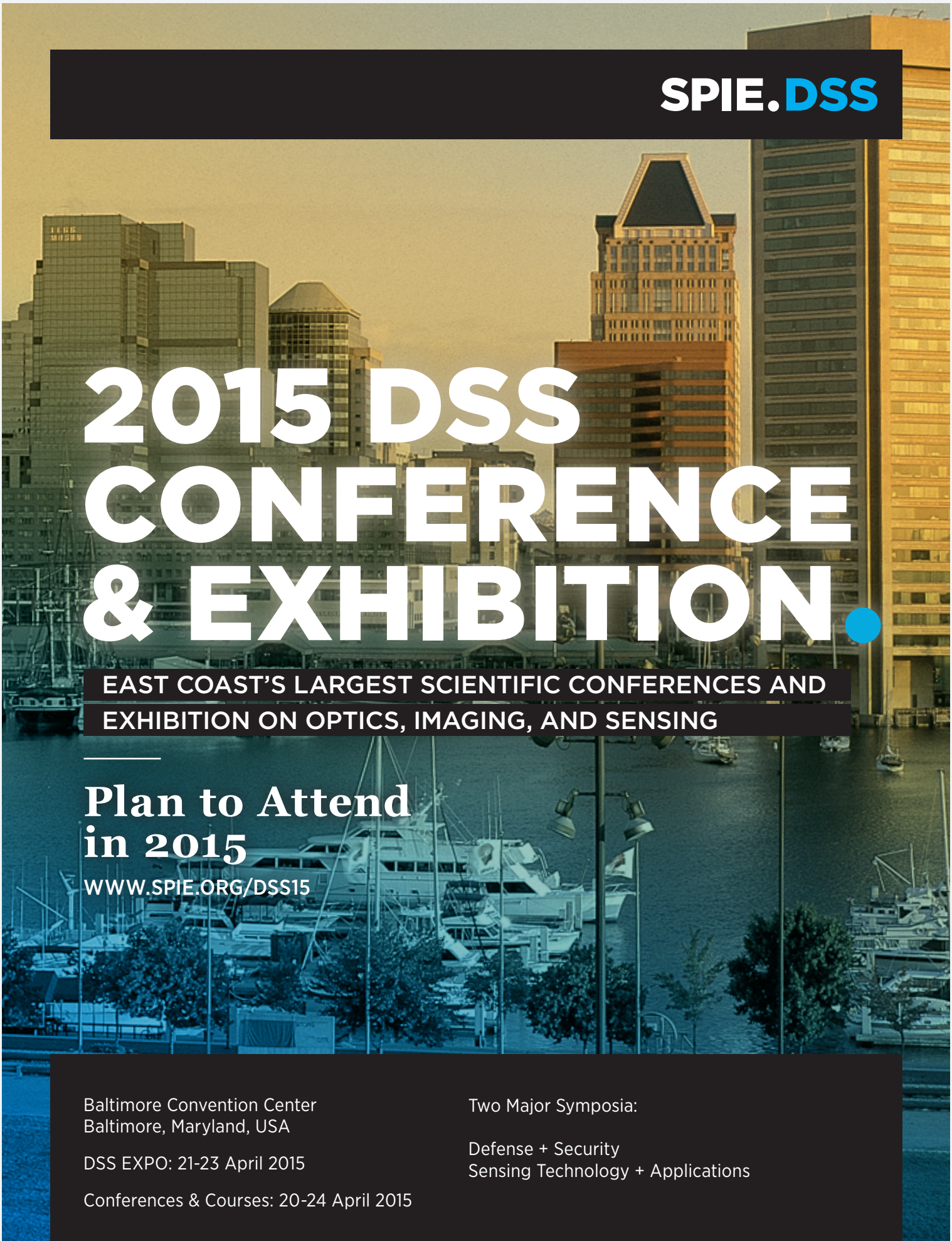

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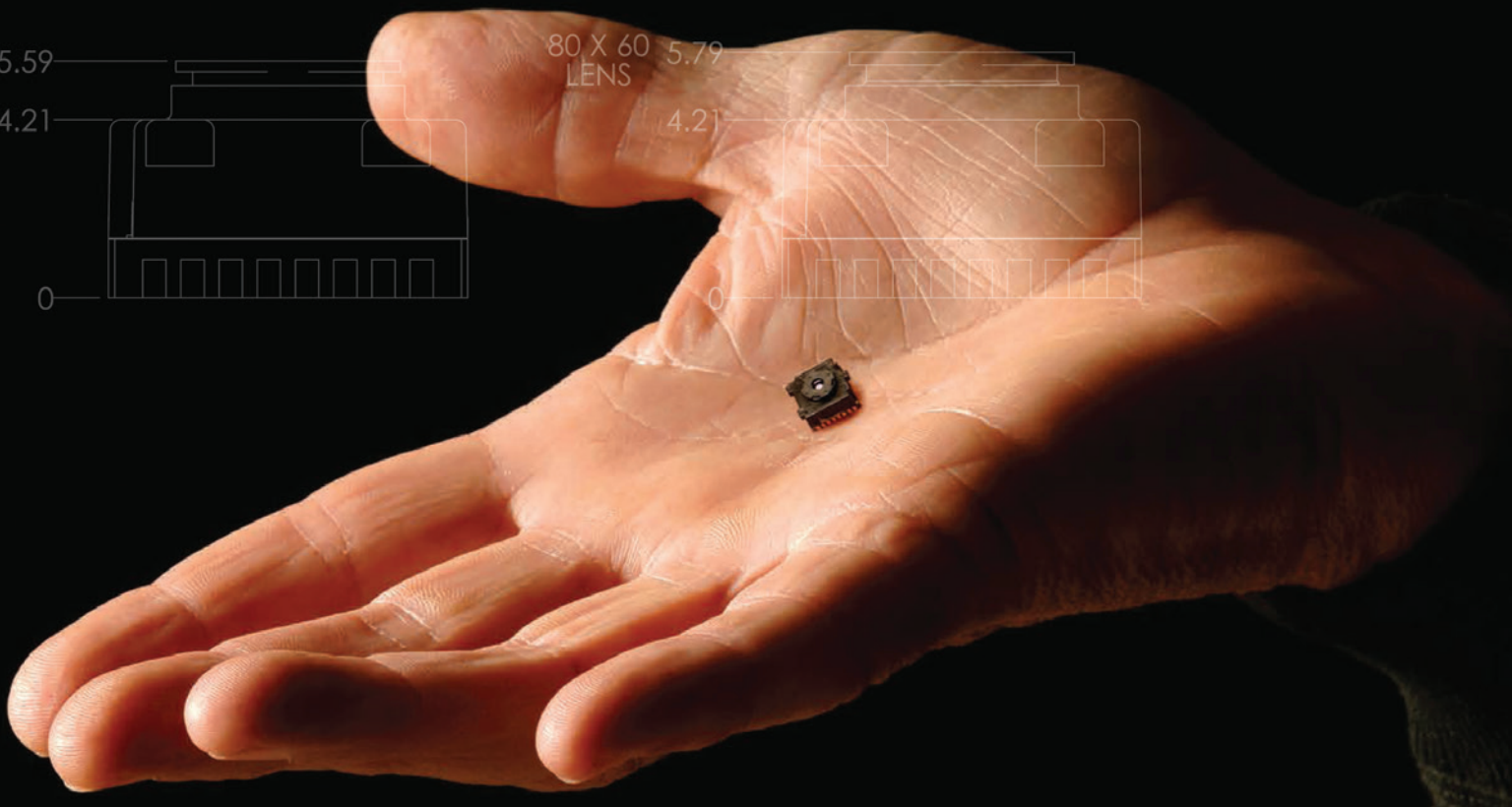

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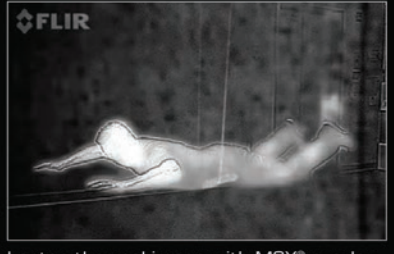

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