

Defense +
Commercial Sensing

2018

TECHNICAL PROGRAM

Conferences and Courses

15-19 April 2018

DCS Expo

17-19 April 2018

Gaylord Palms Resort & Convention Center
Orlando, Florida, USA

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Defense + Commercial Sensing 2018

SENSORS, IR, LASER SYSTEMS,
SPECTRAL IMAGING, RADAR, LIDAR

Conferences & Courses: 15-19 April 2018

DCS Expo: 17-19 April 2018

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Orlando, Florida, USA

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SPIE.



Welcome to SPIE Defense + Commercial Sensing

Hear the latest technical advancements in sensors, infrared technology, laser systems, spectral imaging, radar, LIDAR, and more.

Conferences



Defense + Security

p. 38

Locate conferences on sensors, imaging, and optical technologies for security, law enforcement, avionics/aerospace, defense, and military applications.



Commercial + Scientific Sensing and Imaging

p. 118

Find conferences on sensors, imaging and image processing, and photonics technology innovations for agriculture, manufacturing, health care, pharmaceutical, transportation, information systems, and environmental applications.

TOPICAL TRACKS: Easily locate presentations, exhibitors, special events, and potential courses—all focused on a specific topic.

Agriculture, p. 162

Unmanned Autonomous Systems (UAS), p. 164

Cyber-Physical Systems / The Internet of Things, p. 169



34-COURSES

Courses

p. 31

Build Your Skills. Find a Solution. Make an Impact.

SPIE Courses—quality content taught by recognized experts in industry and academia. Money-back guarantee.



TUESDAY-THURSDAY

World-Class Exhibition

p. 24

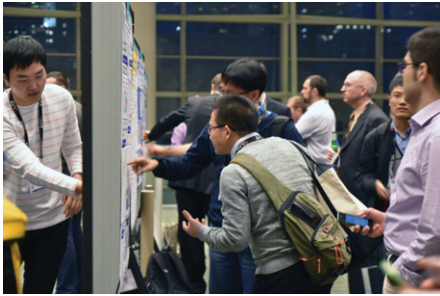
SPIE Defense + Commercial Sensing Expo

Don't miss your chance to speak face-to-face with 400 top suppliers. Researchers, engineers, product developers, and purchasers who specialize in optics and photonics can find everything from components to the most advanced sensor systems.



Award and Plenary Session p. 6

Don't miss these world-class speakers presenting on the latest directions and most promising breakthroughs.



Technical Events p. 8

Join your peers and colleagues at the interactive poster sessions and enjoy group discussions around focused technical topics.



Industry Events p. 12

These important sessions will provide valuable information, insight, and networking opportunities.



Professional Development p. 21

Spend some time focusing on your career development. These sessions will help you hone valuable skills.



Social/Networking/ Student Events p. 22

Join your colleagues and meet collaborators at these relaxed events, including the Welcome Reception— an event not to be missed!



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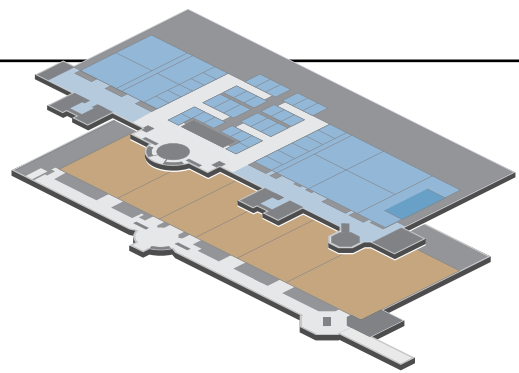




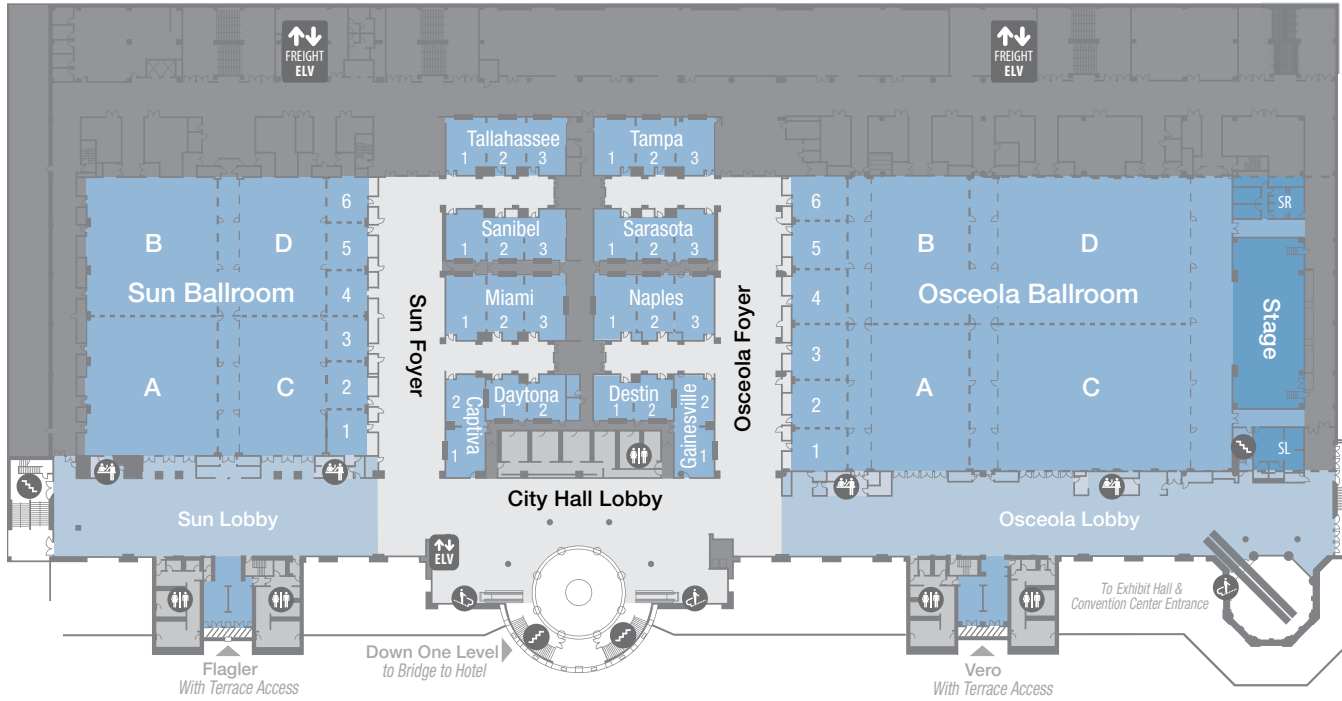
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BALLROOM LEVEL Sun and Osceola Ballrooms



- KEY**
- Restrooms
 - Stairs
 - Registration Desks
 - Elevator
 - Escalator
 - Service Areas



FLORIDA EXHIBITION LEVEL Level One





Symposium-Wide Plenary Session

Monday 16 April 2018 • 5:00 to 7:00 PM • Location: Ballroom Level, Osceola Ballroom C

Don't miss these world-class speakers discussing game-changing technology and valuable insights.

5:00 to 5:15 PM

Welcome, Awards, and Acknowledgements

Presentation of the Early Career Achievement Award - Industry

Presented to



Misty Blowers

Cyber Security Research,
Columbia, Maryland (USA)

The Early Career Achievement Award is presented in recognition of significant and innovative technical contributions in the engineering or scientific fields of relevance to SPIE.

Misty Blowers, Cyber Security Research, Columbia, Maryland, USA, is the 2018 recipient of the Early Career Achievement Award - Industry focus- in recognition of her dedication to advancing applied machine learning solutions to help solve real world problems, and contributions to her employer, SPIE, the US Air Force and US National security.

Presentation of the Joseph W. Goodman Book Writing Award

Presented to



Michael T. Eismann

Chief Scientist, Sensors Directorate,
Air Force Research Laboratory, Wright-
Patterson Air Force Base (USA)

The Joseph W. Goodman Book Writing Award is a new biennial award funded by J.W. and H.M. Goodman. The award recognizes authorship of an outstanding book in the field of optics and photonics, published in the last six years, that has contributed significantly to research, teaching, or the optics and photonics industry. This award is co-sponsored by SPIE and OSA.

Michael T. Eismann, is the 2018 recipient of the Joseph W. Goodman Book Writing Award for Hyperspectral Remote Sensing, published by SPIE Press in 2012.

5:15 TO 5:50 PM



Air Force Research Laboratory: Reflections of a Century, Projections for the Future

Morley O. Stone

Chief Technology Officer,
Air Force Research Lab. (USA)

On December 4, 2017, the Air Force Research Laboratory (AFRL) celebrated its 100th birthday. What started out at McCook Field in Dayton, Ohio, as an Army Air Corps center to research the use of airplanes in the military and seek improvements in airplane technology has morphed and grown over the years to the largest single aerospace research laboratory under a single command. Through those 100 years, scientists and engineers at AFRL and its predecessor laboratories have provided monumental accomplishments across a wide spectrum of technologies that have had dramatic impact on both the U.S. Air Force and the scientific and technical community at large. SPIE and its members, which include numerous Air Force and DoD scientific and technical professionals, have played a key enabling role in assisting with many of those accomplishments through its collective expertise, national and international conferences, exhibitions and scientific publications. This Defense Plenary presentation will look back at a few of those areas of key AFRL accomplishments, like electro-optical, infrared and radio frequency sensing and imaging, laser radar and precision munitions. It will look forward to identify some of the key technologies needed for the Air Force and the nation to maintain technological superiority in areas, like autonomy, human-machine teaming, and directed energy projection and protection.

Dr. Stone, a member of the U.S. Air Force's scientific and technical cadre of senior executives, is the Chief Technology Officer for Air Force Research Laboratory (AFRL) headquartered at Wright-Patterson Air Force Base near Dayton, Ohio. As the primary adviser to the AFRL commander, he is responsible for assisting with the planning and execution of the Air Force's \$2.1 billion science and technology program and an additional \$2.3 billion of customer funded research and development. He also serves as the corporate-level science and technology interface for a government workforce of nearly 6,000 in the laboratory's nine technology directorates and the 711th Human Performance Wing (711 HPW).

SYMPOSIUM-WIDE PLENARY SESSION

Prior to assuming his present position, Dr. Stone served as the Chief Scientist of AFRL's 711 HPW 2008-2014. There he was responsible for the technical direction of a broad, multi-disciplinary research and development portfolio focused on understanding and improving human performance. He also served as the Chair of the Department of Defense's Autonomy Community of Interest 2011-2014. He was the Senior Scientist of Molecular Systems Biotechnology for AFRL 2007-2008, and 2003-2006 he was a Program Manager with the Defense Advanced Research Projects Agency (DARPA). He joined government service in 1992 and served more than 15 years as a research engineer, research biologist and research manager in AFRL's Materials and Manufacturing Directorate.

He earned his Ph.D. in biochemistry from Carnegie Mellon University in 1997 and has 25 years research experience in the areas of biotechnology, materials science and human performance. He is a recipient of the Presidential Rank Award for Meritorious Service, the Office of the Secretary of Defense Medal for Exceptional Civilian Service, the Fed100 Award and Carnegie Mellon University's Alumni Merit Award. Dr. Stone is a Fellow of Air Force Research Laboratory and of the International Society of Optical Engineering.

5:50 TO 6:25 PM

Innovation for a Secure Future



Ray O. Johnson

Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

Ray O. Johnson, an American executive focused on business, innovation, and diversity, is the former Senior Vice President and Chief Technology Officer of the Lockheed Martin Corporation. Johnson guided

the Corporation's technology vision and provided corporate leadership in the strategic areas of technology, engineering, production operations, supply chain, program management, and sustainment, which included more than 72,000 people working on more than 4,000 programs that provided some of the nation's most vital security systems. Johnson has a proven track record in managing large P&L organizations, developing and executing growth and technology strategies, and achieving operational excellence in diverse business environments.

6:25 TO 7:00 PM

The Inevitable and Imperative Rise of Directed Energy Weapons



Henry A. "Trey" Obering III

Executive Vice President
Directed Energy Innovation Services Officer
Booz | Allen | Hamilton

Past Director, Missile Defense Agency
and Lieutenant General, U.S. Air Force (Retired)

Few today doubt the efficacy and impact of precision strike kinetic weapons delivered under wing of a US warplane. The threat alone is often sufficient to cause

bad actors almost anywhere to withdraw and rethink overt hostility. At its face value this outcome must be considered a US foreign policy win; clearly precision strike has had many PR wins, most recently on depowering the ISIL fighters entrenched in Syria and Iraq.

Such a show of air dominance, even used with the highest level of restraint is costly. Non-state actors, vanquished on the battlefield, meld back into the indigenous population without a formal capitulation, reconciliation and

cessation of hostile intent. If they do not re-group into a formal fighting force smaller scale guerrilla attacks from the formerly overt combatants and their sympathizers often ensue. Furthermore, IEDs and small weaponized UXX's including those used for reconnaissance are affordable and proliferate. Militaries such as the USA challenged to engage need a higher precision lower cost per shot tool to hit smaller, softer, targets.

Lasers have promised precision strike & low cost almost since the 1960's. High levels of investment over the years have yielded incredible results, ABL for example. However, these lasers designed for boost phase intercept at incredible range are still emerging technologies. The disruption over the past decade driven by industrial acceptance and need has been the fiber laser, spectral, and coherent beam combination technology, and the emergence of low cost pump diodes. Lasers made from these components promise to be both useful, at lower powers and shorter ranges, and affordable in the very near term. The Ponce deployment showed us that the warfighter is ready to embrace the technology with enthusiasm. We in the defense world see and encourage development & maturation of the myriad components and technologies necessary for the deployment of fiber lasers. Not just the new but also existing components in terms of higher efficiency, smaller size and greater life expectancy for both the industrial & defense markets.

Trey Obering is a Booz Allen Hamilton Executive Vice President based in McLean, Virginia. He works with clients in the Directed Energy area across the DoD and Intelligence communities. An expert in acquisition and program management, he also works with clients in the Air Force Materiel Command, Air Force Space Command, and Missile Defense markets. He leads the Acquisition Program Management and Logistics Functional Community which develops and improves the skills of the hundreds of acquisition and logistics professionals across the firm. Based on his experience, he has led two National Academy of Sciences committees sponsored by the Assistant Secretary of the Air Force (Acquisition) to help the Air Force improve the management of their programs. Prior to joining Booz Allen, he led a comprehensive review of the National Reconnaissance Office for the Director, National Intelligence, which provided a new charter for that organization.

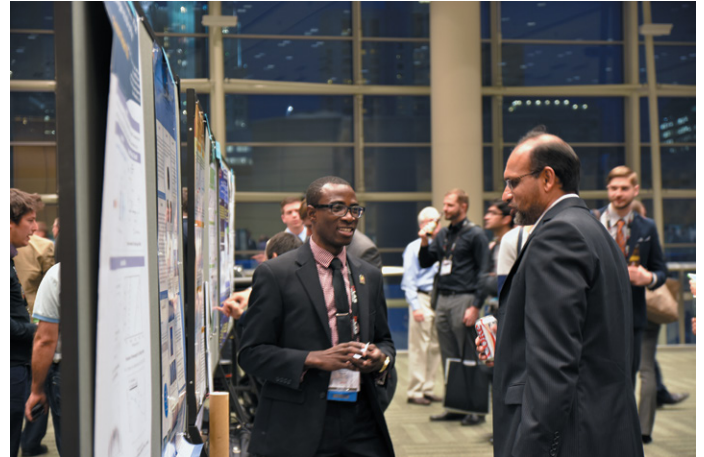
Mr. Obering retired from the US Air Force as a Lieutenant General with more than 35 years of experience in space and defense systems development, integration, and operations. He served as Director of the 8,500-person Missile Defense Agency, Office of the Secretary of Defense. He was the Department of Defense (DoD) Acquisition Executive for the nation's \$10 billion per year missile defense portfolio. In addition, he served as the program manager for the Ballistic Missile Defense System. Prior to his assignment at MDA, he planned and programmed 68 joint, Air Force and international programs with a \$28 billion budget as Mission Area Director for Information Dominance on the Air Staff.

Mr. Obering entered the Air Force in 1973 after completing the University of Notre Dame's ROTC program as a distinguished graduate. He received his pilot wings in 1975 and flew operational assignments in the F-4E. Later, he was assigned to the Space Shuttle program and participated in 15 space shuttle launches as a NASA orbiter project engineer and was responsible for integrating firing room launch operations. Other assignments include tours with the Air Force Inspector General, the Defense Mapping Agency, and Electronic Systems Center.

Mr. Obering has twice earned the DoD's highest non-combat award, the Defense Distinguished Service Medal for leadership. In 2008, he received the prestigious University of Notre Dame Rev. William Corby Award recognizing alumni who have led a distinguished military career. He was honored by the National Defense Industrial Association's Missile Defense Division with the 2011 Kadish Award for Acquisition Excellence.

He received a B.S. degree in Aerospace Engineering from Notre Dame University and an M.S. degree in Astronautical Engineering from Stanford University.

TECHNICAL EVENTS



Join your peers at the interactive poster sessions and enjoy group discussions around focused technical topics.

PANEL DISCUSSION

Machine Learning for Automatic Target Recognition (ML4ATR) (Conf. 10648)

Monday 16 April 2018 • 10:30 AM to 12:30 PM

Location: Ballroom Level, Tampa 2

Panel Moderators: **Riad I. Hammoud**, BAE Systems (USA); **Timothy L. Overman**, Lockheed Martin (USA)

Panelists: **Vincent J. Velten**, Air Force Research Lab. (USA); **Martin O. Hofmann**, Lockheed Martin Corp. (USA); **William C. Snyder**, BAE Systems (USA); **Daniela I. Moody**, Descartes Labs, Inc. (USA); **Anthony J. Hoogs**, Kitware, Inc. (USA); **Joseph L. Mundy**, Vision Systems, Inc. (USA); **May V. Casterline**, NVIDIA (USA); **Denis Garagic**, BAE Systems (USA); **Hakjae Kim**, Intelligence Advanced Research Projects Activity (USA); **Jason Stack**, Office of Naval Research (USA)

The Machine Learning for Automatic Target Recognition (ML4ATR) session at SPIE Defense + Security 2018 (ATR conference) highlights the accomplishments to date and challenges ahead in designing and deploying deep learning and big data analytics algorithms, systems, and hardware for ATR. It provides a forum for researchers, practitioners, solution architects and program managers across all the widely varying disciplines of ATR involved in connecting, engaging, designing solutions, setting up requirements, testing and evaluating to shape the future of this exciting field. ML4ATR topics of interest include training deep learning based ATR with limited measured/real data, multi-modal satellite/hyperspectral/Sonar/FMV Imagery analytics, graph analytic multi-sensory fusion, change detection, pattern-of-life analysis, adversarial learning, trust and ethics. This year ML4ATR hosts 10 panelists from government labs, research institutions and defense R&D companies. Each panelist gives a short keynote talk about their projects on machine learning for ATR. The chairs of this session encourage attendees from the SPIE Defense + Commercial Sensing 2018 community to engage in the discussions with the panel members.

Hyperspectral Imaging Standards Workshop

Monday 16 April 2018 • 1:00 TO 3:00 PM

Location: Ballroom Level, Captiva 2

Workshop Organizers: **David Allen**, National Institute of Standards and Technology (USA), **Chris Durell**, Labsphere Inc. (USA)

Panel Moderator: **Chris Durell**, Labsphere Inc. (USA)

PURPOSE:

Hyperspectral imaging as a field continues to mature from a specialized tool to a routine method applied to many facets of society. Standards provide common reference points that foster an understanding between different entities. This meeting is intended to review the range of standards currently available and to identify gaps where new standards are needed. We are looking to provide the infrastructure for a new standards committee investigating VIS-NIR hyperspectral methods and means and is looking for active participants and industry experts.

The range of standards open for discussion encompass all aspects related to hyperspectral imaging and may include performance specifications, calibration standards, other wavelength ranges, data formats, terminology, and best practices. This workshop will begin with a brief overview of the industry situation today and then open to a panel discussion to provide an open forum for metrology laboratories, instrument vendors, data product analysts, data product vendors, and end-users.

The desired outcome of this meeting will include the formation of a new standards committee that will address the topics discussed. This meeting is open to all DCS registered attendees.

GOALS:

- Provide a forum for the hyperspectral imaging community to discuss current and needed standards
- Address the need for standards to address regulatory requirements
- Discuss the possibility of a uniform set of performance metrics
- Discuss the need for traceability to national standards
- Consider formalizing best practices
- Lay the groundwork for a standards organization committee

INVITED PANEL DISCUSSION

Deep Learning in AI and Information Fusion (Conf. 10646)

Monday 16 April 2018 • 1:15 to 4:45 PM

Location: Ballroom Level, Osceola 1

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

Panel Moderators

Ivan Kadar, Interlink Systems Sciences, Inc. (USA) and **Chee-Yee Chong**, Independent Consultant (USA)

Panelists: **Chee-Yee Chung**, Independent Consultant (USA);

George Cybenko, Dartmouth College (USA);

Lynn Grewe, California State Univ. (USA);

Henry Leung, Univ. Calgary (Canada);

Shashi Phoba, The Pennsylvania State Univ. (USA);

Majumder Uttam, AFMC AFRL/RITB (USA)

In the early days of artificial intelligence (AI) starting say in 1970s and 1980s the predominant reasoning methods were logical and symbolic using e.g., Lisp/Prolog languages, and later in the 1980s AI tools i.e., Knowledge Environment Engineering (KEE) and Automated Reasoning Tool (ART) expert systems, and early heuristic reasoning methods. Also the concept and mathematical representation of “context” logic was defined. The concept and apps of both “knowledge based” and “context” are currently used in several apps in information fusion (IF) along with several methods to apply and learn contextual information.

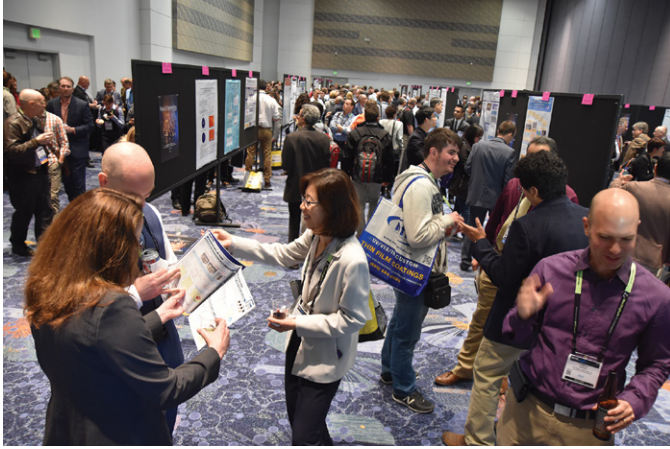
Also in the early 1980’s, AI was viewed as the solution to information fusion problems. In fact, many contributors to the first distributed sensor networks program were AI researchers. However, inadequate computing and AI approaches such as expert systems and heuristic uncertainty reasoning could not address the challenges of information fusion. Thus, important advances in information fusion, and in particular, multi-target tracking, were made with little contribution from AI.

During the long AI winter, researchers addressed the deficiencies of early AI, developing rigorous representation and reasoning techniques for uncertainty, and machine learning approaches. Recently, data science was established as a popular area to exploit the large volumes of data (a.k.a. Big Data) collected by physical sensors and online activities using machine learning and other analytic tools.

Artificial intelligence and data science pose both challenges and opportunities to IF. They are challenges because they appear to address the same problems as information fusion, but with more powerful techniques, thus siphoning away both research funding and research talent. However, these challenges can also be opportunities because AI and data science provide new research directions for information fusion. Examples include: IF with big data, hard and soft data fusion, learning about context, graph techniques for tracking and fusion, dynamic network analysis, apps to cyber and imagery processing.

The objective of this panel is to bring to the attention of the fusion community the importance of the application of Deep Learning in AI and IF, highlighting issues, illustrating potential approaches and addressing challenges. A number of invited experts will discuss challenges in processing and research, and address these challenges with IF. The panelists will illustrate parts of the above-mentioned areas over different applications and association with IF. The panel to highlight impending issues and challenges will use conceptual and real-world related examples associated with the applications of above.

TECHNICAL EVENTS



Poster Session

Tuesday 17 April 2018 • 6:00 to 8:00 PM

Location: Ballroom Level, Osceola Ballroom C

All symposium attendees - You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Joint SPIE IR Materials Working Group and ASC-OP Standards Meeting

Wednesday 18 April 2018 • 8:00 to 10:00 AM

Location: Atrium Level, St. George 102

The Optics and Electro-Optics Standards Council (OEOSC) and the SPIE have joined efforts in the development of new infrared materials standards. The Accredited Standards Committee for Optics (ASC-OP), which operates under the supervision of the OEOSC, created a subcommittee called Task Force 6, Infrared Materials. The SPIE created the Infrared Materials Working Group (IRMWG). Together, these committees are developing standards for infrared materials that will be published as American National Standards. In the future, these domestic standards may serve as starting points for ISO standards, too. Participation is open to all registered attendees, and any person or organization with an interest in the topic of infrared materials. Currently, the Committees are working on the establishment of standard values for the refractive index of different IR materials.

PANEL DISCUSSION

Advanced Imaging: Gain, Polarization, and Metamaterials Integration (Conf. 10639)

Wednesday 18 April 2018 • 11:40 AM to 12:00 PM

Location: Ballroom Level, Osceola 6

Moderator: **Shouleh Nikzad**, Jet Propulsion Lab.

The Keynote and Invited Speakers for the sessions on Advanced Imaging: Gain, Polarization and Metamaterials Integration will participate on a discussion panel and provide an opportunity for the conference attendees to have one-on-one interactions with them. Discussions will cover the current state-of-the-art and exciting future directions for Advanced Imaging Technology as well as new applications that are enabled by it.



Fight Bias, Embrace Diversity

SPIE seeks to cultivate a culture of openness and inclusivity. Help us eradicate bias and make the world of optics and photonics a shining example of all minds coming together to innovate regardless of gender, race, nationality, culture, educational background, politics, sexuality, body-type and age, for the betterment of life.

Educate yourself on the issues faced by a diverse workforce, challenge your own assumptions, and tap into the rich pool of talent, perspectives, and ideas offered by people different from you.

SPIE. DIVERSITY+ INCLUSION



Congratulations to the 2018 Winners

Optics & Optomechanical Components	Environmental Monitoring	Lasers	Medical Diagnostics & Therapeutics
AdlOptica (Germany)	Block Engineering (USA)	Class 5 Photonics (Germany)	ContinUse Biometrics (Israel)
Material Processing & Additive Manufacturing	Imaging & Cameras	Detectors & Sensors	Life Science Instrumentation
LIMO (Germany)	Luminar (USA)	Luminar (USA)	Quantumcyte (USA)
Illumination & Light Sources	Test & Measurement		
SoraaLaser (USA)	Spheryx (USA)		

11TH ANNUAL PRISM AWARDS

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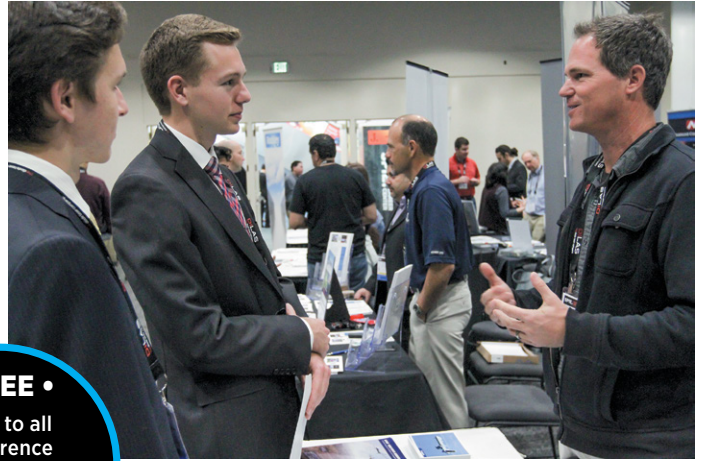
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JUNE – OCTOBER
2018

INDUSTRY EVENTS



• **FREE** •
 Open to all conference attendees, exhibitors, and exhibition visitors.



Learn more about the business side of defense and commercial sensing. These sessions will provide valuable information and networking for anyone, from engineers to CEOs, looking for business content.

INDUSTRY VENDOR SESSION

Thermosense Vendor Presentations and Reception

Monday 16 April 2018 12:15 to 4:45 PM
 Location: Ballroom Level, Osceola A

SESSION CHAIRS:



Andres E. Rozlosnik
 SI Termografia Infrarroja (Argentina)



Sheng-Jen Hsieh
 Texas A&M Univ. (USA)

The Vendors Session started fourteen years ago and has become a very popular and well-attended success. This venue provides an early opportunity for exhibitors to highlight their latest technology and products to the Thermosense, IR industry, and Defense + Commercial Sensing (DCS) community in general, prior to the opening of the DCS 2018 Expo. This also enables the technical conference attendees to better prioritize their activities when visiting the Expo. It is a casual meeting with ample time for questions and answers. This session will feature brief, roughly 15 minute, presentations (technical and commercial) from hardware to software whose product lines impact thermal imaging applications and the infrared industry in general.

2018 Vendors in Presentation Order:

StingRay Optics, LLC (Booth 710)

StingRay Optics Standard Products 2018
 Sam Wyman, Head of Commercial/OEM Sales

New Imaging Technologies (Booth 607)

InGaAs with Linear and Logarithmic response; best of both worlds
 Régis TULAZA, North America and Europe Sales Manager

Reynard Corporation (Booth 916)

Metallization Stacks and Their Applications
 Chris Karp, Business Development Manager

SOFRADIR EC (Booth 806)

Cooled and uncooled IR development for high performances imaging
 Michel ZÉCRI, General Manager SOFRADIR EC

Electro Optical Industries, Inc. (Booth 1304)

New Developments in Panoramic IR Surveillance and Night Vision Testing
 Stephen Scopatz, General Manager of Electro Optical Industries

InfraTec infrared LLC (Booth 732)

Latest news of infrared cameras from InfraTec
 Dr. Sven-A. Wode, Manager Business Development International

Ophir Optronics Ltd. (Booth 809)

Folded optics in Ophir zoom lenses
 Dr. Nissim Asida, Ophir CTO

Telops Inc. (Booth 1125)

Telops' New Infrared Cameras and Applications
 Wes Autran, Business Development Manager

SCD.USA Infrared LLC (Booth 1101)

SCD's Infrared Sensors for Industry, Science and Security
 Robert McDaniel, President of SCD.USA /
 Kobi Zaushnizer, VP Marketing of SCD

FLIR Systems, Inc. (Booth 915)

Overcoming the Challenges of Measuring Temperature at High Speeds with FLIR X-series Cameras
 Jerry Beeney, Business Development Manager

IRCAM GmbH (Booth 1216)

Infrared Cameras for Scientific Applications
 Oliver Schreer, Managing Director

4D Technology Corporation (Booth 1215)

Verifying the Quality of IR Optical Elements at the Functional Wavelength
 Mark Boehm, Southeast Region Manager 4D Technology Corporation

Sensors Unlimited, Inc - A UTC Aerospace Systems Company (Booth 1301)

SWIR Imaging Update - Illustrating a Variety of Applications in the Short-Wave Infrared
 Doug Malchow, Business Development Manager – Industrial

IRflex Corporation (Booth 1222)

MWIR Fiber Combiner for Multispectral Sensing
 Dr. Francois Chenard, President and CTO of IRflex Corporation

Thales Cryogenics B.V. (Booth 523)

Thales Cryogenics – Update on recent developments
 Kevin Giesen, Account Manager at Thales Cryogenics

Fotric Precision Instruments (Booth 1823)

Cloud-Based Professional Infrared Thermal Camera - Fotric X Series
 Tony Yin, General Manager of Fotric Precision Instruments



Designing, Debugging, Simulating, and Testing Complex ARINC 818 Systems

Tuesday 17 April 2018 • 8:30 AM to 5:00 PM

Location: Visit the SPIE Course Desk for details

Get hands-on training and certification for ARINC 818 Systems. This free hands-on workshop will provide a deep dive into the ARINC 818 protocol and its applications. Whether you are new to ARINC 818 or have completed many designs, this workshop will provide valuable information that draws from GRT's experience as the world leader in ARINC 818 tools, systems, and flyable products.

SCHEDULE

9:00 AM: **Overview of ARINC**

10:00 AM: **Best Practices in Testing, Simulating, Debugging, and Validating ARINC 818 Systems**

11:00 AM: **Implementing ARINC 818 Protocol in Your Hardware**

12:00 PM: **ARINC 818-2 for High-Speed Sensors and Complete Video Systems**

1:00 PM: **Lunch**

2:00 to 4:00 PM: **Open Lab and Certification Test**

PRESENTERS



Jon Alexander
 CEO and Senior Engineer,
 Great River Technology



Paul Grunwald
 Chief Systems Architect,
 Great River Technology

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INDUSTRY EVENTS APPEARING ON THE INDUSTRY STAGE THROUGHOUT THE WEEK

SPIE Defense + Commercial Sensing Expo

Tuesday 17 April 2018 • 10:00 AM to 6:00 PM

Location: Exhibition Hall

See 400 companies who provide everything from components to the most advanced sensor systems.

Evening at the Expo

Tuesday 17 April 2018 • 5:00 to 6:00 PM

Location: Exhibition Hall

Free drinks and appetizers are served while you learn about products and services offered by top companies in the industry. This is a popular networking activity in the exhibition hall.

Job Fair

Tuesday 17 April 2018 • 10:00 AM to 6:00 PM

Location: Exhibition Hall

Top employers are coming together to interview and hire candidates. Whether you are looking for employees or looking for a job, this is your chance to connect with the best.

Jumpstarting Innovation: Learn about the National Science Foundation I-Corps Grant Program

Tuesday 17 April 2018 • 8:00 to 9:30 AM

Location: Emerald Bay Meeting Rooms, Emerald Bay 2

Interested in \$25,000-50,000 to find customers for your cool technology? Come learn about the National Science Foundation Innovation Corps ("I-Corps") Program, an exciting no-strings-attached funding program for deep technology teams to find customers and learn about their needs. All technologists - students, faculty, and experienced professionals - may be eligible to participate. Once accepted into the program, participants will have the opportunity to present to investors and strategic partners interested in optical technologies and systems; we will provide free coaching from experienced mentors and investors.

SPEAKER



Viktor Brandneris

I-Corps Instructor and Lean Start-Up Consultant

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USC Viterbi

School of Engineering



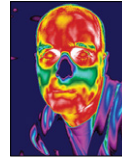
FLIR: High-Speed Thermal Imaging

Tuesday 17 April 2018 • 10:45 to 11:15 AM

Location: Exhibition Hall - Industry Stage

Recent advances in thermal infrared camera technology are enabling very high frame rate imaging and very fast shutter speeds that can be used to visualize high-speed thermal phenomena in novel ways.

SPEAKER



Austin Richards

Austin Richards is a Senior Research Scientist at FLIR, a manufacturer of infrared imaging systems and digital imaging electronics based in Santa Barbara, CA. He specializes in radiometry, test and measurement of IR cameras and sensors and system integration.

SPONSORED BY



DARPA Session: The Impact of Advanced Electronics on Imaging Technology

Tuesday 17 April 2018 • 11:30 AM to 12:00 PM

Location: Exhibition Hall - Industry Stage

Imaging technology is a microcosm of major trends occurring across the electronics industry. Significant advances in digital CMOS, mixed signal electronics, and 3-D integration have all made an impact on imaging hardware, and the mobile handheld industry has been a major driver. But so have advanced processor architectures, algorithms, and machine learning. Machine vision and security features will become increasingly critical. This talk will review these subjects and other programs in advanced electronics at DARPA that will impact imaging technology in the future.

SPEAKER



Jay Lewis

Deputy Director of the Microsystems Technology Office (MTO), DARPA



Spectral Imaging in Precision Agricultural Management: Potential for Crop Health Monitoring and Pathogen Detection

Tuesday 17 April 2018 • 1:15 to 1:45 PM
Location: Exhibition Hall - Industry Stage

There is growing interest in the utility of hyperspectral imaging, particularly from autonomous airborne platforms for agricultural management. The technology has developed considerably over the decades from its roots in satellite imagery and geographical information systems. The enhanced and more detailed information that spectral imaging technology offers has the potential to provide insight beyond basic coverage and plant stress to include pathogens and other threats. New spectral imaging technologies such as front staring or snap-shot systems mitigate issues with spatial non-uniformity and resolution that are often encountered with line-scanning systems. In addition, the introduction of machine learning algorithms shows promise in aiding in the interpretation and utility of the extremely large data sets captured, particularly for non-experts.

SPEAKER



Alexandre Fong
Director Hyperspectral Imaging,
HinaLea Imaging

Emerging Applications for LiDAR

Tuesday 17 April 2018 • 2:00 to 2:45 PM
Location: Exhibition Hall - Industry Stage

LiDAR is currently one of the hottest buzzwords in the photonics industry - mainly due to the belief that it will be a key enabling technology to reach fully autonomous driving. However, as LiDAR systems advance to become more compact and affordable, what other applications are emerging outside of autonomous vehicles? What LiDAR calibration techniques and high volume manufacturing solutions are being developed to meet the requirements of future applications?

JENOPTIK shares its LiDAR Research & Development activities and will discuss how its new i3S LiDAR is uniquely positioned to address new emerging market needs.

SPEAKER



Mike Robinson
Business Development Manager,
JENOPTIK Defense & Civil Systems

Commercialization of Quantum Technologies

Tuesday 17 April 2018 • 3:00 to 3:45 PM
Location: Exhibition Hall - Industry Stage

M Squared has enabled the quantum technology community since 2006 with its award-winning laser platform, SolTiS, the backbone of many quantum technology systems and experiments. This laser system underpins some of the world's most accurate clocks and highest-impact quantum computing research programs.

Today, M Squared is at the heart of the international quantum supply chain, developing components, sub-systems, and sensors for commercial quantum applications, including optical atomic clocks and quantum sensors based on atom interferometry. M Squared is taking quantum technologies out of the lab and harnessing them for real-world applications that will directly benefit society in the near future.

SPEAKER



Graeme Malcolm
CEO and Founder,
M Squared Lasers

Multispectral and Hyperspectral Imaging: Markets and Opportunities

Tuesday 17 April 2018 • 4:00 to 4:30 PM
Location: Exhibition Hall - Industry Stage

First introduced for remote observation from satellites and aircrafts, spectral imaging is at a turning point in its evolution. With its ability to combine chemical and spatial information, spectral imaging meet the need for low-cost, compact sensors, able to provide advanced measurements in the context of Industry 4.0, food safety and sustainable production.

In fact, from bulky and expensive systems, hyperspectral and multispectral cameras are now becoming affordable, easy-to-use and portable tools adapted to on-line or on-field uses from major fields: agriculture, food and beverages, pharmaceuticals, machine vision, healthcare.

We will present a summary of our Report on Spectral Imaging: current status of the market, applications segments and opportunities, analysis of the trends and main challenges to be addressed in the next years.

SPEAKER



Thierry Robin
Partner,
TEMATYS

Infrared Focal Plane Array development at FLIR

Tuesday 17 April 2018 • 4:40 to 5:10 PM
Location: Exhibition Hall - Industry Stage

FLIR will provide an update on its Infrared FPA development.

SPEAKER



Dan Walker
Dan Walker is a VP for Product Management in FLIR's Industrial Business Unit where he has responsibility for FLIR's MWIR and SWIR camera cores.

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INDUSTRY EVENTS APPEARING ON THE INDUSTRY STAGE THROUGHOUT THE WEEK

FLIR: Multi-directional Polarized CMOS Image Sensors

Tuesday 17 April 2018 • 5:20 to 5:50 PM
Location: Exhibition Hall - Industry Stage

Sony has developed CMOS image sensors capable of simultaneously capturing images at four different planes of polarization. This talk will introduce the technology and compare it to traditional CMOS image sensors. Image processing techniques will be discussed. Applications for multi-direction polarization imaging will be introduced and the advantages relative to traditional imaging techniques will be discussed.

SPEAKER



Mike Fussell (B.Sc., MBioEnt)
Product Marketing Manager
FLIR's Machine Vision center of excellence
in Vancouver, Canada

SPONSORED BY



Key Legal Issues Facing the Optics Industry

Wednesday 18 April 2018 • 8:00 AM to 12:00 PM
Location: Visit the SPIE Course Desk for details

Join this free half-day workshop on the legal challenges we are facing today. You will learn from leading experts about a wide range of cutting edge legal issues facing the optics industry, and receive essential tips on how to effectively and efficiently navigate the changing legal landscape. This program is designed to convey actionable information to business leaders in an interactive format, where your questions will be answered.

SCHEDULE

- 8:00 AM: **Coffee and light breakfast**
- 8:30 AM: **Overview of the workshop, introduction of instructors**
- 8:45 to 9:15 AM: **Government Contract Disputes – Prime Contract Litigation and Prime-Sub Disputes in an Age of Diminishing Federal Budgets**

PRESENTERS



Barron Avery
Partner,
BakerHostetler, Washington DC



Mike Levin
Partner,
BakerHostetler, Orlando, FL

9:15 to 9:45 AM:

Prime-Subcontractor Agreements – Teaming Agreements and Flowdowns

PRESENTER



Barron Avery
Partner,
BakerHostetler, Washington DC

9:45 to 10:15 AM:

Domestic Preferences / Buy American Act

PRESENTER



Mike Snarr
Partner,
BakerHostetler, Washington DC

BREAK

10:30 to 10:50 AM:

Committee on Foreign Investment in the United States – A Sea Change is Coming

PRESENTERS



Kerry Scarlott
Partner,
BakerHostetler,
Washington DC



Lana Muranovic
Senior Associate,
BakerHostetler,
Houston, TX

10:50 to 11:15 AM:

Export Controls and Sanctions – Recent Developments and Best Practices

PRESENTERS



Kerry Scarlott
Partner,
BakerHostetler,
Washington DC



Lana Muranovic
Senior Associate,
BakerHostetler,
Houston, TX

11:15 to 11:40 AM:

Cybersecurity – Gov't Requirements and Practical Approaches

PRESENTER



Melinda McLellan
Partner,
BakerHostetler, New York, NY

11:40 AM to Noon:

Trade with China – The Evolving Landscape

ALL PRESENTERS

SPIE Defense + Commercial Sensing Expo

Wednesday 18 April • 10:00 AM to 5:00 PM

Location: Exhibition Hall

See 400 companies who provide everything from components to the most advanced sensor systems.

Job Fair

Wednesday 18 April • 10:00 AM to 5:00 PM

Location: Exhibition Hall

Top employers are coming together to interview and hire candidates. Whether you are looking for employees or looking for a job, this is your chance to connect with the best.

Mid-Infrared Comes of Age: Technology and Applications

Wednesday 18 April 2018 • 10:30 AM to 12:00 PM

Location: Exhibition Hall - Industry Stage

Panelists will discuss opportunities driven by performance optimization, mobility and cost reduction for optical sensing and imaging applications. The speakers will discuss industry needs and advancements in mobile platforms and data integrations for wide-range commercial, security and defense applications. Listen and interact with leaders in the spectroscopy, sensing, UAV and data communities, and come to share your ideas.

MODERATOR



Joseph X. Montemarano

Director, Industrial Enterprise,
Princeton Institute for Science and
Technology of Materials

PANELISTS



Mark Witinski

Co-Founder, VP of
Chemical Analysis
and Security
Pendar Technologies



Ralph Taylor-Smith

Managing Director,
GE Ventures



Adam Piotrowski

President,
Vigo System



Francois Chenard

President,
IRflex Corporation



Eric Takeuchi

Vice President,
Strategy & Business
Development,
DRS Daylight
Solutions

Deep Learning Developments at FLIR

Wednesday 18 April 2018 • 1:15 to 1:45 PM

Location: Exhibition Hall - Industry Stage

Deep Learning is an enabling technology for diverse applications including autonomous driving, video security systems, smart cities and defense applications. FLIR will discuss its activities in deep learning and demonstrate a number of use cases.

SPEAKER



Art Stout

Director of Business Development for FLIR's CTO group where he is responsible for integration of advanced research activities into FLIR's businesses.

SPONSORED BY



Using Shortwave Infrared (SWIR) Cameras for High Temperature Measurement Applications

Wednesday 18 April 2018 • 2:00 to 2:30 PM

Location: Exhibition Hall - Industry Stage

Historically, shortwave infrared (SWIR) cameras using Indium Gallium Arsenide (InGaAs) based detectors have primarily been used as imaging devices in light reflectance applications. Whether the application is agricultural/petrochemical inspection, forensics, spectroscopy or water detection, the cameras have only been used to provide qualitative image data. However, these cameras are also capable of detecting the amount of infrared radiation emitted from materials when they reach temperatures above 300°C. This allows SWIR cameras to be thermographically calibrated to provide accurate, quantitative temperatures values in applications where the measurement targets are hot.

This interactive presentation will discuss the benefits of using thermographically calibrated InGaAs SWIR cameras for temperature measurements on objects above 300°C and provide examples for a variety of user applications.

SPEAKER



Jerry Beeney

Jerry Beeney holds a BS in Mechanical Engineering and worked for over eleven years as a Sales Engineer in FLIR Systems' Science Camera Segment.

SPONSORED BY



INDUSTRY EVENTS APPEARING ON THE INDUSTRY STAGE THROUGHOUT THE WEEK

Solid State Technology for LIDAR, MM Wave, and THz Imaging

Wednesday 18 April 2018 • 3:00 to 3:15 PM

Location: Exhibition Hall - Industry Stage

Hear an update on imec's first US-based R&D design center and its activities in solid state technology for LIDAR, MM Wave, and THz Imaging.

SPEAKER



Bert Gyselinckx

Vice President and General Manager,
Imec, USA

CMOS-based Hyperspectral Imaging: Technologies, Promises, Pitfalls

Wednesday 18 April 2018 • 3:25 to 4:00 PM

Location: Exhibition Hall - Industry Stage

The recent introduction of CMOS optical filter technology has enabled a multitude of commercial applications for hyperspectral imaging with ever more portable, compact and low-cost solutions. New solutions for multi and hyperspectral imaging in SWIR range using InGaAs based imager will be presented and their application potential in food, agriculture, medical and industrial machine vision discussed.

SPEAKER



Jerome Baron

Business Development Manager Imaging,
Imec



Complexity of a Tricorder: Opportunities and Challenges of Portable Spectroscopy in Food Safety Applications

Wednesday 18 April 2018 • 4:15 to 5:00 PM

Location: Exhibition Hall - Industry Stage

Come hear about the opportunities and challenges of portable spectroscopy in food safety applications.

SPEAKER



Marco Snickers

Business Development & Strategy Food & Agriculture,
Ocean Optics

Update: SPIE Public Policy

Thursday 19 April 2018 • 9:15 to 9:45 AM

Location: Exhibition Hall - Industry Stage

Get the latest on Congressional Visits Day, export control, and other updates from the political front.

Check the website for updates.

SPIE Defense + Commercial Sensing Expo

Thursday 19 April 2018 • 10:00 AM to 2:00 PM

Location: Exhibition Hall

See 400 companies who provide everything from components to the most advanced sensor systems.

Lighting the Path Towards Autonomous Mobility

Thursday 19 April 2018 • 10:15 to 11:15 AM

Location: Exhibition Hall - Industry Stage

Autonomous mobility is the disruptive technology of our era, and at its core are optical sensing challenges. Getting better data required to operate safely is the key to a driverless future, and this all hinges on new kind of LiDAR built for self-driving scenarios.

Join SPIE Fellow and Co-Founder of Luminar Jason Eichenholz in a talk on the requirements for self-driving vehicles and a vision for a major breakthrough in LiDAR.

SPEAKER



Jason Eichenholz

Co-Founder and CTO,
Luminar

Next Generation CMOS Image Sensor Technology

Thursday 19 April 2018 • 11:30 AM to 12:00 PM
Location: Exhibition Hall - Industry Stage

The evolution of CMOS Image sensor technology is has yielded exciting new on-sensor capabilities. From polarizers, to hyper-spectral color filter arrays, to enhanced Near-Infrared sensitivity, these new sensors enable new applications by going beyond standard RGB color. Advances in sensor manufacturing have enabled high speed readout and onboard image processing. This presentation provides an overview of the most interesting new CMOS image sensor technologies.

SPEAKER



Mike Fussell

Product Marketing Manager,
FLIR

Mike Fussell (B.Sc., MBioEnt) Is a Product Marketing Manager with FLIR's Machine Vision center of excellence in Vancouver Canada.

SPONSORED BY



Sensors and Instrumentation Technical Advisory Committee (SITAC) - Open Session

Thursday 19 April 2018 • 9:30 AM to 12:00 PM
Location: Ballroom Level, Captiva 2

The Sensors and Instrumentation Technical Advisory Committee (SITAC) advises the Office of the Assistant Secretary for Export Administration within the Department of Commerce on technical questions that affect the level of export controls applicable to sensors and instrumentation equipment and technology.

MODERATOR



Chris Costanzo

Deputy Director, Sensors and Aviation Division
Bureau of Industry and Security,
Department of Commerce

BACKGROUND

Technical Advisory Committees (TACs) advise the Department of Commerce on the technical parameters for export controls applicable to dual-use commodities and technology and on the administration of those controls. The TACs are composed of representatives from industry and Government representing diverse points of view on the concerns of the exporting community. Industry representatives are selected from firms producing a broad range of goods, technologies, and software presently controlled for national security, foreign policy, nonproliferation, and short supply reasons or that are proposed for such controls, balanced to the extent possible among large and small firms.

TAC members are appointed by the Secretary of Commerce and serve terms of not more than four consecutive years. Members of the public who are not members of the TAC are welcome to attend the open session of this committee meeting. A closed session will immediately follow the open session. If you are interested in joining this or future meetings, email SPIE Government Affairs Director Jennifer Douris at jennifer@spie.org.

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Tuesday 17 April 10:00 am to 6:00 pm
Wednesday 18 April 10:00 am to 5:00 pm

Talk with representatives from these and other companies:

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II-VI OPTICAL SYSTEMS

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APPLIED PHYSICS LABORATORY

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For more information, visit the
SPIE Career Center Booth #1615

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CENTER

PROFESSIONAL DEVELOPMENT

Career Advice for Scientists, Engineers, Graduate Students, Post-Docs, and Young Faculty

Tuesday 17 April 2018 • 1:45 to 2:30 PM

Location: St. George 102

PRESENTED BY :



Dr. Ronald Driggers,

University of Central Florida's
College of Optics and Photonics

Dr. Driggers uses his 30 years of leadership experience (Division Head at NRL, ARL, and NVESD) to provide recommendations on managing and pursuing a rewarding career. All of the questions you should be asking will be discussed. How do I get hired above my colleagues? How do I get promoted to Team Lead, Branch Head, or Associate Professor? How will I be evaluated? What can I do to give me an edge? How do I get assigned as journal topical editor or conference committee member? How many papers should I be publishing? Should I write a book? What is "H-Factor?" What is the most effective way to secure external research funding? Questions like these will be discussed as well as the importance of supporting your colleagues, treating others as you would like to be treated, and time management. A career in optics can be fun, interesting, fulfilling, but you need to pay attention to your career path and your record.

Dr. Ronald Driggers,

Univ. of Central Florida

Ronald G. Driggers is a Professor at the University of Central Florida's College of Optics and Photonics and works in the area of electro-optical and infrared imaging systems. He is also a co-founder of Johns Optical Systems in Lake Mary, Florida (since Oct 2014).

Snapshots: 2-Hour Courses for Non-Technical Staff

Basic Optics for Non-Optics Personnel

SC609 • Course Level: Introductory

CEU: 0.2 \$250 Members • \$185 Student Members

\$275 Non-Members USD

Monday 1:30 pm to 3:30 pm

See SPIE cashier to register

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

LEARNING OUTCOMES

This course will enable you to:

- read optical system descriptions and papers
- ask the right questions about optical component performance
- describe basic optical specifications for lenses, filters, and other components
- assess differences in types of filters, mirrors and beam directing optics
- describe how optics is used in our everyday lives

INTENDED AUDIENCE

This course is intended for the non-optical professional who needs to understand basic optics and interface with optics professionals.

INSTRUCTOR

Kevin Harding has been active in the optics industry for over 38 years, and has taught machine vision and optical methods for over 30 years in over 70 workshops and tutorials, including engineering workshops on machine vision, metrology, NDT, and interferometry used by vendors and system houses to train their own engineers. He has been recognized for his leadership in optics and machine vision by the Society of Manufacturing Engineers, Automated Imaging Association, and Engineering Society of Detroit. Kevin is a Fellow of SPIE and was the 2008 President of the Society.

This course is also available in online format

Infrared Imaging Technology Basics **NEW**

SC1246 • Course Level: Introductory

CEU: 0.2 \$250 Members • \$185 Student Members

\$275 Non-Members USD

Monday 10:30 am to 12:30 pm

See SPIE cashier to register

From near-infrared security cameras above your front door, to thermal infrared camera accessories that mount to smartphones, infrared imaging technology is everywhere in 2017. But there is still confusion and misinformation about what it is and what it can and cannot do. This 2-hour, high-level introduction to the topic, with minimal math or physics knowledge required, is for the growing number of non-specialists who need to understand infrared imaging technology and its many applications. The presentation materials consist of infrared images from the instructor's extensive library, the stories these images tell us, how they are made and how the technology and the phenomena it captures relates to the more familiar realm of visible-light cameras and human vision.

LEARNING OUTCOMES

This course will enable you to:

- discuss infrared imaging technology with engineers, scientists, and customers.
- explain and understand the terminology of infrared radiation science and technology.
- explain understand how object emit and reflect infrared energy and how cameras detect it.

INTENDED AUDIENCE

Executives, personnel in sales and business development, and non-technical employees of companies that make infrared cameras.

INSTRUCTOR

Austin Richards is a senior research scientist at FLIR Systems in Santa Barbara, CA. He holds a PhD in astrophysics from UC Berkeley, and has worked in the commercial infrared industry for over 15 years. He is also the principal of Oculus Photonics, a small company devoted to near-ultraviolet imaging systems manufacturing, sales and support. Richards is the author of the SPIE monograph *Alien Vision: Exploring the Electromagnetic Spectrum with Imaging Technology*.

SOCIAL AND NETWORKING/STUDENTS EVENTS



• **NOTE** •
SOME EVENTS
REQUIRE TICKETS
AND REGISTRATION.
SEE INDIVIDUAL
EVENTS FOR
DETAILS.

Join your colleagues at these relaxed events, including the All-Symposium Welcome Reception – an event not to be missed!

SPIE Fellows Luncheon

Monday 16 April 2018 • 12:00 to 1:30 PM

Location: Atrium Level, Orange Blossom Ballroom

All SPIE Fellows are invited to join your colleagues for this eighth annual SPIE hosted luncheon. The new Defense + Commercial 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, email brentj@spie.org.

FELLOWS LUNCHEON PRESENTATION:

Using Light to Enable Autonomous Mobility

Autonomous mobility is the disruptive technology of our era, and at its core are optical sensing challenges. Getting better quality data to safely operate a vehicle is the key to a driverless future, and this all hinges on higher performance LiDAR specifically built for self-driving scenarios. Join SPIE Fellow and Co-Founder of Luminar, Jason Eichenholz in a talk on the requirements for self-driving vehicles and a vision for a major breakthrough in LiDAR.



Dr. Jason Eichenholz
Luminar Technologies Inc.

All-Symposium Welcome Reception

Monday 16 April 2018 • 7:00 to 8:30 PM

Location: South Beach Pool

Relax, socialize, and enjoy refreshments on a warm Orlando evening.

SPIE Senior Member Breakfast

Tuesday 17 April 2017 • 8:00 to 9:00 AM

Location: Atrium Level, Orange Blossom Ballroom

All SPIE Senior Members are invited to join your colleagues for this SPIE-hosted buffet breakfast. Please join us for this informal gathering and a chance to interact with other Senior Members. Please plan to wear your yellow Senior Member ribbon for entry into this event. A special invitation is also made to the DCS18 Rising Researchers to attend this breakfast, where we will acknowledge them and receive their certificates. Senior Members planning to attend are asked to email brentj@spie.org.

Lunch with the Experts - A Student Networking Event

Tuesday 17 April 2018 • 12:30 to 1:30 PM

Location: Atrium Level, Orange Blossom Ballroom

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.

Evening at the Expo

Tuesday 17 April 2018 • 5:00 to 6:00 PM

Location: Exhibition Hall (Level 1)

Enjoy free drinks and appetizers while you learn about products and services offered by top companies in the industry. Don't miss this popular networking activity in the exhibition hall.



Diversity and Inclusion Reception

Wednesday 18 April 2018 • 5:30 to 7:00 PM

Location: Orange Blossom Ballroom

Please join us, come connect with others that are interested in promoting diversity and inclusion.

At previous SPIE conferences the Diversity and Inclusion Committee solicited issues and concerns from conference attendees, but each community is different. This networking event is devoted to continuing the discussion and soliciting your thoughts; help SPIE develop programs or systems to address issues of diversity and inclusion.

Light refreshments will be served. All are welcome. The first 30 attendees will receive a SPIE Diversity tie or scarf.

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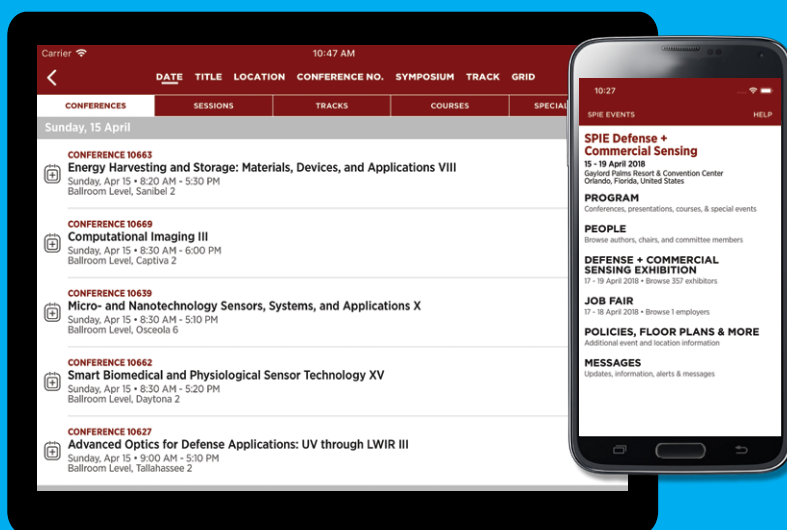
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EXHIBITION DATES AND HOURS

Tuesday 17 April10:00 am to 6:00 pm
 Evening at the Expo5:00 to 6:00 pm
 Wednesday 18 April10:00 am to 5:00 pm
 Thursday 19 April10:00 am to 2:00 pm



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EXPO HIGHLIGHTS:

- 400 Exhibiting Companies
- Industry Sessions
- Job Fair
- Evening at the Expo, Tuesday from 5:00 to 6:00 pm
- SPIE Industry Stage



FEATURED TECHNOLOGIES

- Infrared sources, detectors, and systems
- Optical components including specialized lenses and coatings
- Chemical and biological sensing
- High-speed imaging and sensing
- High-precision optics manufacturing
- LIDAR
- Cameras and CCD components
- Robotics
- Displays
- Law enforcement technology
- Imaging components, equipment, and systems
- Photonic sensors, spectroscopy, multi-spectral, hyperspectral
- Fiber optic components, equipment, and systems
- Fiber sensors
- Lasers and other light sources, laser accessories, and laser systems

Evening at the Expo

Tuesday, 17 April • 5:00 to 6:00 pm

FREE and open to all attendees

Come enjoy free drinks and appetizers while learning about products and services offered by top companies in the industry. Join us for this new networking activity in the exhibition hall.



PARTICIPATING COMPANIES

BOOTH NUMBERS

FLIR Systems, Inc.	915
Florida Photonics Cluster.....	1318
OptiGrate Corp.	
Analog Modules, Inc.	
BEAM Engineering For Advanced Measurements Co.	
CREOL, The College of Optics and Photonics, Univ. of Central Florida	
E.R. Precision Optical Corp.	
Tower Optical Corp.	
The Florida High Tech Corridor	
II-VI Optical Systems.	1501
L3 Space and Sensors.	501
Labsphere, Inc.....	301
LightPath Technologies, Inc.....	400
Metrohm USA, Inc.	1819
Nanotronics Imaging	1031
SPIE	1615
StingRay Optics, LLC	710
Syntec Optics.....	723
Viavi Solutions Inc.	1715
Visimid Technologies	307



LiDAR Demonstration

Location: Exhibition Hall (Level 1)

LiDAR is the core component of optical sensing technology powering autonomous vehicles, and high-performance data is required for safe self-driving. Stop by to see Luminar's breakthrough LiDAR perception capabilities enabling the autonomous future.

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LUMINAR

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EXHIBITOR PRODUCT DEMONSTRATIONS

TIME	TUESDAY, 17 APRIL 2018	WEDNESDAY, 18 APRIL 2018
10:30 AM		<p>Mira DS: Safe, Rugged, Identification Bryan Ray Metrohm Raman</p> <p>Mira DS, ruggedized to handle the challenges of the field, includes a library of explosives and illicit materials. Mira DS' advanced sampling attachments keeps the user safe during data collection.</p>
11:30 AM	<p>Introducing the World's First Flash LiDAR Zoom System Michael Dahlin and Sam Wyman Advanced Scientific Concepts and StingRay Optics</p> <p>ASC3D's award winning Peregrine 3D Flash LiDAR Vision system with the addition of StingRay Optics 167-500mm LiDAR-optimized motorized zoom lens with integrated multi-position diffuser wheel.</p>	<p>High spatial resolution hyperspectral camera based on a continuously variable filter Poul Svensgaard Delta Optical Thin Film A/S</p> <p>The principle of this new approach to HSI will be presented, along with characterization of the camera, real-world measurements, comparison with reference data, simultaneous 3D, and snapshot version.</p>
12:30 PM	<p>DUV RamanPL200 Spectrometer William Hug Photon Systems</p> <p>The Photon Systems DUV RamanPL200 is a miniature deep UV Raman and fluorescence spectrograph employing a three stage TE cooled array detector and Photon Systems proprietary 248nm laser.</p>	<p>SWIR InGaAs applications Nick Lechocinski Axiom Optics</p> <p>Axiom Optics offers an extensive range of SWIR InGaAs products addressing specific needs for demanding applications including active imaging, wavefront sensing, laser beam profiling and low-noise.</p>
1:30 PM	<p>SpectralLED Tunable Light Source Delivers Unmatched Accuracy for Camera and Sensor Calibration Trevor Vogt Gamma Scientific</p> <p>For the ultimate in resolution and accuracy, the SpectralLED® Tunable SWIR source incorporates 9 shortwave infrared wavelengths for synthesis of commercially available light sources.</p>	<p>New developments in precision molded LWIR optics Tom Krekels Umicore Optical Materials USA Inc.</p> <p>Umicore introduces its latest GASIR® based technology developments and product introductions, ranging from a family of manual focus lenses to small wafer level molded lenses for imaging and sensing.</p>
2:30 PM	<p>Cloud4ISR: Large-scale object tracking and information fusion on the cloud Thia Kiruabrajan TrackGen Inc.</p> <p>Cloud4ISR is an integrated plug-in capable service-oriented toolset with design, analysis & visualization modules for object tracking and data fusion with deployment on desktop or cloud computers.</p>	<p>SR-300 Integrating Sphere Ilya Koshkin CI SYSTEMS, INC</p> <p>CI Systems offers a cost effective highly uniform integrating sphere for the VIS-SWIR wavelength range. IT provides uniform radiance for the testing of cameras that operate in a wide spectral range.</p>
3:30 PM	<p>Next Generation ultra high performance CMOS Image Sensors Satoshi Aoyama Brookman Technology Inc.</p> <p>Company's patented technologies on low noise pixel design and high speed readout circuit (Cyclic ADC) provide extremely high performance CMOS Image Sensors for low light and/or high speed cameras.</p>	

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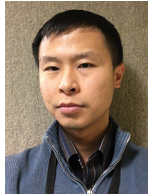
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Paper Number 10655-1



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Sample spacing variations on the feature performance for subsurface object detection using handheld ground penetrating radar
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Wayne State University

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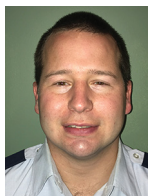
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Defect detection in foams and encapsulants using grating-based x-ray phase contrast imaging
Paper Number 10632-21



Russell Shirey
United States Air Force

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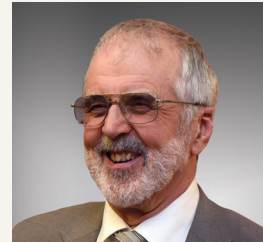
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DEFENSE, HOMELAND SECURITY, AND LAW ENFORCEMENT				
SC1068 Introduction to Night Vision (Browne) 1:30 pm to 5:30 pm, \$390 / \$445				
IMAGERY AND PATTERN ANALYSIS				
SC995 Target Detection Algorithms for Hyperspectral Imagery (Nasrabad) 8:30 am to 5:30 pm, \$625 / \$735,				
IMAGING AND DATA VISUALIZATION				
SC066 Fundamentals of Electronic Image Processing (Weeks) 8:30 am to 5:30 pm, \$695 / \$805				
IMAGING AND SENSING TECHNOLOGIES				
SC1244 Introduction to Imaging with Sensor Arrays (Rao) 8:30 am to 12:30 pm, \$390 / \$445	SC159 Head-Mounted Displays: Design and Applications (Melzer, Browne) 8:30 am to 5:30 pm, \$670 / \$780		SC789 Introduction to Optical and Infrared Sensor Systems (Shaw) 8:30 am to 5:30 pm, \$625 / \$735	
INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE				
SC160 Precision Stabilized Pointing and Tracking Systems (Hilkert) 8:30 am to 5:30 pm, \$625 / \$735			SC1245 Machine Learning Techniques for Radio Frequency Object Classification (Majumder, Blasch) 1:30 pm to 5:30 pm, \$390 / \$445	
SC1191 Quantum Sensors (Lanzagorta, Venegas-Andraca) 8:30 am to 12:30 pm, \$390 / \$445				
IR SENSORS AND SYSTEMS				
SC1241 Fundamentals of Infrared Sensing (Boreman) 8:30 am to 5:30 pm, \$660 / \$770	SC1213 Design of Cost Effective Infrared Imaging Lenses (Schuster) 8:30 am to 12:30 pm, \$390 / \$445		SC710 NIR and SWIR Imaging Applications (Richards) 1:30 pm to 5:30 pm, \$390 / \$445	SC950 Infrared Imaging Radiometry (Richards) 8:30 am to 5:30 pm, \$625 / \$735
SC900 Uncooled Thermal Imaging Detectors and Systems (Hanson) 8:30 am to 5:30 pm, \$665 / \$775	SC154 Electro-Optical Imaging System Performance (Holst) 8:30 am to 5:30 pm, \$705 / \$815			SC067 Testing and Evaluation of E-O Imaging Systems (Holst) 8:30 am to 5:30 pm, \$705 / \$815
SC1000 Introduction to Infrared and Ultraviolet Imaging Technology (Richards) 1:30 pm to 5:30 pm, \$445 / \$500	SC1073 Radiometry and its UAV Applications (Grant) 8:30 am to 5:30 pm, \$740 / \$850		<div style="border: 1px solid black; padding: 10px; background-color: #f0f0f0;"> <p>Student Members receive significant discounts. Visit the course desk or cashier desk for more information.</p> </div>	
	SC1212 Quantitative Imaging with Uncooled Infrared Cameras (Hagen) 1:30 pm to 5:30 pm, \$390 / \$445			

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LASER SENSORS AND SYSTEMS				
	SC1103 3D Imaging Laser Radar (Kamerman) 8:30 am to 5:30 pm, \$625 / \$735			SC1242 Atmospheric Lidar Principles and Applications (Gimmestad) 8:30 am to 5:30 pm, \$625 / \$735 NEW
NEXT-GENERATION SENSORS AND SYSTEMS				
SC1232 Introduction to LIDAR for Autonomous Vehicles (Shaw) 8:30 am to 12:30 pm, \$390 / \$445 NEW				
OPTICAL AND OPTOMECHANICAL ENGINEERING				
	SC156 Basic Optics for Engineers (Boreman) 8:30 am to 5:30 pm, \$665 / \$775			SC1052 Optical Systems Engineering (Kasunic) 8:30 am to 5:30 pm, \$705 / \$815 NEW
	SC014 Introduction to Optomechanical Design (Vukobratovich) 8:30 am to 5:30 pm, \$1,125 / \$1,380			
SENSOR DATA AND INFORMATION EXPLOITATION				
SC994 Multisensor Data Fusion for Object Detection, Classification and Identification (Klein) 8:30 am to 5:30 pm, \$705 / \$815	SC1215 Deep Learning Architectures for Defense and Security (Nasrabadi) 8:30 am to 5:30 pm, \$625 / \$735	SC1243 Data Fusion and Kalman Filtering for Object Tracking (State Estimation) with Multiple Radar Sensors (Klein) 8:30 am to 5:30 pm, \$705 / \$815 NEW	SC1135 Multispectral Image Fusion and Night Vision Colorization (Zheng, Blasch) 8:30 am to 12:30 pm, \$390 / \$445	
SC1072 Statistics for Imaging and Sensor Data (Bajorski) 8:30 am to 5:30 pm, \$695 / \$805	SC194 Multispectral and Hyperspectral Image Sensors (Lomheim) 8:30 am to 12:30 pm, \$470 / \$525			
SC1220 Imaging Spectrometry (Hagen) 1:30 pm to 5:30 pm, \$390 / \$445 NEW				
SNAPSHOTS: 2-HOUR COURSES FOR NON-TECHNICAL STAFF				
	SC1246 Infrared Imaging Technology Basics (Richards) 10:30 am to 12:30 pm, \$250 / \$275 NEW			
	SC609 Basic Optics for Non-Optics Personnel (Harding) 1:30 pm to 3:30 pm, \$250 / \$275			

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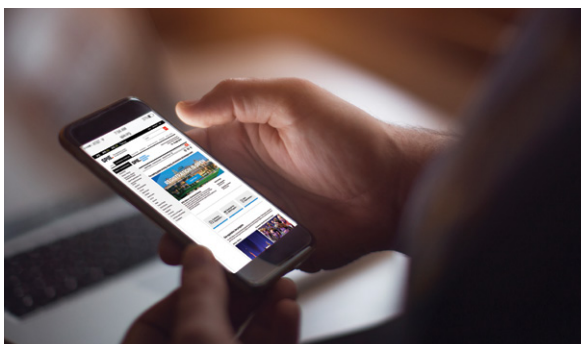
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IR Sensors and Systems				
	10624 Infrared Technology and Applications XLIV (<i>Andresen, Fulop, Hanson, Miller, Norton</i>) p.40			
		10625 Infrared Imaging Systems: Design, Analysis, Modeling, and Testing XXIX (<i>Holst, Krapels</i>) p. 44		
10627 Advanced Optics for Defense Applications: UV through LWIR III (<i>Vizgaitis, Andresen, Marasco, Sanghera, Snyder</i>) p. 48			10626 Tri-Technology Device Refrigeration (TTDR) III (<i>Epstein, Andresen, Benschop, Heremans, Riabzev, Sheik-Bahae</i>) p. 46	
Defense, Homeland Security, and Law Enforcement				
	10628 Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XXIII (<i>Bishop, Isaacs</i>) p. 50			
	10629 Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing XIX (<i>Guicheteau, Fountain, Howle</i>) p. 53			
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		10631 Ocean Sensing and Monitoring X (<i>Hou, Arnone</i>) p. 58		
		10632 Anomaly Detection and Imaging with X-Rays (ADIX) III (<i>Ashok, Greenberg, Gehm, Neifeld</i>) p. 61		
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		10637 Laser Technology for Defense and Security XIV (<i>Dubinskiy, Newell</i>) p. 73		
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		10642 Situation Awareness in Degraded Environments 2018 (<i>Sanders-Reed, Arthur</i>) p. 89		
	10643 Autonomous Systems: Sensors, Vehicles, Security and the Internet of Everything (<i>Dudzic, Ricklin</i>) p. 91			
		10654 Fiber Optic Sensors and Applications XV (<i>Mendez, Baldwin, Du, Udd, Pickrell, Wang</i>) p. 120		

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Sensor Data and Information Exploitation				
		10644 Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XXIV (<i>Velez-Reyes, Messinger</i>) p. 94		
	10645 Geospatial Informatics, and Motion Imagery Analytics VIII (<i>Palaniappan, Doucette, Seetharaman</i>) p. 98			
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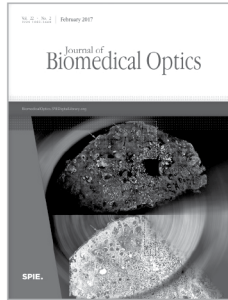
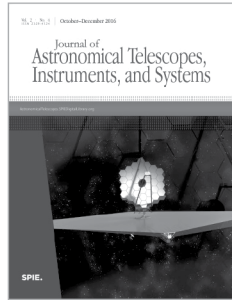
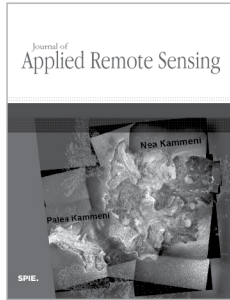


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	10657 Next-Generation Spectroscopic Technologies XI (<i>Druy, Crocombe, Barnett, Profeta, Azad</i>) p. 129			
			10658 Compressive Sensing VII: From Diverse Modalities to Big Data Analytics (<i>Ahmad</i>) p. 132	
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			10660 Quantum Information Science, Sensing, and Computation X (<i>Donkor, Hayduk, Frey, Lomonaco, Myers</i>) p. 136	
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10662 Smart Biomedical and Physiological Sensor Technology XV (<i>Cullum, Kiehl, McLamore</i>) p. 142				
10663 Energy Harvesting and Storage: Materials, Devices, and Applications VIII (<i>Dhar, Balaya, Dutta</i>) p. 144				
	10664 Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III (<i>Thomasson, McKee, Moorhead</i>) p. 146		10665 Sensing for Agriculture and Food Quality and Safety X (<i>Kim, Chao, Chin, Cho</i>) p. 148	
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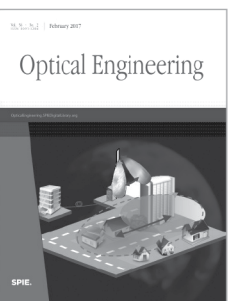
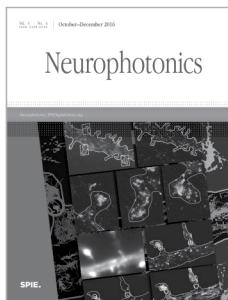
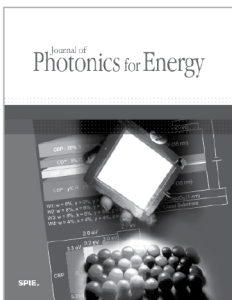
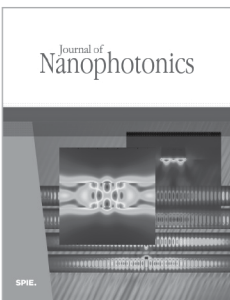
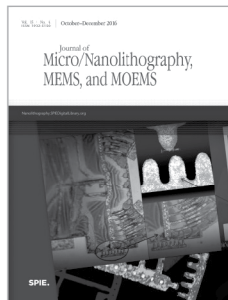
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Guna Seetharaman, U.S. Naval Research Lab. (USA)
Mansoor Sheik-Bahae, The Univ. of New Mexico (USA)
Charles M. Shoemaker, U.S. Army Communications-Electronics Research Development and Engineering Command (USA)

Miguel P. Snyder, U.S. Army RDECOM CERDEC NVESD (USA)
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Miguel Velez-Reyes, The Univ. of Texas at El Paso (USA)
Jay Vizgaitis, optX imaging systems (USA)
Dietrich Wiegmann, U.S. Army Research Lab. (USA)
David A. Wikner, U.S. Army Research Lab. (USA)
Edmund G. Zelnio, Air Force Research Lab. (USA)

CONFERENCE 10624

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B

Monday–Thursday 16–19 April 2018 • Proceedings of SPIE Vol. 10624

Infrared Technology and Applications XLIV

Conference Chairs: **Bjørn F. Andresen**, Consultant, Infrared Technologies & Applications (Israel); **Gabor F. Fulop**, Maxtech International, Inc. (USA), Infrared Imaging News (USA); **Charles M. Hanson**, SenseIR Solutions, LLC (USA); **John Lester Miller**, Cascade Electro Optics, LLC (USA); **Paul R. Norton**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

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MONDAY 16 APRIL

WELCOME

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B 8:00 AM TO 8:10 AM

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

SESSION 1

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B MON 8:10 AM TO 11:50 AM

NIR/SWIR

Session Chairs: **Martin H. Ettenberg**, Princeton Infrared Technologies, Inc. (USA); **Wolfgang A. Cabanski**, AIM INFRAROT-MODULE GmbH (Germany)

8:10 am: **Thermoelectrically-cooled extended-SWIR FPAs using unipolar barrier detectors** (*Invited Paper*), Michael H. MacDougal, Andrew Hood, Jeremy Thomas, Attollo Engineering, LLC (USA); Gary Wicks, Terry Golding, Amethyst Research Inc. (USA); Edward K. Huang, FLIR Systems, Inc. (USA) [10624-1]

8:40 am: **Extended SWIR imaging for targeting and reconnaissance**, Rainer Breiter, Matthias Benecke, Detlef Eich, Heinrich Figgemeier, Andreas Weber, Tobias Ihle, Joachim Wendler, AIM INFRAROT-MODULE GmbH (Germany) [10624-2]

9:00 am: **High-resolution 1.3M pixel extended wavelength InGaAs camera** (*Invited Paper*), Martin H. Ettenberg, Hai Nguyen, Michael Lange, Chris Martin, Princeton Infrared Technologies, Inc. (USA) [10624-3]

9:30 am: **Shockley-Read-Hall (SRH) recombination current in planar diffused P-n heterostructure InP/In_{0.53}Ga_{0.47}As/InP high-density small pitch focal plane arrays** (*Invited Paper*), Roger E. DeWames, Manufacturing Techniques (USA); Eric A. DeCuir Jr., Jonathan Schuster, U.S. Army Research Lab. (USA); Nibir K. Dhar, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [10624-4]

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

10:30 am: **Low SWaP SWIR video engine for image intensifier**

replacement, Itay Hirsh, Adi Aharon, Avraham R. Fraenkel, Aviho Giladi, Paul Kondrashov, Einat Louzon, Avner Mediouni, Kobi Rozenshein, Nickolay Syrel, SCD Semiconductor Devices (Israel); Avi Tuito, Israel Ministry of Defense (Israel) [10624-5]

10:50 am: **Numerical modeling of heterointerface traps and their impact on SWIR InGaAs detector performance**, Andreu L. Glasmann, Enrico Bellotti, Boston Univ. (USA) [10624-6]

11:10 am: **Highly efficient MIM diodes for NIR and SWIR applications**, Elif Gul Arsoy, Emre Can Durmaz, Meric Özcan, Yasar Gurbuz, Sabanci Univ. (Turkey) [10624-7]

11:30 am: **Colorimetry and multispectral imaging in the shortwave infrared**, Martin Gerken, Harry Schlemmer, HENSOLDT Optronics GmbH (Germany) [10624-8]

Lunch Break Mon 11:50 am to 1:30 pm

SESSION 2

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B MON 1:30 PM TO 4:40 PM

Select Applications

Session Chairs: **Weida Hu**, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China); **Mario O. Münzberg**, HENSOLDT Sensors GmbH (Germany)

1:30 pm: **A holistic approach to high performance infrared system design** (*Invited Paper*), Ronald G. Driggers, Richard Vollmerhausen, Univ. of Central Florida (USA); Michael Scholten, Duke Littlejohn, DRS Technologies, Inc. (USA) [10624-9]

2:00 pm: **Towards ultra-small pixel pitch cooled MW and LW IR-modules**, Holger Lutz, Rainer Breiter, Detlef Eich, Heinrich Figgemeier, Stefan Hanna, Reinhard Oelmaier, Joachim Wendler, AIM INFRAROT-MODULE GmbH (Germany) [10624-10]

2:20 pm: **Recent progress of infrared remote sensors for Chinese FY-4 Meteorological Satellite** (*Invited Paper*), Lei Ding, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) [10624-11]

2:50 pm: **Wide-field-of-view visible and infrared pushbroom airborne hyperspectral imager**, Yueming Wang, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) [10624-12]

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

3:40 pm: **Design and early results of a high-resolution dual-band MWIR imager for defence science applications**, Louis Moreau, Charles Belzile, Jean-François Lavigne, ABB Analytical Measurement (Canada); Jean-François Gravel, Defence Research and Development Canada (Canada); Florent M. Prel, Luc Levesque, Sylviane Lelièvre, ABB Analytical Measurement (Canada) [10624-13]

4:00 pm: **Towards a compact, portable, handheld device for contactless real-time standoff detection of hazardous substances**, Christopher Carson, David Stothard, John Macarthur, Matthew Warden, Fraunhofer Ctr. for Applied Photonics (United Kingdom); Lorenz Butschek, Stefan Hugger, Jan Jarvis, Marko Haertel, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany); André Merten, Markus Schwarzenberg, Jan Grahmann, Fraunhofer-Institut für Photonische Mikrosysteme (Germany); Marcin Ratajczyk, VIGO System S.A. (Poland) [10624-14]

4:20 pm: **Evaluation of space radiation effects on HgCdTe avalanche photodiode arrays for lidar applications**, Xiaoli Sun, James B. Abshire, Jean-Marie Lauenstein, NASA Goddard Space Flight Ctr. (USA); William Sullivan III, Jeff Beck, DRS Technologies, Inc. (USA); John E. Hubbs, Ball Aerospace & Technologies Corp. (USA) [10624-15]

SYMPOSIUM-WIDE PLENARY SESSION
LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6-7 for details.

TUESDAY 17 APRIL

SESSION 3

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B TUE 8:00 AM TO 10:20 AM

T2SL I

Session Chairs: **Meimei Z. Tidrow**, U.S. Army Night Vision & Electronic Sensors Directorate (USA);
Lucy Zheng, Institute for Defense Analyses (USA);
Philip C. Klipstein, SCD Semiconductor Devices (Israel)

8:00 am: **Very long wavelength type-II InAs/GaSb superlattice infrared detectors**, Linda Höglund, IRnova AB (Sweden); Jean-Baptiste Rodriguez, Institut d'Électronique et des Systèmes, Univ. Montpellier (France); Carl Asplund, Rickard Marcks von Würtemberg, Shagufra Naureen, Himanshu Kataria, IRnova AB (Sweden); Remi Rossignol, Philippe Christol, Institut d'Électronique et des Systèmes, Univ. Montpellier (France); Eric M. Costard, IRnova AB (Sweden) [10624-16]

8:20 am: **Type II superlattice infrared photodetector research at Fraunhofer IAF**, Tim O. Stadelmann, Volker Daumer, Vera Gramich, Tsvetelina Hugger, Lutz Kirste, Vera Klinger, Norbert Kohn, Wolfgang Luppold, Raphael Müller, Jasmin Niemasz, Robert Rehm, Frank Rutz, Johannes Schmidt, Martin Walther, Matthias Wauro, Andreas Wörl, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany) [10624-18]

8:40 am: **Strain-engineered ternary strained layer superlattice infrared detectors**, Charles J. Reyner, Gamin Ariyawansa, Josh M. Duran, Arnold M. Kiefer, John E. Scheihing, Air Force Research Lab. (USA) [10624-19]

9:00 am: **Transitioning large diameter Type II superlattice detector wafers to manufacturing**, Dave Forrai, L3 Space and Sensors (USA) [10624-20]

9:20 am: **Carrier density and transport in Be-doped InAsSb for infrared detector materials**, Lilian K. Casias, The Univ. of New Mexico (USA); Christian P. Morath, Elizabeth H. Steenberg, Preston T. Webster, Air Force Research Lab. (USA); Jin Kim, Sandia National Labs. (USA); Gilberto A. Umana-Membreno, The Univ. of Western Australia (Australia); Vincent M. Cowan, Air Force Research Lab. (USA); Ganesh Balakrishnan, Sanjay Krishna, The Univ. of New Mexico (USA) [10624-21]

9:40 am: **Vertical transport study of InAs/GaSb type-II superlattice nBp MWIR detectors using electron beam-induced current measurements**, Zahra Taghipour, The Univ. of New Mexico (USA); Alireza Kazemi, Sen Mathews, The Ohio State Univ. (USA); Elizabeth H. Steenberg, Christian P. Morath, Vincent M. Cowan, Air Force Research Lab. (USA); Sergey I. Maximenko, Edward H. Aifer, U.S. Naval Research Lab. (USA); Sanjay Krishna, The Ohio State Univ. (USA) [10624-22]

10:00 am: **Dual-band MWIR/LWIR focal plane arrays based on III-V strained-layer superlattices**, Brett Z. Nosh, Alexander R. Gurga, Sevag Terterian, Shuoqin Wang, Rajesh D. Rajavel, HRL Labs., LLC (USA) [10624-23]

Coffee Break/Dedicated Exhibition Time Tue 10:20 am to 11:20 am

SESSION 4

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B TUE 11:20 AM TO 11:50 AM

Keynote Session

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

11:20 am: **Next generation infrared imaging technologies (Keynote Presentation)**, Whitney E. Mason, DARPA (USA) [10624-24]

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

SESSION 5

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B TUE 1:30 PM TO 2:20 PM

T2SL II

Session Chairs: **Meimei Z. Tidrow**, U.S. Army Night Vision & Electronic Sensors Directorate (USA);
Lucy Zheng, Institute for Defense Analyses (USA);
Philip C. Klipstein, SCD Semiconductor Devices (Israel)

1:30 pm: **III-V infrared focal plane array development in US (Invited Paper)**, Alicia Williams, Meimei Tidrow, U.S. Army (USA) [10624-25]

2:00 pm: **Valence band features affecting carrier transport in III-V superlattice nBn detectors**, David R. Rhiger, Edward P. Smith, Raytheon Co. (USA) [10624-26]

SESSION 6

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B TUE 2:20 PM TO 5:10 PM

HgCdTe

Session Chair: **Whitney Mason**, DARPA (USA)

2:20 pm: **Dark current characterization of Au and Hg-vacancy hybrid doped p-type epitaxy long-wavelength HgCdTe infrared photodetectors**, Qing Li, Weida Hu, Chun Lin, Xiaoshuang Chen, Wei Lu, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) [10624-27]

2:40 pm: **High-performance SWIR/MWIR and MWIR/MWIR bispectral MCT detectors by AIM**, Heinrich Figgemeier, Christopher Ames, Johannes Beetz, Rainer Breiter, Detlef Eich, Stefan Hanna, Karl-Martin Mahlein, Timo Schallenberg, Jan Wenisch, AIM INFRAROT-MODULE GmbH (Germany) [10624-28]

Coffee Break Tue 3:00 pm to 3:30 pm

3:30 pm: **Numerical simulation of passivated long-wave IR HgCdTe surfaces and their effect on detector performance**, Ilya Prigozhin, Boston Univ. (USA) and MIT Lincoln Lab. (USA); Andreu L. Glasmann, Enrico Bellotti, Boston Univ. (USA) [10624-29]

3:50 pm: **Achievement of high image quality MCT sensors with Sofradir vertical industrial model**, Laurent Rubaldo, Pierre Guinedor, Alexandre Brunner, Vincent Destefanis, Paul Fougères, Armelle Kapferer, Nicolas Péré-Laperne, Diane Sam-Giao, Alexandre Kerlain, Augustin Cathignol, SOFRADIR (France); François Boulard, Olivier Gravrand, CEA-LETI (France) ... [10624-31]

4:10 pm: **The status of MCT detector development at ASELSAN**, Suleyman Umut Eker, Melih Kaldirim, Emrah Sasmaz, Alp Tolungüç, Burak Asici, Ayse San, Berna Barutcu, Selcuk Ozer, ASELSAN A.S. (Turkey) ... [10624-32]

CONFERENCE 10624

4:30 pm: **From CdZnTe bulk growth to HgCdTe infra-red detectors: mastering the chain for high-performance and reliable imaging**, Augustin Cathignol, Delphine Brellier, Erik Gout, Paul Fougères, Marie-Christine Manzato, Cécile Roman-Tinnes, Alexandre Brunner, Yann Loreau, Stephen Giraud, Laurent Rubaldo, Sandrine Chabanet, Armelle Kapferer, Yann Reibel, Vincent Destefanis, SOFRADIR (France) [10624-33]

4:50 pm: **Bulk characterization and surface analysis of epitaxy ready cadmium zinc telluride substrates for use in IRFPA manufacturing for IR imaging**, James P. Flint, Michael D. Cooper, Galaxy Compound Semiconductors, Inc. (USA); Jason Mackenzie, Francis J. Kumar, Redlen Technologies (Canada) [10624-34]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Dark current reduction using low stress diffusion mask, Young Ho Kim, Byoung Wook Lee, Sung Yong Ko, i3system, Inc. (Korea, Republic of); Chang Soo Ha, Agency for Defense Development (Korea, Republic of); Han Jung, i3system, Inc. (Korea, Republic of) [10624-67]

Interface engineering in InSb crystal growth for focal plane array device performance, Nathan W. Gray, Andrew Prax, William B. Alexander, Jason Merrell, 5N Plus Semiconductors, LLC (USA) [10624-68]

Balancing between V/III ratio and strain compensation for T2SL growth, Kevin Ru, Jaden Song Sr., Quantum Infrared Technologies Ltd. (China) [10624-69]

Progress towards in situ electrical characterization of 63 MeV proton-irradiation induced defects in infrared materials using deep level transient spectroscopy, Christian P. Morath, Air Force Research Lab. (USA) [10624-70]

FEA study on thermal stress of HgCdTe infrared focal plane array detector, Zhenhua Ye, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) [10624-71]

Characterization of As and P ion implantation in HgCdTe epilayers, Changzhi Shi, Chun Lin, Yanfeng Wei, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) [10624-30]

A study on ALD ZnS passivation of HgCdTe IRFPAs detectors, A.L. Cui, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) and Univ. of Chinese Academy of Sciences (China); Zhenhua Ye, C.H. Sun, L.F. Liu, X.N. Hu, R.J. Ding, L. He, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) [10624-72]

Recent progress on uncooled infrared sensor based on ferroelectric polymer, Jianlu Wang, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) [10624-74]

Implementation of SOI diode uncooled IRFPA in TEC-less and shutter-less operation, Daisuke Fujisawa, Yasuhiro Kosasayama, Takao Takikawa, Hisatoshi Hata, Takashi Takenaga, Tetsuya Satake, Koichi Yamashita, Daisuke Suzuki, Mitsubishi Electric Corp. (Japan) [10624-75]

A low-power CMOS readout IC with on-chip column-parallel SAR ADCs for microbolometer applications, Shahbaz Abbasi, Atia Shafique, Ömer Ceylan, Melik Yazici, Sabanci Univ. (Turkey); Mehmet Kaynak, IHP GmbH (Germany); Yasar Gurbuz, Sabanci Univ. (Turkey) [10624-77]

Improvement in NEDT characteristics of InAs/GaAs quantum dot based 320x256 focal plane array implanted with hydrogen ions, Sourabh Upadhyay, Debi Prasad Panda, Debabrata Das, Indian Institute of Technology Bombay (India); N.B.V. Subrahmanyam, Pramod Bhagwat, Babha Atomic Research Ctr. (India); Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) [10624-78]

WEDNESDAY 18 APRIL

SESSION 7

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B WED 8:00 AM TO 10:00 AM

HOT

Session Chairs: **Michael T. Eismann**, Air Force Research Lab. (USA); **Antoni Rogalski**, Wojskowa Akademia Techniczna im. Jaroslawa Dabrowskiego (Poland)

8:00 am: **Influence of radiative recombination on performance of p-i-n HOT long wavelength infrared HgCdTe photodiodes** (*Invited Paper*), Ma?gorzata Kopytko, Krzysztof Jóźwikowski, Piotr Marcin Martyniuk, Antoni Rogalski, Wojskowa Akademia Techniczna im. Jaroslawa Dabrowskiego (Poland) [10624-35]

8:30 am: **HOT MWIR detectors on silicon substrates** (*Invited Paper*), Binh-Minh Nguyen, Yu Cao, Adam J. Williams, Diego E. Carrasco, James R. Jenkins, Ray Li, Terry J. De Lyon, Steven S. Bui, Brett Z. Nosh, Rajesh D. Rajavel, HRL Labs., LLC (USA) [10624-36]

9:00 am: **Antimonide-based e-SWIR, MWIR, and LWIR barrier infrared detector and focal plane array development**, David Z. Ting, Alexander Soibel, Arezou Khoshakhlagh, Sam A. Keo, Sir B. Rafal, Anita Fisher, Brian J. Pepper, Edward M. Luong, Cory J. Hill, Sarath D. Gunapala, Jet Propulsion Lab. (USA) [10624-37]

9:20 am: **Potential and limitations for very-high-operating-temperature (VHOT) MWIR focal plane arrays using halogen-passivated PbSe**, David Shelton, Justin Sigley, Orges Furxhi, Ronald G. Driggers, St. Johns Optical Systems (USA) [10624-38]

9:40 am: **HOT MWIR InAs/InAsSb T2SL discrete photodetector development**, Jongwoo Kim, Henry H. Yuan, Joe Kimchi, JihFen Lei, Teledyne Judson Technologies (USA); Elizabeth Rangel, Peter Dreiske, Teledyne Imaging Sensors (USA); Amal Ikhlassi, Teledyne Scientific Co. (USA) [10624-40]

Coffee Break/Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 8

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B WED 11:00 AM TO 11:30 AM

A Word from the Masters

Session Chair: **Paul Norton**,

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

11:00 am: **Infrared: An Arcane Art**, William Parrish, Seek Thermal, Inc. (USA) [10624-42]

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

SESSION 9

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B WED 1:30 PM TO 6:20 PM

Uncooled FPAs and Applications

Session Chairs: **Kevin C. Liddiard**, Electro-optic Sensor Design (Australia); **Colin E. Reese**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Masafumi Kimata**, Ritsumeikan Univ. (Japan)

1:30 pm: **Wide-angle and polarization-selective plasmonic nano-metagrating absorbers**, Shinpei Ogawa, Mitsubishi Electric Corp. (Japan); Masafumi Kimata, Ritsumeikan Univ. (Japan) [10624-43]

1:50 pm: **Broadband photoresponse of graphene photodetectors from visible to long-wavelength infrared wavelengths**, Shinpei Ogawa, Masaaki Shimatani, Shoichiro Fukushima, Satoshi Okuda, Mitsubishi Electric Corp. (Japan); Yasushi Kanai, Takao Ono, Kazuhiko Matsumoto, Osaka Univ. (Japan) [10624-44]

2:10 pm: **Wide-band circular polarized cross bowtie antenna in LWIR**, Shenjie Miao, Navaneeth Premkumar, Florida Institute of Technology (USA); Yuancheng Xu, Apple Inc. (USA); Brian A. Lail, Florida Institute of Technology (USA) [10624-45]

2:30 pm: **Single layer microbolometer detector pixel using ZnO material**, M. Yusuf Tanrikulu, Cigdem Yildizak, Adana Science and Technology Univ. (Turkey); Orhan Akar, Middle East Technical Univ. (Turkey); Ali K. Okyay, Okyay Technologies (Turkey); Tayfun Akin, Middle East Technical Univ. (Turkey) [10624-46]

2:50 pm: **Infrared leaky-wave antenna using a uniaxial graphene metasurface**, Navaneeth Premkumar, Michael F. Finch, Brian A. Lail, Florida Institute of Technology (USA) [10624-47]

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

3:40 pm: **High-performance uncooled digital 17 μ m QVGA-IRFPA using microbolometer based on amorphous silicon with massively parallel Sigma-Delta-ADC readout**, Dirk Weiler, Frank Hochschulz, Claudia Busch, Matthias Stein, Marvin D. Michel, Daniel Würfel, Renee Lerch, Martin Petermann, Thomas Geruschke, Sebastian Blaesser, Sascha Weyers, Fraunhofer-Institut für Mikroelektronische Schaltungen und Systeme (Germany) [10624-48]

4:00 pm: **Physical modeling of Si/Si1-xGex based multi-quantum well microbolometer to optimize Ge content for higher thermal sensitivity**, Atia Shafique, Shahbaz Abbasi, Ömer Ceylan, Sabanci Univ. (Turkey); Alex Goeritz, Yuji Yamamoto, Canan Baristiran Kaynak, Mehmet Kaynak, IHP GmbH (Germany); Yasar Gurbuz, Sabanci Univ. (Turkey) [10624-49]

4:20 pm: **Frequency-selective metasurface integrated uncooled microbolometers**, Mahmoud Almasri, Amjed A. Abdullah, Univ. of Missouri (USA); Tao Liu, Missouri Univ. of Science and Technology (USA); Akshai Kumar Reddy, Univ. of Missouri (USA); Chuang Qu, Missouri Univ. of Science and Technology (USA); Weinan Zhang, Omar Alkorjia, Ibrahim Jasim, Cameron Warder, Shayne Wadle, Hawa Benshatwan, Univ. of Missouri (USA); Edward Kinzel, Missouri Univ. of Science and Technology (USA) . . . [10624-50]

4:40 pm: **The implications of 1/f noise in uncooled thermal imagers**, Charles M. Hanson, SenseIR Solutions, LLC (USA) [10624-51]

5:00 pm: **Small uncooled bolometer with a broad spectral response**, Francis Génèreux, Bruno Tremblay, David Gay, Martin Briand, Sébastien Deshaies, Michel Poirier, Jean-Sol Caron, Christine Alain, INO (Canada) [10624-52]

5:20 pm: **Pixel resistance optimization of a Si0.5Ge0.5/Si MQWs thermistor based on in situ B doping for microbolometer applications**, Canan Baristiran Kaynak, Yuji Yamamoto, Alexander Goritz, Falk Korndorfer, Peter Zaumseil, Philipp Kulse, Katrin Schulz, Matthias Wietstruck, IHP GmbH (Germany); Atia Shafique, Yasar Gurbuz, Sabanci Univ. (Turkey); Mehmet Kaynak, IHP GmbH (Germany) and Sabanci Univ. (Turkey) [10624-53]

5:40 pm: **Development of titanium oxide based 12 μ m pixel pitch uncooled infrared detector**, Yongjin Jeong, Myung-Ho Kwon, Sang Gu Kang, Han Jung, i3system, Inc. (Korea, Republic of) [10624-54]

6:00 pm: **Smart digital fusion between visible color low light and infrared sensors**, Benjamin Fradin de la Renaudière, Bertin Technologies (France) [10624-57]

THURSDAY 19 APRIL

SESSION 10

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B THU 8:00 AM TO 10:00 AM

Smart Processing

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

8:00 am: **Spatial and spectral filtering on focal plane arrays**, Yoram Karni, Michal Nitzani, Eyal Berkowicz, Eli Jacobsohn, Ilana Grimberg, Sivan Gliksmann, Yaron Kodriano, SCD Semiconductor Devices (Israel) [10624-55]

8:20 am: **An adaptive signal conditioning method for infrared detection systems and its hardware realization**, Peng Rao, YunFeng Zhao, Xin Chen, Bing Han, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) [10624-56]

8:40 am: **YOLO v2-based remote small drone detection using Infrared Images**, JunHwan Ryu, Taehwan Kim, Sungho Kim, Yeungnam Univ. (Korea, Republic of) [10624-58]

9:00 am: **A directional-progressive search method for infrared small target detection**, Xiangyue Zhang, Shenyang Institute of Automation (China); Qinghai Ding, Space Star Technology Co., Ltd. (China); Haibo Luo, Zheng Chang, Bin Hui, Junchao Zhang, Shenyang Institute of Automation (China) [10624-76]

9:20 am: **Thermal image improvement methods and their real time implementations on FPGAs**, Demet Cicek Turunc, Ismail Özsaç, Omer Gunay, ASELSAN A.S. (Turkey) [10624-59]

9:40 am: **A 1024x512 ROIC with 30 μ m pixel pitch and 250 Hz high frame rate for shortwave infrared detector**, ZhangCheng Huang, Songlei Huang, Xuquan Wang, Yu Chen, Jiaxiong Fang, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) [10624-60]

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

SESSION 11

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B THU 10:30 AM TO 11:10 AM

QWIP

Session Chair: **Eric M. Costard**, IRnova AB (Sweden)

10:30 am: **Small pitch resonator-QWIP detectors and arrays**, Kwong-Kit Choi, U.S. Army Research Lab. (USA); Steven Allen, L3 Cincinnati Electronics (USA); Jason Sun, Kimberley Oliver, Richard Fu, U.S. Army Research Lab. (USA) [10624-61]

10:50 am: **High-resolution QWIP and T2SL IDDCAs by IRnova**, Himanshu Kataria, Maxime Pozzi, Dean Evans, Jörgen Alverbro, Shagufta Naureen, Waldemar Diel, Carl Asplund, Linda Höglund, Eric M. Costard, IRnova AB (Sweden); Sooho Bae, i3system, Inc. (Korea, Republic of) [10624-62]

SESSION 12

ROOM: BALLROOM LEVEL, OSCEOLA BALLROOM B THU 11:10 AM TO 12:30 PM

Q-Dots

Session Chair: **John Lester Miller**, Cascade Electro-Optics, LLC (USA)

11:10 am: **Low-cost II-VI colloidal quantum dots for infrared imaging and detection**, Richard E. Pimpinella, Brendan W. Benapfl, Thomas Miynarski, Christoph Grein, Episensors, Inc. (USA) [10624-63]

11:30 am: **Short-wave infrared photodetector using p-i-p quantum dots (InAs/GaAs) for high-temperature operation**, Vidya P. Deviprasad, Hemant Ghadi, Debabrata Das, Debiprasad Panda, Harshal Rawool, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) [10624-64]

11:50 am: **Modelling of dark current and noise dependence on capping thickness in quantum dots based infrared photodetectors**, Vidya P. Deviprasad, Hemant Ghadi, Swetapadma Sahoo, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) [10624-65]

12:10 pm: **Heterogeneously coupled InAs Stranski-Krastanov and submonolayer quantum dot infrared photodetector for next-generation IR imaging**, Debabrata Das, Debiprasad Panda, Jhuma Saha, Harshal Rawool, Sourabh Upadhyay, Vinayak Chavan, Elvis Cardoz, Subhananda Chakrabarti, Indian Institute of Technology Bombay (India) [10624-66]

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INFRARED IMAGING NEWS

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CONFERENCE 10625

LOCATION: BALLROOM LEVEL, SUN BALLROOM B

Tuesday–Wednesday 17–18 April 2018 • Proceedings of SPIE Vol. 10625

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

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

Program Committee: **Gisele Bennett**, Georgia Institute of Technology (USA); **Piet Bijl**, TNO Defence, Security and Safety (Netherlands); **Katrin Braesicke**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **James A. Buford Jr.**, U.S. Army RDECOM AMRDEC (USA); **James A. Dawson**, Dynetics, Inc. (USA); **Russell M. Drake**, Raytheon Network Centric Systems (USA); **Ronald G. Driggers**, St. Johns Optical Systems (USA); **Richard L. Espinola**, U.S. Naval Research Lab. (USA); **David P. Forrai**, L-3 Communications Cincinnati Electronics (USA); **Orges Furxhi**, St. Johns Optical Systems (USA); **David P. Haefner**, U.S. Army RDECOM CERDEC NVESD (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); **Endre Repasi**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Joseph P. Reynolds**, U.S. Army RDECOM CERDEC NVESD (USA); **Nicolas Rivière**, ONERA (France); **Michael A. Soel**, FLIR Systems, Inc. (USA); **Andrew W. Sparks**, L-3 Sonoma EO (USA); **Curtis M. Webb**, Northrop Grumman Electronic Systems (USA)

TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SUN BALLROOM B TUE 7:40 AM TO 10:00 AM

Test I

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

7:40 am: **Performance prediction from EO system measurements using IRWindows™ and NVIPM**, David P. Haefner, U.S. Army RDECOM CERDEC NVESD (USA) [10625-1]

8:00 am: **Instrument for the measurement of normalized spectral response of cameras in the thermal bands**, Orges Furxhi, St. Johns Optical Systems (USA); David P. Haefner, Stephen D. Burks, U.S. Army RDECOM CERDEC NVESD (USA) [10625-2]

8:20 am: **Through display system SiTF and uniformity**, Stephen D. Burks, U.S. Army RDECOM CERDEC NVESD (USA) [10625-3]

8:40 am: **A spectrally tuneable light engine for UV-VIS-NIR-SWIR and beyond**, Jeff Holt, Christopher N. Durell, Labsphere, Inc. (USA); Alan Irwin, Santa Barbara Infrared, Inc. (USA) [10625-4]

9:00 am: **MTF measurements, identifying bias, and estimating uncertainty**, David P. Haefner, U.S. Army RDECOM CERDEC NVESD (USA) [10625-5]

9:20 am: **Thermal infrared reference sources fabricated from low-cost components and materials**, Harald Hovland, Torbjørn Skauli, Norwegian Defence Research Establishment (Norway) [10625-6]

9:40 am: **Modulation transfer function measurements on a MWIR T2SL focal plane array in IDCCA configuration**, Sylvie Bernhardt, Jean Nghiem, Julien Jaeck, Sophie Derelle, Edouard Huard, Jérôme Primot, ONERA (France); Linda Höglund, Eric Costard, IRnova AB (Sweden); Philippe Christol, Institut d'Électronique et des Systèmes (France) [10625-7]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 2

LOCATION: BALLROOM LEVEL, SUN BALLROOM B TUE 11:00 AM TO 12:20 PM

Test II

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

11:00 am: **Automated spot defect characterization in a field portable night vision goggle test set**, Stephen D. Scopatz, Electro Optical Industries, Inc. (USA); Gilles Aubry, Guillaume Arquetoux, HGH Systèmes Infrarouges (France); Metehan Ozten, Electro Optical Industries, Inc. (USA) [10625-8]

11:20 am: **On the relationships between higher and lower bit-depth system measurements**, Stephen D. Burks, U.S. Army RDECOM CERDEC NVESD (USA) [10625-9]

11:40 am: **Post-optic MTF measurement using a reference optic**, David P. Haefner, Conor Dunn, Miguel Snyder, James Stevens, U.S. Army RDECOM CERDEC NVESD (USA) [10625-10]

12:00 pm: **Down selection of climatic data for infrared signature modeling**, Ian L. Kermonde, Frank Drost, Rodney A. J. Borg, Defence Science and Technology Group (Australia) [10625-11]

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

SESSION 3

LOCATION: BALLROOM LEVEL, SUN BALLROOM B TUE 1:20 PM TO 3:00 PM

Systems

Session Chairs: **James A. Buford Jr.**, U.S. Army Research, Development and Engineering Command (USA); **Russell M. Drake**, Raytheon Network Centric Systems (USA); **Andrew W. Sparks**, L-3 Sonoma EO (USA)

1:20 pm: **Active hull cooling system performance analysis**, David A. Vaitekunas, W. R. Davis Engineering, Ltd. (Canada) [10625-12]

1:40 pm: **Performance of simulated asynchronous detectors**, Sina Simingalam, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Joseph P. Reynolds, U.S. Army RDECOM CERDEC NVESD (USA) .. [10625-13]

2:00 pm: **30 years: Past, present, and future of high fidelity IR scene projectors**, Scottie Mobley, James A. Buford Jr., U.S. Army Research, Development and Engineering Command (USA); Robert W. Smith, Robert L. Murrer, Missile Defense Agency (USA) [10625-14]

2:20 pm: **Non-uniformity correction mitigating the effect of lens temperature**, Charles Kim, Elisabeth Correa, Northrop Grumman Electronic Systems (USA) [10625-15]

2:40 pm: **Sensor fusion and augmented reality with the SAFIRE system**, Philip J. Saponaro Jr., Wayne Treible, Univ. of Delaware (USA); Brian Phelan, Kelly Sherbondy, U.S. Army Research Lab. (USA); Chandra Kambhamettu, Univ. of Delaware (USA) [10625-16]

Coffee Break Tue 3:00 pm to 3:30 pm

SESSION 4

LOCATION: BALLROOM LEVEL, SUN BALLROOM B TUE 3:30 PM TO 5:50 PM

Modeling, Metrics, and Tools

Joint Session with conferences 10625 and 10650

Session Chairs: **Richard L. Espinola**, U.S. Naval Research Lab. (USA); **Katrin Braesicke**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Endre Repasi**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Nicolas Rivière**, ONERA (France)

3:30 pm: **Imaging simulation of active EO-camera**, José Pérez, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10625-17]

- 3:50 pm: **Super-resolution in the presence of atmospheric optical turbulence**, Russell Hardie, Univ. of Dayton (USA); Michael Rucci, Barry Karch, Air Force Research Lab. (USA); Alex Dapore, Doug Droeger, L-3 Cincinnati Electronics (USA) [10650-16]
- 4:10 pm: **Development of a man-portable turbulence mitigation system**, James L. Bonnett, Aaron Paolini, Stephen T. Kozacik, Ariel Sherman, Eric J. Kelmelis, EM Photonics, Inc. (USA) [10650-17]
- 4:30 pm: **Estimating uncertainty in limiting resolution of full motion video**, Richard Gueler, Craig Olson, Andrew Sparks, L-3 Sonoma EO (USA) [10650-18]
- 4:50 pm: **Validating pyBSM: A Python package for modeling imaging systems**, Daniel A. LeMaster, Air Force Research Lab. (USA) [10650-19]
- 5:10 pm: **Statistical evaluation of motion-based MTF for full-motion video using the Python-based PyBSM image quality analysis toolbox**, Craig Olson, David Gaudio, Andrew Beard, Richard Gueler, L-3 Sonoma EO (USA) [10650-20]
- 5:30 pm: **Precision motion enables unique optical zoom and staring capabilities of a miniature payload**, Gal Peled, Nir Karasikov, Roman Yasinov, Vadim Derechinsky, Rita Yetkariou, Israel Shayer, Alan Feinstein, Nanomotion Inc. (USA) [10650-21]

- 11:40 am: **Neural net algorithms trained with simulated data for target identification**, Christopher Howell, Kimberly E. Kolb, U.S. Army RDECOM CERDEC NVESD (USA) [10625-26]
- 12:00 pm: **Validating models of target acquisition performance in the dismantled soldier context**, Mackenzie G. Glaholt, Rachel K. Wong, Justin G. Hollands, Defence Research and Development Canada, Toronto (Canada) [10625-27]
- Lunch/Exhibition Break Wed 12:20 pm to 1:40 pm

SESSION 7

LOCATION: BALLROOM LEVEL, SUN BALLROOM B WED 1:40 PM TO 3:00 PM

Modeling III

- Session Chairs: **James A. Dawson**, Dynetics, Inc. (USA); **Eddie L. Jacobs**, The Univ. of Memphis (USA); **Joseph P. Reynolds**, U.S. Army REDCOM CERDEC NVESD (USA)
- 1:40 pm: **When does clutter stop behaving as noise?**, Joseph P. Reynolds, Bradley L. Preece, Jeffrey T. Olson, U.S. Army RDECOM CERDEC NVESD (USA) [10625-29]
- 2:00 pm: **Human perception testing methodology for evaluating EO/IR imaging systems**, John J. Graybeal, KINEX, Inc. (USA); Todd W. Du Bosq, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Samuel S. Monfort, KINEX, Inc. (USA); Babajide O. Familoni, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [10625-30]
- 2:20 pm: **What is V50?**, Gerald C. Holst, JCD Publishing (USA) [10625-31]
- 2:40 pm: **TTP and (D)RI of ships**, Arthur D. van Rheenen, Lars T. Heen, Eirik B. Madsen, Erik Brendhagen, Kristin H. Løkken, Bernt Almklov, Eirik Glimsdal, Norwegian Defence Research Establishment (Norway) [10625-32]
- Coffee Break Wed 3:00 pm to 3:30 pm

SESSION 8

LOCATION: BALLROOM LEVEL, SUN BALLROOM B WED 3:30 PM TO 5:30 PM

Modeling IV

- Session Chairs: **Gisele Bennett**, Georgia Institute of Technology (USA); **Terrence S. Lomheim**, The Aerospace Corp. (USA); **Ronald G. Driggers**, St. Johns Optical Systems (USA)
- 3:30 pm: **Specific object model prediction of triangle orientation discrimination**, Robert Short, Univ. of Central Florida (USA); Richard Vollmerhausen, St. Johns Optical Systems (USA); Ronald Driggers, Univ. of Central Florida (USA) [10625-33]
- 3:50 pm: **Infrared search and track performance estimates for detection of commercial unmanned aerial vehicles**, Robert W. Nicholas, Univ. of Central Florida (USA); David Shelton, St. Johns Optical Systems (USA); Ronald Driggers, St. Johns Optical Systems (USA) and Univ. of Central Florida (USA) [10625-34]
- 4:10 pm: **Design, demonstration, and testing of low F-number LWIR panoramic imaging relay optics**, Orges Furxhi, St. Johns Optical Systems (USA); Ronald Driggers, Univ. of Central Florida (USA) [10625-35]
- 4:30 pm: **A target detection multi-layer matched filter for color and hyperspectral cameras**, Tomoya Miyanishi, Acquisition, Technology & Logistics Agency (ATLA) (Japan); Bradley L. Preece, Joseph P. Reynolds, U.S. Army RDECOM CERDEC NVESD (USA) [10625-36]
- 4:50 pm: **Operation and performance modeling of THz and mm-wave arrays for pupil plane imaging**, Nafiseh Mohammadian, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) and IMEC USA - Florida (USA); Lei Zhang, Amandeep Singh, IMEC USA - Florida (USA); Peter Offermans, IMEC (Netherlands); Ronald Driggers, CREOL, The College of Optics & Photonics, Univ. of Central Florida (USA) and IMEC USA - Florida (USA) [10625-37]
- 5:10 pm: **A comparison of MWIR and LWIR imaging systems with regard to range performance**, Berk B. Turgut, Gökçug Genchan Artan, TÜBITAK SAGE (Turkey) [10625-38]

WEDNESDAY 18 APRIL

INTRODUCTION

LOCATION: BALLROOM LEVEL, SUN BALLROOM B 8:00 AM TO 8:10 AM

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

SESSION 5

LOCATION: BALLROOM LEVEL, SUN BALLROOM B WED 8:10 AM TO 10:00 AM

Modeling I

Session Chairs: **Dave Forrai**, L-3 Cincinnati Electronics (USA); **Orges Furxhi**, St. Johns Optical Systems (USA)

- 8:10 am: **Initial test of MITA/DIMM with an operational CBP system**, Kevin C. Baldwin, David M. Brown, Randall T. Hanna, Andrea M. Brown, Joseph A. French, Johns Hopkins Univ. Applied Physics Lab., LLC (USA); Steven K. Moyer, Jonathan G. Hixson, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [10625-19]
- 8:30 am: **Evaluating the performance of an IR imaging system: A tutorial (Invited Paper)**, Brian Teaney, David P. Haefner, U.S. Army RDECOM CERDEC NVESD (USA) [10625-20]
- 9:00 am: **Virtual DRI incorporating the effects of vibration on simulated imagery**, Jonathan G. Hixson, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [10625-21]
- 9:20 am: **Optronic system imaging simulator (OSIS): Imager simulation tool of the ECOMOS project**, Daniel Wegner, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10625-22]
- 9:40 am: **MRTD: man versus machine**, Arthur D. van Rheenen, Norwegian Defence Research Establishment (Norway); Petter Taule, Norwegian Univ. of Science and Technology (Norway); Jan B. Thomassen, Eirik B. Madsen, Norwegian Defence Research Establishment (Norway) [10625-23]
- Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, SUN BALLROOM B WED 11:00 AM TO 12:20 PM

Modeling II

Session Chairs: **Michael A. Soel**, FLIR Systems, Inc. (USA); **David P. Haefner**, U.S. Army RDECOM CERDEC NVESD (USA); **Jonathan G. Hixson**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

- 11:00 am: **Enhanced background generation for scene rendering with GTSIMS**, Keith Prussing, Oliver Pierson, Chris Cordell, Georgia Institute of Technology (USA); John Stewart, Kevin Nielson, Georgia Tech Research Institute (USA) [10625-24]
- 11:20 am: **Measurements of SWIR backgrounds using the swux unit of measure**, Austin A. Richards, FLIR Systems, Inc. (USA); Martin Hübner, HENSOLDT Optronics GmbH (Germany); Michael Vollmer, Technische Hochschule Brandenburg (Germany) [10625-25]

CONFERENCE 10626

LOCATION: BALLROOM LEVEL, MIAMI 3

Wednesday 18 April 2018 • Proceedings of SPIE Vol. 10626

Tri-Technology Device Refrigeration (TTDR) III

Conference Chairs: **Mansoor Sheik-Bahae**, The Univ. of New Mexico (USA); **Richard I. Epstein**, The Univ. of New Mexico (USA), ThermoDynamic Films, LLC (USA); **Bjørn F. Andresen**, Consultant, Infrared Technologies & Applications (Israel); **Tonny Benschop**, Thales Cryogenics B.V. (Netherlands); **Joseph P. Heremans**, The Ohio State Univ. (USA); **Sergey V. Riabzev**, RICOR Cryogenic & Vacuum Systems (Israel)

Program Committee: **Igor D. Burlakov**, Orion Research-and-Production Association (Russian Federation); **Bernardo Farfan**, The Univ. of New Mexico (USA), ThermoDynamis Films, LLC (USA); **Matthew Grayson**, Northwestern Univ. (USA); **Markus P. Hehlen**, Los Alamos National Lab. (USA); **Carl S. Kirkconnell**, West Coast Solutions (USA); **Ingo N. Rühlich**, AIM INFRAROT-MODULE GmbH (Germany); **Alexander Vepruk**, SCD Semiconductor Devices (Israel); **Yinong Wu**, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China)

WEDNESDAY 18 APRIL

WELCOME

LOCATION: BALLROOM LEVEL, MIAMI 3 8:00 AM TO 8:10 AM

Session Chair: **Tonny Benschop**,
Thales Cryogenics B.V. (Netherlands)

SESSION 1

LOCATION: BALLROOM LEVEL, MIAMI 3 WED 8:10 AM TO 10:10 AM

Mechanical Coolers: Miniaturization

Session Chairs: **Carl S. Kirkconnell**, West Coast Solutions (USA);
Ingo N. Rühlich, AIM INFRAROT-MODULE GmbH (Germany)

8:10 am: **Performance of the Lockheed Martin Space MINI cryocooler**, David Frank, Michael Guzinski, Alyssa Ruiz, Eric W. Roth, Lockheed Martin Space Systems Co. (USA) [10626-1]

8:30 am: **Experimental investigation on the miniature mixed refrigerant refrigerator driven by a mini-compressor**, Gaofei Chen, Maoqiong Gong, Technical Institute of Physics and Chemistry (China) [10626-2]

8:50 am: **Computational fluid dynamics study of displacer "shuttle loss" in miniature Stirling cryocoolers**, Carl S. Kirkconnell, West Coast Solutions (USA); S. M. Ghiaasiaan, Ali Ghavami, Georgia Institute of Technology (USA) [10626-3]

9:10 am: **RMs1: The state of the art SWaP cryocooler**, Cédric Segueineau, Jean-Yves Martin, Christophe Vasse, Christian Abadie, Sylvain Chaumeau, Thierry Etchanchu, Gilles Laplagne, Julien Le Bordays, Mikel Sacau, Sébastien Van-Acker, Thales Cryogénie S.A. (France); Tonny Benschop, Thales Cryogenics B.V. (Netherlands) [10626-4]

9:30 am: **Compact high-performance linear coolers for harsh environments**, Ingo N. Rühlich, Markus Mai, Carsten Rosenhagen, Thomas Wiedmann, Andreas Withopf, Sebastian Zehner, AIM INFRAROT-MODULE GmbH (Germany) [10626-5]

9:50 am: **Overview of Ricor's advanced cryocoolers for HOT IR detectors**, Avishai Filis, RICOR Cryogenic & Vacuum Systems (Israel) [10626-6]

Coffee Break and Dedicated Exhibition Time Wed 10:10 am to 11:10 am

SESSION 2

LOCATION: BALLROOM LEVEL, MIAMI 3 WED 11:10 AM TO 12:10 PM

Mechanical Coolers: Design and Testing I

Session Chairs: **Sergey V. Riabzev**, RICOR Cryogenic & Vacuum Systems (Israel); **Yinong Wu**, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China)

11:10 am: **Ruggedizing vibration sensitive components of electro-optic module using wideband dynamic absorber**, Alexander Vepruk, Yakov Openheim, SCD Semiconductor Devices (Israel); Avi Tuito, Israel Ministry of Defense (Israel) [10626-7]

11:30 am: **A 50W@170K pulse tube cryocooler used in wide-field survey telescope**, Zhenhua Jiang, Yinong Wu, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) [10626-8]

11:50 am: **MEMS based shock pulse detection sensor for improved rotary Stirling cooler end of life prediction**, Martin Hübner, HENSOLDT Optronics GmbH (Germany); Mario O. Münzberg, HENSOLDT Sensors GmbH (Germany) [10626-9]

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

SESSION 3

LOCATION: BALLROOM LEVEL, MIAMI 3 WED 1:30 PM TO 3:00 PM

Laser Cryocoolers

Session Chairs: **Mansoor Sheik-Bahae**, The Univ. of New Mexico (USA); **Jun Zhang**, Institute of Semiconductors, Chinese Academy of Sciences (China)

1:30 pm: **Demonstration of all solid state cryocooler using optical refrigeration (Invited Paper)**, Junwei Meng, Aram Gragossian, Eric Lee, Mohammadreza Ghasemkhani, Alexander R. Albrecht, Azzurra Volpi, The Univ. of New Mexico (USA); Markus P. Hehlen, Los Alamos National Lab. (USA) and The Univ. of New Mexico (USA); Richard I. Epstein, The Univ. of New Mexico (USA) and ThermoDynamic Films LLC (USA); Mansoor Sheik-Bahae, The Univ. of New Mexico (USA) [10626-10]

2:00 pm: **Sideband Raman cooling in semiconductor (Invited Paper)**, Jun Zhang, Institute of Semiconductors, Chinese Academy of Sciences (China) [10626-11]

2:30 pm: **Laser cooling for radiation-balanced thin disk lasers (Invited Paper)**, Mansoor Sheik-Bahae, The Univ. of New Mexico (USA) [10626-12]

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

SESSION 4

LOCATION: BALLROOM LEVEL, MIAMI 3 WED 3:30 PM TO 5:50 PM

Mechanical Coolers: Design and Testing II

Session Chairs: **Tonny Benschop**, Thales Cryogenics B.V. (Netherlands); **Alexander Veprik**, SCD Semiconductor Devices (Israel)

- 3:30 pm: **Robust Stirling coolers for sensing in extreme environmental conditions**, Roel Arts, Daniel Willems, Jeroen C. Mullié, Ronnie van Leeuwen, Peter Bollens, Garmt de Jonge, Thales Cryogenics B.V. (Netherlands). [10626-13]
- 3:50 pm: **Structural analysis of an infrared focal plane dewar assembly for meteorological satellite**, Dafu Liu, Qinfei Xu, Defeng Mo, Lin Xu, Lei Zhang, Wen Sun, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) [10626-14]
- 4:10 pm: **Overview of RICOR's reliability theoretical analysis, accelerated life demonstration test results and verification by field data**, Igor Vainshtein, RICOR-Cryogenic & Vacuum Systems (Israel). [10626-15]
- 4:30 pm: **Lifetime validation of high-reliability (>30,000hr) rotary cryocoolers for specific customer profiles**, Jean-Marc Cauquil, Cédric Segueineau, Christophe Vasse, Gaetan Raynal, Thales Cryogénie S.A. (France); Tonny Benschop, Thales Cryogenics B.V. (Netherlands). . . [10626-16]
- 4:50 pm: **AIM dual-use cryocoolers for commercial applications**, Ingo N. Rühlich, Markus Mai, Carsten Rosenhagen, Thomas Wiedmann, Andreas Withopf, Sebastian Zehner, AIM INFRAROT-MODULE GmbH (Germany) [10626-17]
- 5:10 pm: **Practical aspects of using warm-up calorimetry of HOT integrated Dewar detector assemblies**, Alexander Veprik, Baruch Shlomovich, SCD Semiconductor Devices (Israel); Avi Tuito, Israel Ministry of Defense (Israel) [10626-18]
- 5:30 pm: **NG HEC flight coaxial cryocoolers performance**, Tanh Nguyen, John Russo, Gary Basel, Danny Chi, Lynn Abelson, Northrop Grumman Aerospace Systems (USA) [10626-19]

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CONFERENCE 10627

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2

Sunday–Monday 15–16 April 2018 • Proceedings of SPIE Vol. 10627

Advanced Optics for Defense Applications: UV through LWIR III

Conference Chairs: **Jay N. Vizgaitis**, optX imaging systems (USA); **Bjørn F. Andresen**, Consultant, Infrared Technologies & Applications (Israel); **Peter L. Marasco**, Air Force Research Lab. (USA); **Jasbinder S. Sanghera**, U.S. Naval Research Lab. (USA); **Miguel P. Snyder**, U.S. Army RDECOM CERDEC NVESD (USA)

Program Committee: **Christopher C. Alexay**, StingRay Optics, LLC (USA); **Guy Beadie**, U.S. Naval Research Lab. (USA); **Kyle R. Bryant**, U.S. Army AMRDEC (USA); **Robert B. Chipper**, Raytheon EO Innovations (USA); **John P. Deegan**, Rochester Precision Optics, LLC (USA); **Mark Durham**, DRS Technologies, Inc. (USA); **Anatoly M. Filachev**, Orion Research-and-Production Association (Russian Federation); **Stephen P. McGeoch**, Thales Optronics Ltd. (United Kingdom); **Craig Olson**, L-3 Communications (USA); **Clara Rivero-Baleine**, Lockheed Martin Missiles and Fire Control (USA); **Joël Rollin**, Thales Angénieux S.A. (France); **Harry H. Schlemmer**, HENSOLDT Optronics GmbH (Germany); **Doron Sturlesi**, Rafael Advanced Defense Systems Ltd. (Israel); **Alan Symmons**, LightPath Technologies, Inc. (USA); **Stan Szapiel**, Raytheon ELCAN Optical Technologies (Canada); **Nicholas A. Thompson**, Qioptiq Ltd. (United Kingdom); **Jue Wang**, Corning Specialty Materials, Inc. (USA)

SUNDAY 15 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 SUN 9:00 AM TO 10:30 AM

Optical System Design I

Session Chairs: **Kyle R. Bryant**, U.S. Army Aviation & Missile Research, Development & Engineering Ctr. (USA);
Craig Olson, L-3 Sonoma EO (USA)

9:00 am: **Refractive optically multiplexed LWIR imaging system** (*Invited Paper*), Corrie J. Smeaton, Emma Landsiedel, Vinay Shah, Yaron Rachlin, R. Hamilton Shepard III, MIT Lincoln Lab. (USA) [10627-1]

9:30 am: **Design study of a MWIR/LWIR dual FOV lens**, Jamie L. Ramsey, Blair Unger, George Lindberg, Rochester Precision Optics, LLC (USA) [10627-2]

9:50 am: **The relation between uncooled arrays pixel size and optics in the long-wave infrared**, Thomas Hingant, Jan Verplancke, Umicore IR Glass (France); John W. Franks, Umicore Electro-Optic Materials (United Kingdom) [10627-3]

10:10 am: **Additive manufacturing volume optimization for athermal optics**, Kyle R. Bryant, U.S. Army Aviation & Missile Research, Development & Engineering Ctr. (USA); Devlin Hayduke, Materials Sciences Corp. (USA) [10627-4]

Coffee Break. Sun 10:30 am to 11:00 am

SESSION 2

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 SUN 11:00 AM TO 12:20 PM

Optical System Design II

Session Chairs: **Kyle R. Bryant**, U.S. Army Aviation & Missile Research, Development & Engineering Ctr. (USA);
Craig Olson, L-3 Sonoma EO (USA)

11:00 am: **NRL glasses for multispectral optics designs**, Shyam Bayya, Daniel Gibson, Vinh Nguyen, Jasbinder Sanghera, U.S. Naval Research Lab. (USA); Mikhail Kotov, Sotera Defense Solutions, Inc. (USA); Collin McClain, Univ. Research Foundation (USA) [10627-5]

11:20 am: **Free-form based lateral-shift compact zoom system: theory and computer simulations**, Catherine Greenhalgh, Stan Szapiel, Raytheon ELCAN Optical Technologies (Canada) [10627-6]

11:40 am: **An optical system design with duo-lateral detector and finding position of light source with operational utilisation of this system**, Hande Soykuvet, Roketsan A.S. (Turkey) [10627-7]

12:00 pm: **Wide bandwidth, achromatic, planar silicon lenses for long-wave infrared imaging**, Gregory J. Kintz, Invis Technologies Corp. (USA) [10627-8]

Lunch Break Sun 12:20 pm to 1:50 pm

SESSION 3

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 SUN 1:50 PM TO 3:20 PM

GRIN

Session Chairs: **Clara Rivero-Baleine**, Lockheed Martin Missiles and Fire Control (USA); **Jasbinder S. Sanghera**, U.S. Naval Research Lab. (USA)

1:50 pm: **Advances in Infrared GRIN: novel materials towards components and devices** (*Invited Paper*), Kathleen Richardson, Myungkoo Kang, Laura Sisken, Anupama Yadav, Cesar Blanco, Michael Antia, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Antoine Lepicard, Marc Dussauze, Institut des Sciences Moléculaires, Univ. de Bordeaux 1 (France); Casey M. Schwarz, Ursinus College (USA); Carlo Pantano, The Pennsylvania State Univ. (USA); Clara Baleine, Lockheed Martin Missiles and Fire Control (USA); Andrew Kirk, Samantha Mensah, Lockheed Martin Corp. (USA); Stephen Kuebler, Chris Grabill, Spencer Novak, Cheng Li, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Juejun Hu, Anuradha Agarwal, Massachusetts Institute of Technology (USA); Theresa Mayer, Virginia Polytechnic Institute and State Univ. (USA) . . [10627-9]

2:20 pm: **SWaP advantage of replacing high-performance glass achromatic doublet with a polymeric nanolayer GRIN achromatic singlet**, Howard Fein, Peak Nano Optics (USA) [10627-10]

2:40 pm: **Effect of molding index drop on chalcogenide GRIN profiles**, George Lindberg, Josh Cruz, Blair Unger, John P. Deegan, Robert Benson, Rochester Precision Optics, LLC (USA); Shyam Bayya, Daniel Gibson, Jasbinder Sanghera, Vinh Nguyen, U.S. Naval Research Lab. (USA); Mikhail Kotov, Sotera Defense Solutions, Inc. (USA) [10627-11]

3:00 pm: **GRIN optics for dual-band IR sensors**, Daniel Gibson, Shyam Bayya, Jasbinder Sanghera, Vinh Nguyen, U.S. Naval Research Lab. (USA); Mikhail Kotov, Sotera Defense Solutions, Inc. (USA); Collin McClain, Univ. Research Foundation (USA); Jay Vizgaitis, optX Imaging Systems (USA) [10627-12]

Coffee Break. Sun 3:20 pm to 3:50 pm

SESSION 4

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 SUN 3:50 PM TO 5:10 PM

Coatings, Filters, and Metasurfaces I

Session Chair: **Clara Rivero-Baleine**, Lockheed Martin Missiles and Fire Control (USA)

3:50 pm: **Up converting as a tool for laser protecting smart filters**, Ariela Donval, Noam Gross, Eran Partouche, Tali Fisher Masliah, Moshe Oron, KiloLambda Technologies, Ltd. (Israel) [10627-13]

4:10 pm: **Characterization of glancing angle deposited (GLAD) optical coatings for UV applications**, Christopher J. Chinhong, Corning Specialty Materials, Inc. (USA); James E. Platten, Corning Specialty Materials, Inc. (USA); Michael J. D'Lallo, Thomas E. Gebo, Corning Specialty Materials, Inc. (USA) [10627-14]

4:30 pm: **Silicon oxynitride based scratch resistant anti-reflective coatings**, Jue Wang, Jonathan P. Bouchard, Gary A. Hart, Jean Francois Oudard, Charles A. Paulson, Paul A. Sachenik, James J. Price, Corning Incorporated (USA) [10627-15]

4:50 pm: **Long-duration CW laser testing of optical windows with random antireflective surface structures on both interfaces**, Christopher R. Wilson, Thomas C. Hutchens, The Univ of North Carolina at Charlotte (USA); Lynda E Busse, Jesse A. Frantz, L. Brandon Shaw, Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA); Ishwar D. Aggarwal, Sotera Defense Solutions (USA) and The Univ of North Carolina at Charlotte (USA) . [10627-29]

MONDAY 16 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 MON 8:40 AM TO 10:10 AM

Coatings, Filters, and Metasurfaces II

Session Chair: **Jue Wang**, Corning Incorporated (USA)

8:40 am: **Spectral performance and durability of dual-band infrared antireflection coatings on 3rd Gen FLIR lens substrates**, Chris Piazzo, Alexis Weckel, Karen D. Hendrix, Mark Kozlowski, Viavi Solutions Inc. (USA) [10627-16]

9:00 am: **Low auto-fluorescence broadband antireflection coatings for human genome sequencing optical platform**, Jing Du, Jue Wang, Horst Schreiber, Jean Francois Oudard, Corning Incorporated (USA) [10627-17]

9:20 am: **Densification of SiO₂ and Nb₂O₅ films for protective silver mirrors**, Jue Wang, Leonard Wamboldt, Jason S. Ballou, Timothy Soucy, Corning Incorporated (USA) [10627-18]

9:40 am: **Micro-structured optical coatings: periodic-array enhanced functionalities** (*Invited Paper*), Xinbin Cheng, Tao He, Zhou Zhou, Jinlong Zhang, Zhanshan Wang, Tongji Univ. (China) [10627-19]

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

SESSION 6

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 MON 10:40 AM TO 12:00 PM

Materials and Manufacturing I

Session Chairs: **Alan Symmons**, LightPath Technologies, Inc. (USA); **John P. Deegan**, Rochester Precision Optics, LLC (USA)

10:40 am: **Development in EFG sapphire at II-VI Optical Systems**, Melissa Seitz, II-VI Optical Systems (USA) [10627-20]

11:00 am: **Advantages of plastic optical systems**, Alan Symmons, LightPath Technologies (USA) [10627-31]

11:20 am: **Optical and crystal growth studies of ZnO-Bi₂O₃-B₂O₃ glass**, Casey M. Schwarz, Ursinus College (USA); Myungkoo Kang, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Carlo Pantano, The Pennsylvania State Univ. (USA); Kathleen Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Clara Rivero-Baleine, Lockheed Martin Missiles and Fire Control (USA); Stephen Kuebler, Univ. of Central Florida (USA); Chris Grabill, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Jarrett Rice, The Pennsylvania State Univ. (USA); Quentin Altemose, Katie Raichle, Brittani Schnable, Ursinus College (USA); Ian Wietecha-Reiman, The Pennsylvania State Univ. (USA) [10627-22]

11:40 am: **Thermal conductivity of chalcogenide glasses measured by Raman spectroscopy**, Anupama Yadav, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Derek Kita, Peter Su, Anuradha Agarwal, Juejun Hu, Massachusetts Institute of Technology (USA); Marc Dussauze, Univ. Bordeaux 1 (France); Kathleen Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10627-23]

Lunch Break Mon 12:00 pm to 1:30 pm

SESSION 7

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 MON 1:30 PM TO 3:20 PM

Materials and Manufacturing II

Session Chairs: **Alan Symmons**, LightPath Technologies, Inc. (USA); **John P. Deegan**, Rochester Precision Optics, LLC (USA)

1:30 pm: **Precision glass molding versus diamond turning: Determining the crossover point that maximizes the benefits of each manufacturing method for infrared applications** (*Invited Paper*), Jeremy Huddleston, Alan Symmons, LightPath Technologies, Inc. (USA) [10627-24]

2:00 pm: **Chalcogenide molded freeform optics for QCL**, Francois Chenard, Oseas Alvarez, Andrew Buff, IRflex Corporation (USA); Allen Yi, The Ohio State Univ. (USA) [10627-25]

2:20 pm: **Lightweight mechanically alloyed aluminum metal matrix composites**, Martyn Acreman, Don H. Hashiguchi, Materion Brush Beryllium & Composites (USA); David Tricker, Andrew Tarrant, Materion Aerospace Metal Composites (United Kingdom) [10627-26]

2:40 pm: **Self-localization manufacturing of cylindrical mirror in magnetorheological finishing**, Xiaoqiang Peng, Can Yang, Shanyong Chen, Chaoliang Guan, National Univ. of Defense Technology (China) [10627-27]

3:00 pm: **Infrared plasmon polaritons in high-mobility graphene for hyperspectral imaging**, Andre U. Sokolnikov, Visual Solutions and Applications (USA) [10627-30]

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CONFERENCE 10628

LOCATION: BALLROOM LEVEL, SUN 1

Monday-Wednesday 16-18 April 2018 • Proceedings of SPIE Vol. 10628

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

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: **Canicious G. Abeynayake**, Defence Science and Technology Group (Australia); **Derek T. Anderson**, Mississippi State Univ. (USA); **Benjamin E. Barrowes**, U.S. Army Engineer Research and Development Ctr. (USA); **Leslie M. Collins**, Duke Univ. (USA); **Anthony A. Faust**, Defence Research and Development Canada, Suffield (Canada); **Tesfaye G-Michael**, Naval Surface Warfare Ctr. Panama City Div. (USA); **Pete Howard**, U.S. Army CERDEC NVESD (USA); **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); **Alina Zare**, Univ. of Florida (USA)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SUN 1 MON 8:00 AM TO 10:10 AM

Sensing Mélange

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

8:00 am: **Thermal remote sensing approach combined with field spectroscopy for detecting underground structures intended for defence and security purposes in Cyprus** (*Invited Paper*), George Melillos, Kyriacos Themistocleous, Diofantos G. Hadjimitsis, Cyprus Univ. of Technology (Cyprus). [10628-1]

8:30 am: **Inside-the-wall detection of objects with low metal content using the GPR sensor: Effects of different wall structures on the detection performance**, Mesut Dogan, Middle East Technical Univ. (Turkey) and Ardahan Univ. (Turkey); Omer Yesilyurt, Gönül Turhan-Sayan, Middle East Technical Univ. (Turkey) [10628-2]

8:50 am: **Laser multi-beam differential interferometric sensor for acoustic detection of buried objects**, Vyacheslav Aranchuk, Ina Aranchuk, Brian Carpenter, Craig Hickey, Daniel Kleinert, Hank Buchanan, The Univ. of Mississippi (USA) [10628-3]

9:10 am: **Modeling of optical parametrization for automatic target recognition (ATR) systems**, Courtney D. Taylor, Brian Lindmark, Naval Surface Warfare Ctr. Panama City Div. (USA) [10628-4]

9:30 am: **Forensic database of homemade and nonstandard explosives**, Marek Kotrlý, Ivana Turková, Ivo Beroun, Institute of Criminalistics Prague (Czech Republic) [10628-5]

9:50 am: **Laboratory demonstration of IED detection using a high-flux neutron source**, Robert O'Connell, Gabriel Becerra, Phoenix Nuclear Labs. (USA) [10628-6]

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

SESSION 2

LOCATION: BALLROOM LEVEL, SUN 1 MON 10:40 AM TO 12:00 PM

Downward Looking GPR Sensing I

Session Chairs: **Leslie M. Collins**, Duke Univ. (USA); **Sai L. Chiang**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

10:40 am: **A validation study of the simulation software 'gprMax' by varying antenna stand-off height**, Josh Wilkinson, Nigel Davidson, Defence Science and Technology Lab. (United Kingdom) [10628-7]

11:00 am: **A GPR-based landmine identification method using energy and dielectric features**, Alper Genc, ASELSAN A.S. (Turkey); Gözde Bozdagi Akar, Middle East Technical Univ. (Turkey) [10628-8]

11:20 am: **Scene analysis using semi-supervised clustering**, Peter J. Dobbins, Joseph N. Wilson, Univ. of Florida (USA) [10628-9]

11:40 am: **Standardized international down-looking GPR data collections**, Marie Talbott, Erik Rosen, Institute for Defense Analyses (USA) [10628-10]

Lunch Break Mon 12:00 pm to 1:30 pm

SESSION 3

LOCATION: BALLROOM LEVEL, SUN 1 MON 1:30 PM TO 3:10 PM

Downward Looking GPR Sensing II

Session Chairs: **Canicious G. Abeynayake**, Defence Science and Technology Group (Australia); **Brian C. Barlow**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

1:30 pm: **How do we choose the best model? The impact of cross-validation design on model evaluation for buried threat detection in ground penetrating radar**, Jordan M. Malof, Daniël Reichman, Leslie M. Collins, Duke Univ. (USA) [10628-11]

1:50 pm: **Improving the histogram of oriented gradient feature for buried threat detection in ground penetrating radar by implementing it as a trainable convolutional neural network**, Jordan M. Malof, John Bralich III, Daniël Reichman, Leslie M. Collins, Duke Univ. (USA) [10628-12]

2:10 pm: **How much shape information is enough, or too much? Designing imaging descriptors for threat detection in ground penetrating radar data**, Daniël Reichman, Leslie M. Collins, Duke Univ. (USA) [10628-13]

2:30 pm: **If training data appears to be mislabeled, should we relabel it? Improving supervised learning algorithms for threat detection in ground penetrating radar data**, Daniël Reichman, Duke Univ. (USA); Leslie M. Collins, Duke Univ (USA) [10628-14]

2:50 pm: **Comparison of several single and multiple instance learning methods for detecting buried explosive objects using GPR data**, Hichem Frigui, Mahdi Moalla, Andrew Kareem, Univ. of Louisville (USA) [10628-15]

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

SESSION 4

LOCATION: BALLROOM LEVEL, SUN 1 MON 3:40 PM TO 4:20 PM

Forward Looking Sensing

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

3:40 pm: **Novel application of windowed beamforming function imaging for FLGPR**, Ismael J. Xique, Joseph Burns, Brian T. Thelen, Ryan M. LaRose, Michigan Tech Research Institute (USA) [10628-16]

4:00 pm: **Comparison of experimental three-band IR detection of buried objects and multiphysics simulations**, Renato C. Rabelo, Heather P. Tilley, Jeffrey K. Catterlin, Gamani Karunasiri, Fabio Alves, Naval Postgraduate School (USA) [10628-17]

SYMPOSIUM-WIDE PLENARY SESSION
LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

- 5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**
- 5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)
- 5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin
- 6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6–7 for details.

TUESDAY 17 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, SUN 1 TUE 8:00 AM TO 10:00 AM

UXO Electromagnetic Induction Sensing and Clearance

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

- 8:00 am: **UXO clearance operation in Laos**, Motoyuki Sato, Tohoku Univ. (Japan). [10628-23]
- 8:20 am: **Wire detection and length determination using low frequency electromagnetics**, Benjamin E. Barrowes, U.S. Army Engineer Research and Development Ctr. (USA). [10628-24]
- 8:40 am: **Accounting for the influence of salt water in the physics required for processing underwater UXO EMI signals**, Fridon Shubitidze, Kevin O'Neill, Benjamin E. Barrowes, Dartmouth College (USA); John B. Sigman, Duke Univ. (USA). [10628-25]
- 9:00 am: **Exploiting measurement subspaces for wideband electromagnetic induction processing**, Charles E. Hayes, Waymond R Scott Jr., James H. McClellan, Georgia Institute of Technology (USA). [10628-26]
- 9:20 am: **EMI real-time subsurface target location by analytical dHP**, Kevin O'Neill, Fridon Shubitidze, Benjamin E. Barrowes, Dartmouth College (USA). [10628-27]
- 9:40 am: **High-frequency EMI sensing for estimating depleted uranium radiation levels in soils**, Fridon Shubitidze, Thayer School of Engineering at Dartmouth (USA); Benjamin E. Barrowes, U.S. Army Engineer Research and Development Ctr. (USA); Kevin O'Neill, Thayer School of Engineering at Dartmouth (USA). [10628-28]
- Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, SUN 1 TUE 11:00 AM TO 11:40 AM

EMI Sensing I

Session Chairs: **Motoyuki Sato**, Tohoku Univ. (Japan); **Ken E. Yasuda**, U.S. Army RDECOM CERDEC NVESD (USA)

- 11:00 am: **Modelling the broadband electromagnetic induction response of three-dimensional targets**, Jonathan E. Gabbay, Waymond R. Scott Jr., Georgia Institute of Technology (USA). [10628-29]
- 11:20 am: **Comparison of electromagnetic induction coils optimized using stream functions to conventional coils**, Mark A. Reed, Waymond R. Scott Jr., Georgia Institute of Technology (USA). [10628-30]
- Lunch/Exhibition Break Tue 11:40 am to 1:10 pm

SESSION 7

LOCATION: BALLROOM LEVEL, SUN 1 TUE 1:10 PM TO 1:50 PM

EMI Sensing II

Session Chairs: **Motoyuki Sato**, Tohoku Univ. (Japan); **Ken E. Yasuda**, U.S. Army RDECOM CERDEC NVESD (USA)

- 1:10 pm: **Performance bounds for target location estimation from electromagnetic induction measurements**, Andrew J. Kerr, Georgia Tech Research Institute (USA) and Georgia Institute of Technology (USA); Waymond R. Scott Jr., James H. McClellan, Georgia Institute of Technology (USA). [10628-31]
- 1:30 pm: **EMPACT 3D: An advanced EMI discrimination sensor for CONUS and OCONUS applications**, Joe Keranen, Jonathan S. Miller, Gregory Schultz, Morgan Sander-Olhoef, White River Technologies, Inc. (USA); Stephen Laudato, U.S. Army Night Vision & Electronic Sensors Directorate (USA). [10628-32]

SESSION 8

LOCATION: BALLROOM LEVEL, SUN 1 TUE 1:50 PM TO 3:30 PM

EMI, GPR, and Applied Deep Learning Techniques

Session Chairs: **Aaron LaPointe**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Ken E. Yasuda**, U.S. Army RDECOM CERDEC NVESD (USA)

- 1:50 pm: **Generative adversarial networks for ground penetrating radar in hand held explosive hazard detection**, Charlie Veal, Joshua L. Dowdy, Derek T. Anderson, Blake Brockner, Mississippi State Univ. (USA); Grant J. Scott, Univ. of Missouri (USA). [10628-33]
- 2:10 pm: **Sample spacing variations on the feature performance for subsurface object detection using handheld ground penetrating radar (Rising Researcher Presentation)**, Brendan Alvey, Dominic K. C. Ho, Univ. of Missouri (USA); Alina Zare, Univ. of Florida (USA). [10628-34]
- 2:30 pm: **Introduction of the advanced ALIS: Advanced landmine imaging system**, Motoyuki Sato, Tohoku Univ. (Japan). [10628-35]
- 2:50 pm: **Qualified interpolation of non-uniformly sampled handheld radar data**, Drew Gonsalves, Peter J. Dobbins, Joseph N. Wilson, Univ. of Florida (USA). [10628-36]
- 3:10 pm: **Deep fusion: a neural network approach for buried hazard detection**, Ferit Toska, Univ. of Florida (USA). [10628-37]
- Coffee Break. Tue 3:30 pm to 4:00 pm

SESSION 9

LOCATION: BALLROOM LEVEL, SUN 1 TUE 4:00 PM TO 5:40 PM

Synthetic Aperture Sonar (SAS) I

Session Chairs: **Derek T. Anderson**, Mississippi State Univ. (USA); **Robert H. Luke III**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

- 4:00 am: **Opto-acoustic intensity probes for seabed target tracking and detection**, Cameron A. Matthews, Naval Surface Warfare Ctr. Panama City Div. (USA); Chris Gardner, National Oceanic and Atmospheric Administration Southeast Fisheries Science Ctr. (USA). [10628-18]
- 4:20 am: **A target detection algorithm for underwater synthetic aperture sonar imagery**, Aquila P. Galusha, James M. Keller, Univ. of Missouri (USA); Alina Zare, Univ. of Florida (USA). [10628-19]
- 4:40 am: **Fractal analysis of seafloor textures for target detection in synthetic aperture sonar imagery**, Thomas Nabelek, James M. Keller, Univ. of Missouri (USA); Alina Zare, Univ. of Florida (USA). [10628-20]
- 5:00 am: **A quantitative comparison of automated anomaly detection methods for target detection in sonar imagery**, Princess Lyons, Daniel Suen, Alina Zare, Univ. of Florida (USA); James M. Keller, Univ. of Missouri (USA). [10628-21]
- 5:20 am: **Possibilistic fuzzy local information C-means with automated feature selection for seafloor segmentation**, Joshua Peebles, Daniel Suen, Alina Zare, Univ. of Florida (USA); James M. Keller, Univ. of Missouri (USA). [10628-22]

CONFERENCE 10628

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Permittivity and conductivity parameter estimations using full waveform inversion, Jheyston Serrano, Ana Ramirez, Sergio A. Abreo, Univ. Industrial de Santander (Colombia); Brian M. Sadler, U.S. Army Research Lab. (United States) [10628-57]

WEDNESDAY 18 APRIL

SESSION 10

LOCATION: BALLROOM LEVEL, SUN 1 WED 8:00 AM TO 10:00 AM

Side-attack Threat Sensing I

Session Chairs: **Tesfaye G-Michael**, Naval Surface Warfare Ctr. Panama City Div. (USA); **Brian C. Barlow**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

8:00 am: **Multiple-modality program for standoff detection of side-attack explosive hazards**, Kathryn Williams, U.S. Army RDECOM CERDEC NVESD (USA); Erik Rosen, Institute for Defense Analyses (USA) [10628-38]

8:20 am: **Analyzing three dimensional radar voxel data using the discrete Fourier transform for SAEH detection**, Pooparat Plodpradista, James M. Keller, Dominic K. C. Ho, Mihail Popescu, Andrew R. Buck, Univ. of Missouri (USA) [10628-39]

8:40 am: **Extracting features from high-resolution three dimensional radar imagery through volume slicing and clustering**, Quenton LaRoe, James M. Keller, Mihail Popescu, Andrew R. Buck, Univ. of Missouri (USA) [10628-53]

9:00 am: **Physics-based data augmentation for high frequency 3D radar systems**, Miles Crosskey, Patrick Wang, Rayn Sakaguchi, Kenneth D. Morton Jr., CoVar Research (USA) [10628-41]

9:20 am: **High-resolution MIMO X-band radar for side-looking anomaly detection**, David Boutte, Vincent R. Radzicki, James Hogg, Paul Taylor, Steven Hunt, AKELA, Inc. (USA) [10628-42]

9:40 am: **Confidence level estimation in multi-target classification problem**, Bo Fu, Pingping Zhu, Cornell Univ. (USA); Jason C. Isaacs, Naval Surface Warfare Ctr. Panama City Div. (USA); Silvia Ferrari, Cornell Univ. (USA) [10628-56]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 11

LOCATION: BALLROOM LEVEL, SUN 1 WED 11:00 AM TO 11:40 AM

Synthetic Aperture Sonar (SAS) II

Session Chairs: **James M. Keller**, Univ. of Missouri (USA); **Peter D. Howard**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

11:00 am: **Quantitative evaluation of superpixel clustering**, Dylan Stewart, Alina Zare, Univ. of Florida (USA); J. T. Cobb, Naval Surface Warfare Ctr. Panama City Div. (USA) [10628-44]

11:20 am: **Estimation of automatic target recognition performance for synthetic aperture sonar with integration angle reduction**, Julia Gazagnaire, Benjamin R. McLaughlin, Jason C. Isaacs, Naval Surface Warfare Ctr. Panama City Div. (USA) [10628-45]

Lunch/Exhibition Break Wed 11:40 am to 1:10 pm

SESSION 12

LOCATION: BALLROOM LEVEL, SUN 1 WED 1:10 PM TO 2:50 PM

Synthetic Aperture Sonar (SAS) III

Session Chairs: **James M. Keller**, Univ. of Missouri (USA); **Peter D. Howard**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

1:10 pm: **Simulated target insertion for automatic target recognition performance estimation**, Julia Gazagnaire, Jeannine A. Abiva, Naval Surface Warfare Ctr. Panama City Div. (USA) [10628-46]

1:30 pm: **Investigation of methods to improve time delay estimation for synthetic aperture sonar motion estimation**, Julia Gazagnaire, Naval Surface Warfare Ctr. Panama City Div. (USA); Pierre-Philippe J. Beaujean, Florida Atlantic Univ. (USA) [10628-47]

1:50 pm: **Estimating height using repeat-pass interferometry for synthetic aperture sonar**, Jeannine A. Abiva, Tesfaye G-Michael, Naval Surface Warfare Ctr. Panama City Div. (USA) [10628-48]

2:10 pm: **Topographic independent component analysis-based false alarm reduction for change detection in sonar imagery**, Tesfaye G-Michael, Naval Surface Warfare Ctr. Panama City Div. (USA); Rodney G. Roberts, Florida State Univ. (USA) [10628-50]

2:30 pm: **Clustering approaches to feature change detection**, Tesfaye G-Michael, Naval Surface Warfare Ctr. Panama City Div. (USA); Max Gunzburger, Janet Peterson, Florida State Univ. (USA) [10628-52]

Coffee Break Wed 2:50 pm to 3:20 pm

SESSION 13

LOCATION: BALLROOM LEVEL, SUN 1 WED 3:20 PM TO 4:20 PM

Side-attack Threat Sensing II

Session Chairs: **Jason C. Isaacs**, Naval Surface Warfare Ctr. Panama City Div. (USA); **Kathryn Williams**, U.S. Army RDECOM CERDEC NVESD (USA)

3:20 pm: **Convolutional neural network based side attack explosive hazard detection in three dimensional voxel radar**, Blake Brockner, Joshua L. Dowdy, Charlie Veal, Derek T. Anderson, Mississippi State Univ. (USA); Kathryn Williams, U.S. Army RDECOM CERDEC NVESD (USA); Robert Luke, U.S. Army Night Vision & Electronic Sensors Directorate (USA); David Sheen, Pacific Northwest National Lab. (USA) [10628-51]

3:40 pm: **High-bandwidth acoustic detection system (HBADS) for stripmap synthetic aperture acoustic imaging of canonical ground targets using airborne sound and a 16 element receiving array**, Steven S. Bishop, Timothy R Moore, Peter M. Gugino, Brett T. Smith, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Kathryn P. Kirkwood, Murray S. Korman, U.S. Naval Academy (USA) [10628-55]

4:00 pm: **Backscattering stripmapped synthetic aperture air acoustic array experiments for imaging a ground canonical target through a hexagonal rod array of clutter**, Steven S. Bishop, Timothy R. Moore, Peter M. Gugino, Brett T. Smith, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Kathryn P. Kirkwood, Murray S. Korman, U.S. Naval Academy (USA) [10628-54]

CONFERENCE 10629

LOCATION: BALLROOM LEVEL, SUN 4

Monday–Wednesday 16–18 April 2018 • Proceedings of SPIE Vol. 10629

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

Conference Chairs: **Jason A. Guicheteau**, U.S. Army Edgewood Chemical Biological Ctr. (USA); **Augustus Way Fountain III**, U.S. Army Edgewood Chemical Biological Ctr. (USA); **Chris R. Howle**, Defence Science and Technology Lab. (United Kingdom)

Program Committee: **Russell G. Bartholomew**, U.S. Army Edgewood Chemical Biological Ctr. (USA); **Christopher C. Carter**, Johns Hopkins Univ. Applied Physics Lab. (USA); **Darren K. Emge**, U.S. Army Edgewood Chemical Biological Ctr. (USA); **Anthony Esposito**, Defense Threat Reduction Agency (USA); **Timothy J. Johnson**, Pacific Northwest National Lab. (USA); **Aaron LaPointe**, U.S. Army RDECOM CERDEC NVESD (USA); **Paul M. Pellegrino**, U.S. Army Research Lab. (USA)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SUN 4 MON 8:00 AM TO 8:30 AM

Keynote Session

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

8:00 am: **First results off a QCL-CPA based standoff system for detecting hazardous substances in the IR fingerprint domain** (*Keynote Presentation*), Frank Wilsenack, Arne Lorenzen, Wehrwissenschaftliches Institut für Schutztechnologien (Germany); François Brygo, Cédric Awanzino, Bertin Technologies (France); François Guty, Arnaud Grisard, Christian Larat, Dominique Papillon, Muriel Schwarz, Eric Lallier, Thales Research & Technology (France); Hans Dieter Tholl, Franz Münzhuber, Diehl Defence GmbH & Co. KG (Germany); Jürgen Kunz, Diehl BGT Defence GmbH & Co. KG (Germany); Michael Raab, Marcel Rattunde, Stefan Hugger, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany); Mariusz Kastek, Tadeusz Piatkowski, Wojskowa Akademia Techniczna im. Jarosława Dąbrowskiego (Poland) [10629-1]

SESSION 2

LOCATION: BALLROOM LEVEL, SUN 4 MON 8:30 AM TO 10:10 AM

Advances in Chemical Threat Sensing I

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

8:30 am: **Using infrared spectroscopy in the design of new sorbent materials for detection of chemical warfare agents**, Michael R. Papantonakis, Courtney A. Roberts, U.S. Naval Research Lab. (USA); Tyler G. Grissom, Oak Ridge Institute for Science and Education (USA); Andrew Kusterbeck, Nova Research, Inc. (USA); Viet K. Nguyen, Robert Furstenberg, R. Andrew McGill, U.S. Naval Research Lab. (USA) [10629-2]

8:50 am: **Detection and identification of chemical warfare agents using MWIR active hyperspectral imaging**, Keith Ruxton, Robin Head, M Squared Lasers Ltd. (United Kingdom); Rhea J. Clewes, Defence Science and Technology Lab. (United Kingdom); Nils Hempler, Graeme P. A. Malcolm, Gareth T. Maker, M Squared Lasers Ltd. (United Kingdom) [10629-3]

9:10 am: **Threat detection using a standoff, wide-area hyperspectral Raman imaging sensor**, Nathaniel R. Gomer, Matthew P. Nelson, ChemImage Corp. (USA) [10629-4]

9:30 am: **Photonic micro-gas-chromatography detection of chemical threat agents**, Robert Furstenberg, U.S. Naval Research Lab. (USA); Christopher J. Breshike, American Society for Engineering Education (USA); Benjamin Andrews, Andrew Kusterbeck, Dawn Dominguez, Nova Research, Inc. (USA); Christopher A. Kendziora, R. Andrew McGill, Todd Stievater, Dmitry Kozak, U.S. Naval Research Lab. (USA) [10629-5]

9:50 am: **UV Raman imaging of surface contaminants using tunable laser and narrow bandpass filters**, Lars Landström, Fredrik Kullander, Hampus Lundén, Pär Wästerby, FOI-Swedish Defence Research Agency (Sweden) [10629-6]

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

SESSION 2

LOCATION: BALLROOM LEVEL, SUN 4 MON 10:40 AM TO 12:00 PM

Advanced in Chemical Threat Sensing II

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

10:40 am: **A portable standoff spectrometer for chemical warfare agent identification using integrated monolithic quantum cascade laser arrays from 6.5-11 microns**, Mark F. Witinski, Pendar Technologies (USA) [10629-7]

11:00 am: **High-speed and large-area scanning of surfaces for trace chemicals using wavelength-tunable quantum cascade lasers**, David B. Kelley, Derek A. Wood, Anish K. Goyal, Petros Kotidis, Block Engineering, Inc. (USA) [10629-8]

11:20 am: **Enabling standoff detection of hazardous materials using a fiber optic coupled quantum cascade infrared laser system**, Kenneth J. Ewing, Kevin J. Major, Jasbinder S. Sanghera, Rafael R. Gattass, L. Brandon Shaw, Lynda Busse, U.S. Naval Research Lab. (USA); Enrique Lopez, Michael Pushkarsky, David Arnone, Justin Kane, DRS Daylight Solutions (USA); Rhea J. Clewes, Linda Lee, Chris Howle, Defence Science and Technology Lab. (United Kingdom) [10629-9]

11:40 am: **Development of a compact airborne threat analyzer integrating quantum cascade laser arrays and quartz-enhanced photoacoustic spectroscopy**, Romain Blanchard, Brandt Pein, Mark F. Witinski, Christian Pfluegl, Daryoosh Vakhshoori, Pendar Technologies (USA) [10629-10]

Lunch Break Mon 12:00 pm to 1:30 pm

SESSION 4

LOCATION: BALLROOM LEVEL, SUN 4 MON 1:30 PM TO 3:10 PM

Radiological, Nuclear Sensing

Session Chair: **Timothy J. Johnson**,
Pacific Northwest National Lab. (USA)

1:30 pm: **UAV-based LiDAR and gamma probe with real-time data processing and downlink for survey of nuclear disaster locations**, Thomas Hinterhofer, Martin Pfennigbauer, Andreas Ullrich, RIEGL Laser Measurement Systems GmbH (Austria); Michael Hofstätter, AIT Austrian Institute of Technology GmbH (Austria) [10629-11]

1:50 pm: **Gamma ray sensors based on ionizing organic nanocomposites**, Narsingh Bahadur Singh, Univ. of Maryland, Baltimore County (USA); Ching Hua Su, NASA Marshall Space Flight Ctr. (USA); Narasimha Prasad, NASA Langley Research Ctr. (USA); Fow-Sen Choa, Bradley Arnold, Univ. of Maryland, Baltimore County (USA); Christopher Cooper, Stacey Sova, Puneet Gill, Lisa Kelly, Paul Smith, Brian Cullum, Univ. of Maryland (USA) .. [10629-12]

2:10 pm: **Analysis of neutron radiation defects in ytterbium doped fibers (YDFs) using high Z shielding**, Diana Cruz, Samuel D. Butler, Air Force Institute of Technology (USA); Briana J. Singleton, Asian Office of Aerospace Research and Development (Japan); Becca E. Ewing, Wright State Univ. (USA) [10629-13]

2:30 pm: **Development of the virtual source training toolkit for physically accurate simulation of the response of handheld radiation detectors**, John A. Wright, Kirill N. Shokhiev, Eric N. Rappeport, Daniel B. Brown, Bogdan R. Cosofret, Physical Sciences Inc. (USA) [10629-14]

2:50 pm: **Characterization of uranium ore concentrate chemical composition via Raman spectroscopy**, Yin-Fong Su, Samuel A. Bryan, Jordan F. Corbey, Lucas E. Sweet, Russ G. Tonkyn, Timothy J. Johnson, Pacific Northwest National Lab. (USA) [10629-15]

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

CONFERENCE 10629

SESSION 5

LOCATION: BALLROOM LEVEL, SUN 4 MON 3:40 PM TO 4:40 PM

Biological Threat Detection

Session Chair: **Russell G. Bartholomew**, U.S. Army Edgewood Chemical Biological Ctr. (USA)

3:40 pm: **Characterization of biomolecules for biothreats detection using low-frequency Raman spectroscopy**, Rabih Jabbour, Ashish Tripathi, Erik D. Emmons, Phillip G. Wilcox, Jason A. Guicheteau, U.S. Army Edgewood Chemical Biological Ctr. (USA) [10629-16]

4:00 pm: **A grating coupled-surface plasmon resonance and fluorescent plasmonics (GC-SPR/GC-FP) biosensor for diagnosis of Lyme disease**, Nathaniel Cady, SUNY Polytechnic Institute (USA); Gabriel Zenteno, Univ. at Albany (USA); Benjamin Taubner, Wadsworth Ctr. (USA); Eunice Chou, SUNY Polytechnic Institute (USA); Arturo Pilar, Ernest Guignon, William Page, Ciencia, Inc. (USA); Yi-Pin Lin, Wadsworth Ctr. (USA) [10629-17]

4:20 pm: **Optical detection and classification of microbes in suspicious powders**, William F. Hug, Photon Systems, Inc. (USA); Rohit Bhartia, Jet Propulsion Lab. (USA); Kripa K. Sijapati, Quoc Nguyen, Prashant Oswal, Ray D. Reid, Photon Systems, Inc. (USA) [10629-18]

SYMPOSIUM-WIDE PLENARY SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6-7 for details.

TUESDAY 17 APRIL

SESSION 6

LOCATION: BALLROOM LEVEL, SUN 4 TUE 8:00 AM TO 10:00 AM

Explosive Detection

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

8:00 am: **Recent development of UV Raman standoff explosive detection systems for near trace detection**, Robert D. Waterbury, Robert Babnick, Thuyan Conghuyentonn, Hunter Hardy, Tim Molner, Darius Vunck, Alakai Defense Systems, Inc. (USA) [10629-19]

8:20 am: **Persistence of explosive particles in various environmental conditions**, Michael R. Papantonakis, Viet K. Nguyen, Robert Furstenberg, U.S. Naval Research Lab. (USA); Tyler G. Grissom, Oak Ridge Institute for Science and Education (USA); Andrew Kusterbeck, Nova Research, Inc. (USA); Christopher A. Kendziora, R. Andrew McGill, U.S. Naval Research Lab. (USA) [10629-20]

8:40 am: **Comparison of handheld Raman sensors through opaque containers**, Phillip G. Wilcox, Jason A. Guicheteau, U.S. Army Edgewood Chemical Biological Ctr. (USA) [10629-21]

9:00 am: **Using infrared backscatter imaging spectroscopy to detect trace explosives at standoff distances**, Christopher J. Breshike, American Society for Engineering Education (USA); Christopher A. Kendziora, Robert Furstenberg, R. Andrew McGill, U.S. Naval Research Lab. (USA) [10629-22]

9:20 am: **Mobile real-time quantum cascade spectrometer for defense and security**, Charles Harb, RingIR, Inc. (USA) [10629-23]

9:40 am: **High-confidence discrimination of explosive materials on surfaces using a non-spectroscopic optical biomimetic sensing method**, Kevin J. Major, Kenneth J. Ewing, Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA); Thomas C. Hutchens, Menelaos K. Poutous, Matthew Potter, Christopher Wilson, The Univ. of North Carolina at Charlotte (USA); Ishwar D. Aggarwal, The Univ. of North Carolina at Charlotte (USA) and Sotera Defense Solutions, Inc. (USA) [10629-24]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 7

LOCATION: BALLROOM LEVEL, SUN 4 TUE 11:00 AM TO 11:40 AM

Photonic Integrated Circuit Threat Sensing I

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

11:00 am: **Enhanced whispering gallery mode sensors**, Judith Su, Cheng Li, The Univ. of Arizona (USA) [10629-25]

11:20 am: **Whispering-gallery microresonators for sensing technologies**, Lan Yang, Washington Univ. in St. Louis (USA) [10629-26]

Lunch/Exhibition Break Tue 11:40 am to 1:10 pm

SESSION 8

LOCATION: BALLROOM LEVEL, SUN 4 TUE 1:10 PM TO 3:10 PM

Vapor, Aerosol Detection

Session Chair: **Anthony Esposito**, Defense Threat Reduction Agency (USA)

1:10 pm: **Remote sensing of chlorine using UV LiDAR at U.S. Army Dugway Proving Ground**, James T. Pearson, William L. Brown, U.S. Army Dugway Proving Ground (USA); Joshua P. Herron, Space Dynamics Lab. (USA) [10629-27]

1:30 pm: **Four-wavelength LiDAR for in-situ speciation of aerosols**, Brad Petersen, Michael Wojcik, Alan Bird, Jason Wooden, Jim Peterson, Morgan Davidson, Monte Frandsen, Space Dynamics Lab. (USA) [10629-28]

1:50 pm: **Development and calibration of an eye-safe elastic backscatter LiDAR for chemical and biological aerosol tracking**, Joshua P. Herron, Utah State Univ. (USA); Michael Wojcik, Space Dynamics Lab. (USA); George W. Lemire, William L. Brown, U.S. Army Dugway Proving Ground (USA); Kori D. Moore, Space Dynamics Lab. (USA) [10629-29]

2:10 pm: **Optical parametric oscillator-based trace detection of gases in the mid-infrared region using phase-fluctuation optical heterodyne spectroscopy**, Jack Thomas, Adam Polak, Gerald Bonner, Fraunhofer Ctr. for Applied Photonics (United Kingdom); Sandra Enderle, Hochschule Aalen (Germany); Malcolm Dunn, Univ. of St. Andrews (United Kingdom); David J. M. Stothard, Fraunhofer Ctr. for Applied Photonics (United Kingdom) [10629-30]

2:30 pm: **Regional sensing with an open-path dual comb spectroscopy and a UAS**, Ian Coddington, Kevin Cossel, Eleanor Waxman, Fabrizio R. Giorgetta, Esther Baumann, National Institute of Standards and Technology (USA); Robert Wright, Sean Coburn, Daniel Hesselius, Univ. of Colorado Boulder (USA); Michael Cermak, Eli Hoenig, National Institute of Standards and Technology (USA); Gregory Rieker, Univ. of Colorado Boulder (USA); Nathan R. Newbury, National Institute of Standards and Technology (USA) [10629-31]

2:50 pm: **Remote detection of unknown chemical clouds with multispectral imagery on vehicles**, Le Brun Gay, Aymeric Alazarine, Sylvain Favier, Manon Verneau, Bertin Technologies (France); Sébastien Blanchard, Bertin Corp. (USA) [10629-32]

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

SESSION 9

LOCATION: BALLROOM LEVEL, SUN 4 TUE 3:40 PM TO 5:00 PM

Photonic Integrated Circuit Threat Sensing II

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

3:40 pm: **Localization and quantification of trace-gas fugitive emissions using a portable optical spectrometer**, Eric Zhang, IBM Thomas J. Watson Research Ctr. (USA); Cheyenne C. Teng, Princeton Univ. (USA); Theodore G. van Kessel, Levente Klein, Ramachandran Muralidhar, Chi Xiong, Yves Martin, Jason S. Orcutt, Marwan Khater, Laurent Schares, Tymon Barwicz, Nathan Marchack, Swetha Kamalapurkar, Sebastian U. Engelmann, IBM Thomas J. Watson Research Ctr. (USA); Gerard Wysocki, Princeton Univ. (USA); Norma Sosa, William M. J. Green, IBM Thomas J. Watson Research Ctr. (USA) [10629-33]

4:00 pm: **Design, manufacture, and testing of a silicon nitride ring resonator-based biosensing platform**, Benjamin L. Miller, Michael R. Bryan, Daniel J. Steiner, Univ. of Rochester Medical Ctr. (USA) [10629-34]

4:20 pm: **Fish-bone subwavelength grating waveguide photonic integrated circuit sensor array**, Justin R. Bickford, Mikella Farrell, Ellen Holthoff, Pak Cho, U.S. Army Research Lab. (USA) [10629-35]

4:40 pm: **Real-time gas analysis using mid-infrared microcavities**, Pao Lin, Texas A&M Univ. (USA) [10629-36]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C ... TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

High-efficiency active environmental sampling with UV-curable peelable coatings, Vlad Henzl, Ann Junghans, Los Alamos National Lab. (USA) [10629-45]

Multi-heterodyne hyperspectral imaging for chemical identification, Jonas Westberg, Lukasz Sterczewski, Gerard Wysocki, Princeton Univ. (USA) [10629-47]

Coherent dual-comb spectroscopy of broad absorbers in the mid infrared, Fabrizio R. Giorgetta, Gabriel Ycas, Esther Baumann, Ian Coddington, Daniel Herman, Scott A. Diddams, Nathan R. Newbury, National Institute of Standards and Technology (USA) [10629-48]

Enhanced photo-acoustic spectroscopy sensitivity through intra-cavity OPO excitation, Adam Polak, David J. M. Stothard, Fraunhofer Ctr. for Applied Photonics (United Kingdom) [10629-49]

Novel colorimetric dyes and sensing platform for fiber-based chemical sensing, Richard M. Osgood III, Stephen Giardini, Conor Hennessy, Diane M. Steeves, U.S. Army Natick Soldier Research, Development and Engineering Ctr. (USA); Alexander Stolyarov, Richard Kingsborough, Lalitha Parameswaran, Mordechai Rothschild, MIT Lincoln Lab. (USA); Jin Ho Kim, Gustavo Fernandes, Do-Joong Lee, Jimmy Xu, Brown Univ. (USA); Steven Kooi, MIT Institute for Soldier Nanotechnologies (USA) [10629-50]

Near-field infrasound classification of rocket launch signatures, Kaleb Smith, Mitchell Solomon, Kaylen J. Bryan, Anthony O. Smith, Adrian M. Peter, Florida Institute of Technology (USA) [10629-51]

Sequential Bayesian estimation algorithm with dynamic spatial-temporal aggregation for detection and identification of radiological threats, John A. Wright, Bogdan R. Cosofret, Kirill N. Shokhirev, Eric N. Rappoport, Physical Sciences Inc. (USA) [10629-52]

Thermal bioaerosol cloud tracking with Bayesian classification: advanced capability demonstration, Christian W. Smith, Julia R. Dupuis, Connor Greene, William J. Marinelli, Physical Sciences Inc. (USA) .. [10629-53]

Molecular explosives detection using Tarkka TOF: Investigations of the potential to detect explosives objects, H.J. Jost, Karsa Ltd (Finland); Jani Hakala, Aleksei Shcherbinin, Jyri Mikkilä, Verner Hemmilä, Oskari Kausiala, Karsa Ltd. (Finland) [10629-54]

WEDNESDAY 18 APRIL

SESSION 10

LOCATION: BALLROOM LEVEL, SUN 4 WED 8:00 AM TO 10:40 AM

CBE Threat Signature Modeling and Algorithm Advancements

Session Chair: **Darren K. Emge**, U.S. Army Edgewood Chemical Biological Ctr. (USA)

8:00 am: **Accurate measurement of the optical constants for organic and organophosphorous liquids for optical modeling**, Tanya L. Myers, Russell G. Tonkyn, Tyler O. Danby, Brent M. De Vetter, Bruce E. Bernacki, Matthew S. Taubman, Timothy J. Johnson, Pacific Northwest National Lab. (USA) [10629-41]

8:20 am: **Simulating ATR spectra for detecting nerve agent-sorbent binding**, Michael R. Papanonakis, Courtney A. Roberts, U.S. Naval Research Lab. (USA); Andrew Shabaev, George Mason Univ. (USA); Youngchan Kim, R. Andrew McGill, Christopher A. Kendziora, Robert Furstenberg, Samuel G. Lambrakos, U.S. Naval Research Lab. (USA) [10629-38]

8:40 am: **On constructing surface-distributed-scatterer ensembles for analysis of deposited-explosive-particle diffuse-reflectance spectra**, Robert Furstenberg, Christopher A. Kendziora, U.S. Naval Research Lab. (USA); Andrew Shabaev, George Mason Univ. (USA); Youngchan Kim, R. Andrew McGill, Samuel G. Lambrakos, U.S. Naval Research Lab. (USA) [10629-39]

9:00 am: **Mid-infrared reflection signatures for trace chemicals on surfaces**, Derek A. Wood, David B. Kelley, Anish K. Goyal, Petros Kotidis, Block Engineering, Inc. (USA) [10629-40]

9:20 am: **Modeling liquid organophosphorus thin films on substrates**, Bruce E. Bernacki, Timothy J. Johnson, Tanya L. Myers, Thomas A. Blake, Pacific Northwest National Lab. (USA) [10629-37]

9:40 am: **Infrasound threat classification: a statistical comparison of deep learning architectures**, Mitchell Solomon, Kaleb Smith, Kaylen Bryan, Anthony O. Smith, Florida Institute of Technology (USA); Dean A. Clauter, Air Force Technical Applications Ctr. (USA); Adrian M. Peter, Florida Institute of Technology (USA) [10629-42]

10:00 am: **Deep wavelet scattering features for infrasonic threat identification**, Kaylen J. Bryan, Kaleb E. Smith, Mitchell Solomon, Florida Institute of Technology (USA); Dean A. Clauter, Air Force Technical Applications Ctr. (USA); Anthony O. Smith, Adrian M. Peter, Florida Institute of Technology (USA) [10629-43]

10:20 am: **Active standoff chemical identification detector**, Jay P. Giblin, Julia R. Dupuis, John Dixon, Joel Hensley, David J. Mansur, William J. Marinelli, Physical Sciences Inc. (USA) [10629-44]

CONFERENCE 10630

LOCATION: BALLROOM LEVEL, SUN 5

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Cyber Sensing 2018

Conference Chairs: **Igor V. Ternovskiy**, Air Force Research Lab. (USA); **Peter Chin**, Boston Univ. (USA)

Program Committee: **Patrick W. Jungwirth**, U.S. Army Research, Development and Engineering Command (USA); **Tony C. Kim**, Air Force Research Lab. (USA); **Michael A. Kolodny**, U.S. Army Research Lab. (USA); **Uttam Kumar Majumder**, Air Force Research Lab. (USA); **Tien Pham**, U.S. Army Research Lab. (USA)

TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SUN 5 TUE 9:00 AM TO 10:00 AM

Cyber Security Framework

Session Chairs: **Igor V. Ternovskiy**, Air Force Research Lab. (USA);
Peter Chin, Boston Univ. (USA)

9:00 am: **Implementations of moving target defense**, Nathaniel Evans,
Argonne National Lab. (USA) [10630-1]

9:20 am: **The growing threat of cybersecurity attack in sports**, Nathaniel
Evans, Stephanie Jenkins, Argonne National Lab. (USA) [10630-2]

9:40 am: **Security tag computation and propagation in OSFA**,
Patrick W. Jungwirth, Philip Chan, U.S. Army Research Lab. (USA);
Hameed Badawy, New Mexico State Univ. (USA) and Army High
Performance Computing Research Ctr. (USA) [10630-4]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 2

LOCATION: BALLROOM LEVEL, SUN 5 TUE 11:00 AM TO 12:00 PM

Analog Domain and Cyber Security I

Session Chairs: **Igor V. Ternovskiy**, Air Force Research Lab. (USA);
Peter Chin, Boston Univ. (USA)

11:00 am: **Detailed tracking of program control flow using analog side-
channel signals: A promise for IoT malware detection and a threat for
many cryptographic implementations**, Haider Adnan Khan, Monjur Alam,
Alenka Zajic, Milos Prvulovic, Georgia Institute of Technology (USA) [10630-5]

11:20 am: **Deep learning-based classification and anomaly detection of
side-channel signals**, Xiao Wang, Quan Zhou, Jacob Harer, Gavin Brown,
Shangran Qiu, Zhi Dou, Boston Univ. (USA); Carlos Aguayo Gonzalez,
Alan Hinton, John Wang, PFP Cybersecurity (USA); Peter Chin, Boston Univ.
(USA) [10630-6]

11:40 am: **Overhead analysis of the utilization of hardware assisted
virtualization for protecting guest operating system applications**,
Michael Clark, Riverside Research (USA) [10630-7]

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

SESSION 3

LOCATION: BALLROOM LEVEL, SUN 5 TUE 1:30 PM TO 3:10 PM

Analog Domain and Cyber Security II

Session Chairs: **Igor V. Ternovskiy**, Air Force Research Lab. (USA);
Peter Chin, Boston Univ. (USA)

1:30 pm: **Block-level algorithm classification based on RF side-channel**,
James T. Graham, Ronald Riley, Ashwin Fisher, Riverside Research
(USA) [10630-8]

1:50 pm: **Register hamming distance from side-channels**,
Ronald A. Riley, Riverside Research (USA); Ashwin Fisher, Riverside Research
Institute (USA) [10630-9]

2:10 pm: **Exploiting side-channel emissions to detect changes in FPGA
firmware**, Ryan Fuller, Ronald Riley, James Graham, Riverside Research
(USA) [10630-10]

2:30 pm: **Classification of low-SNR side-channels**, Ronald A. Riley,
James T. Graham, Ashwin Fisher, Riverside Research (USA) [10630-11]

2:50 pm: **Generalization of algorithm recognition in RF side-channel
between devices**, Ronald A. Riley, James T. Graham, Ashwin Fisher,
Riverside Research (USA) [10630-12]

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

SESSION 4

LOCATION: BALLROOM LEVEL, SUN 5 TUE 3:40 PM TO 5:40 PM

Analog Domain and Cyber Security III

Session Chairs: **Igor V. Ternovskiy**, Air Force Research Lab. (USA);
Peter Chin, Boston Univ. (USA)

3:40 pm: **Utilizing EM emanations for out-of-band detection of unknown
attack code in a PLC**, Nathaniel Boggs, Jimmy C. Chau, Ang Cui,
Red Balloon Security, Inc. (USA) [10630-13]

4:00 pm: **Preliminary classification results of RF emission based feature
extraction in Internet of Things devices**, Devin Spatz, Devin Smarra,
Air Force Research Lab. (USA) and Defense Engineering Corp. (USA);
Igor V. Ternovskiy, Air Force Research Lab. (USA) [10630-14]

4:20 pm: **On the use of imaging technique for anomalous behavior
detection of Internet of Things devices**, Devin Smarra, Devin Spatz,
Air Force Research Lab. (USA) and Defense Engineering Corp. (USA);
Bob Scheuller, Air Force Research Lab. (USA) and Riverside Research (USA);
Igor V. Ternovskiy, Air Force Research Lab. (USA) [10630-15]

4:40 pm: **A graph-theoretic understanding of network-wide implications
of local cyber protections for mission assurance**, Sean Lane,
Brigham Young Univ. (USA); Michael Clark, Riverside Research (USA);
Sandip Roy, Mengran Xue, Washington State Univ. (USA); Sean Warnick,
Brigham Young Univ. (USA) [10630-16]

5:00 pm: **Lightweight hardware monitoring of IoT devices**,
Daniel Rapczynski, Jason Wampler, INCA Engineering (USA); Andrew Toth,
U.S. Army Research Lab. (USA) [10630-17]

5:20 pm: **Control flow graph modifications for improved RF-based
processor tracking performance**, George Cybenko, Thayer School of
Engineering at Dartmouth (USA); Mark Chilenski, Piyush Kumar,
Corey Cleveland, Isaac Dekine, Gil M. Raz, Systems & Technology Research
(USA) [10630-18]

WEDNESDAY 18 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, SUN 5 WED 8:40 AM TO 10:00 AM

Cyber Sensing Phenomenology

Session Chairs: **Igor V. Ternovskiy**, Air Force Research Lab. (USA);
Peter Chin, Boston Univ. (USA)

- 8:40 am: **A study of underwater particle scattering behavior when using OAM beams**, Austin W. Jantzi, Melanie G. Cockrell, Luke K. Rumbaugh, William D. Jemison, Clarkson Univ. (USA) [10630-19]
- 9:00 am: **Scale model imaging testbed for training and testing learning algorithms**, Robert Schueler, Air Force Research Lab. (USA) and Riverside Research (USA); Igor V. Ternovskiy, Air Force Research Lab. (USA) . [10630-20]
- 9:20 am: **On optical properties and modeling of a lobster eye based reflector**, Igor V. Ternovskiy, Air Force Research Lab. (USA) [10630-21]
- 9:40 am: **Analysis of error in two passive phase localization algorithms**, Charles Berdanier, Air Force Research Lab. (USA) [10630-22]
- Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, SUN 5 WED 11:00 AM TO 12:20 PM

Machine Learning and Cyber Sensing

Session Chairs: **Igor V. Ternovskiy**, Air Force Research Lab. (USA);
Peter Chin, Boston Univ. (USA)

- 11:00 am: **Track generation in semi-supervised learning of self-structured algorithm using noisy and sparse, visual, and infrared data**, Bala Konate, Air Force Research Lab. (USA) and Defense Engineering Corp. (USA); James T. Graham, Air Force Research Lab. (USA) and Riverside Research (USA); Igor V. Ternovskiy, Air Force Research Lab. (USA) . [10630-23]
- 11:20 am: **Similarity measures for target tracking with aerial images**, Igor V. Ternovskiy, Jenfeng Sam Li, James T. Graham, Air Force Research Lab. (USA) [10630-24]
- 11:40 am: **Wavelet decomposition to reduce clutter for SAR object classification using deep neural networks**, Uttam Kumar Majumder, Nate Inkawhich, Air Force Research Lab. (USA) [10630-25]
- 12:00 pm: **Understanding adversarial attack and defense towards deep compressed neural networks**, Qi Liu, Tao Liu, Wujie Wen, Florida International Univ. (USA) [10630-26]
- Lunch/Exhibition Break Wed 12:20 pm to 1:50 pm

SESSION 7

LOCATION: BALLROOM LEVEL, SUN 5 WED 1:50 PM TO 3:30 PM

Networks and Cyber Sensing

Session Chairs: **Igor V. Ternovskiy**, Air Force Research Lab. (USA);
Peter Chin, Boston Univ. (USA)

- 1:50 pm: **A software defined networking-based network security system**, Karanam Dayananda, Jeremy Straub, North Dakota State Univ. (USA) [10630-27]
- 2:10 pm: **Development and implementation of VoIP honeypots with a wide range of analysis**, Ladislav Behan, Lukas Kapicak, VSB-Technical Univ. of Ostrava (Czech Republic) [10630-28]
- 2:30 pm: **Improving cyber sensing in asymmetric big data through sparse Bayesian truthing**, Wenjian Wang, Tomasz Jansson, Juan Hodelin, John Chauvin, Min-Yi Shih, Physical Optics Corp. (USA) [10630-29]
- 2:50 pm: **Interoperability, open design, and exploit blockchain distributed ledger in health care and financial systems**, Gregory Shlyuger, Mount Sinai Health System (USA) [10630-30]
- 3:10 pm: **Identifying and detecting applications within TLS traffic**, Michael De Lucia, Univ. of Delaware (USA) and U.S. Army Research Lab. (USA); Chase Cotton, Univ. of Delaware (USA) [10630-31]

CONFERENCE 10631
LOCATION: BALLROOM LEVEL, SUN 3

Tuesday–Wednesday 17–18 April 2018 • Proceedings of SPIE Vol. 10631



Ocean Sensing and Monitoring X

Conference Chairs: **Weilin “Will” Hou**, U.S. Naval Research Lab. (USA); **Robert A. Arnone**, The Univ. of Southern Mississippi (USA)

Program Committee: **Samir Ahmed**, The City College of New York (USA); **Brandon Cochenour**, Naval Air Warfare Ctr. Aircraft Div. (USA); **Fraser R. Dalgleish**, Florida Atlantic Univ.-Harbor Branch Oceanographic Institute (USA); **Chuanmin Hu**, Univ. of South Florida (USA); **Linda J. Mullen**, Naval Air Systems Command (USA); **James Sullivan**, Florida Atlantic Univ.-Harbor Branch Oceanographic Institute (USA); **Michael Twardowski**, Florida Atlantic Univ.-Harbor Branch Oceanographic Institute (USA)

TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SUN 3 TUE 8:30 AM TO 10:30 AM

Remote Sensing of Ocean Environment

Session Chairs: **Weilin “Will” Hou**, U.S. Naval Research Lab. (USA); **Robert A. Arnone**, The Univ. of Southern Mississippi (USA); **Chuanmin Hu**, Univ. of South Florida (USA)

8:30 am: **Seasonal trends of biophysical ocean properties and anomalies across the Mississippi Shelf**, Robert A. Arnone, Brooke Jones, Inia SotoRamos, The Univ. of Southern Mississippi (USA) [10631-1]

8:50 am: **Anomalous marine biophysical conditions due to 2016 and 2017 wind and flooding events in the Northeastern Gulf of Mexico**, Brooke Jones, Robert A. Arnone, The Univ. of Southern Mississippi (USA) [10631-2]

9:10 am: **Hyperspectral determination of ocean color as an ocean monitoring tool: Example applications in the Gulf of Mexico**, Jason K. Jolliff, Sherwin Ladner, David Lewis, Ewa Jarosz, Adam Lawson, Travis Smith, Allison Penko, Sean McCarthy, U.S. Naval Research Lab. (USA) [10631-3]

9:30 am: **Near-realtime calibration of the Ocean Land Colour Imager**, Jennifer Bowers, Paul Martinolich, Vencore, Inc. (USA); Richard Crout, Sherwin Ladner, Adam Lawson, U.S. Naval Research Lab. (USA) . . . [10631-4]

9:50 am: **Comparison of aerosol models from the ocean color satellite sensors and AERONET-OC and their impact on reflectance spectra in coastal waters**, Alexander Gilerson, Eder Herrera, Yaron Klein, The City College of New York (USA); Robert Foster, U.S. Naval Research Lab. (USA); Barry Gross, The City College of New York (USA); Robert A. Arnone, The Univ. of Southern Mississippi (USA); Sam Ahmed, The City College of New York (USA) [10631-5]

10:10 am: **Ocean surface characterization using snapshot hyperspectral polarimetric imager**, Carlos Carrizo, Andrii Golovin, Ahmed El-Habashi, The City College of New York (USA); Robert Foster, Deric Gray, Jeff Bowles, U.S. Naval Research Lab. (USA); Alexander Gilerson, The City College of New York (USA) [10631-6]

Dedicated Exhibition Time and Lunch Break Tue 10:30 am to 1:10 pm

SESSION 3

LOCATION: BALLROOM LEVEL, SUN 3 TUE 1:10 PM TO 3:10 PM

Harmful Algal Blooms (HAB)

Session Chair: **James M. Sullivan**, Harbor Branch Oceanographic Institute (USA)

1:10 pm: **Harmful algal bloom dynamics in Southeast Florida and the Indian River Lagoon**, James M. Sullivan, Malcolm N. McFarland, Nicole Stockley, M. Dennis Hanisak, Harbor Branch Oceanographic Institute (USA) [10631-9]

1:30 pm: **Using observation networks to examine the impact of Lake Okeechobee discharges on the St. Lucie Estuary, Florida**, Nicole Stockley, James M. Sullivan, M. Dennis Hanisak, Malcolm N. McFarland, Harbor Branch Oceanographic Institute (USA) [10631-10]

1:50 pm: **Interannual variability in the Indian River Lagoon, Florida, measured by a network of environmental sensors**, M. Dennis Hanisak, Kristen S. Davis, Harbor Branch Oceanographic Institute (USA) . . . [10631-11]

2:10 pm: **Seasonal and inter-annual variability in sea surface temperature and chlorophyll-a concentration along the west Florida shelf: analyzing 5 years of satellite data**, Erica T. Krueger, Felix Jose, Florida Gulf Coast Univ. (USA) [10631-12]

2:30 pm: **Individual particle measurements to study algal blooms in the Indian River Lagoon, FL**, Malcolm N. McFarland, Nicole Stockley, Harbor Branch Oceanographic Institute (USA); Michael S. Twardowski, James M. Sullivan, Florida Atlantic Univ. (USA) [10631-13]

2:50 pm: **Satellite monitoring and interpretation of dynamically changing concentrations of Karenia Brevis harmful algal blooms in the West Florida Shelf**, Samir Ahmed, Ahmed El-Habashi, NOAA-CREST, The City College of New York (USA); Vincent Lovko, Mote Marine Lab. (USA) [10631-14]

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

SESSION 4

LOCATION: BALLROOM LEVEL, SUN 3 TUE 3:40 PM TO 4:40 PM

Oil Spill Detection

Session Chairs: **Samir Ahmed**, The City College of New York (USA); **Fraser R. Dalgleish**, Harbor Branch Oceanographic Institute (USA)

3:40 pm: **Oil detection through infrared polarimetry**, David B. Chenault, Polaris Sensor Technologies, Inc. (USA) [10631-15]

4:00 pm: **Remote measurement of thick oil spill depth using thermal imagery**, Toomas H. Allik, Active EO Inc. (USA); Roberta E. Dixon, CACI International Inc. (USA); Mark S. Walters, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [10631-16]

4:20 pm: **Mapping and reconnaissance imager, night-enhanced, for sensing of contaminants, oil, and unseen threats (MARINE SCOUT)**, Toomas H. Allik, Active EO Inc. (USA); Scot Myhr, George Ax, John Gill, Evan Sippel, Lance LeClair, MTEQ, Inc. (USA); Mark Walters, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Roberta E. Dixon, CACI International Inc. (USA) [10631-17]

SESSION 5

LOCATION: BALLROOM LEVEL, SUN 3 TUE 4:40 PM TO 6:00 PM

In Situ Sensing

Session Chairs: **Michael S. Twardowski**, Florida Atlantic Univ. (USA), Harbor Branch Oceanographic Institute (USA); **Fraser R. Dalgleish**, Harbor Branch Oceanographic Institute (USA)

4:40 pm: **An analytical model to derive suspended particulate matter concentration in natural waters by inversion of optical attenuation and backscattering**, Michael S. Twardowski, Harbor Branch Oceanographic Institute (USA); Cédric Jamet, Lab. d’Océanologie et de Géosciences (France) [10631-18]

5:00 pm: **Characterizing instabilities in the developed and transitional boundary layer**, Silvia Matt, Weilin Hou, Wesley Goode, U.S. Naval Research Lab. (USA) [10631-19]

5:20 pm: **The Naval Meteorology and Oceanography Command’s first unmanned systems operational demonstration and test exercise**, Todd E. Bowers, Naval Meteorology and Oceanography Command (USA) [10631-20]

5:40 pm: **Naval operational oceanography unmanned systems: past, present, and future**, Todd E. Bowers, Michael Bendzłowicz, Naval Meteorology and Oceanography Command (USA) [10631-21]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Nonnegative matrix factorization based feature selection analysis for hyperspectral imagery of sediment-laden riverine flow, Nicholas V. Scott, Riverside Research (USA); Ian C. Moore, Xavier Univ. (USA) [10631-7]

Phase-based statistics from direct numerically simulated imagery of sediment-laden oscillatory flow for Bayesian belief network analysis, Nicholas V. Scott, Riverside Research (USA); Tian-Jian Hsu, Univ. of Delaware (USA) [10631-8]

On-orbit polarization sensitivity evaluation of FY-3B MERSI, Ling Sun, National Satellite Meteorological Ctr. (China); Ran Huo, Danyang Cao, Lei Gao, North China Univ. of Technology (China) [10631-44]

Spectrally resolved infrared sea surface pyrometric measurements, Michael E. Thomas, Marc B. Airola, Jessica K. Makowski, Johns Hopkins Univ. (USA) [10631-46]

Exploration of the effects of multiple wavelength laser beams propagating underwater, Michael Kelly, Svetlana Avramov-Zamurovic, Charles L. Nelson, U.S. Naval Academy (USA) [10631-47]

WEDNESDAY 18 APRIL

SESSION 6

LOCATION: BALLROOM LEVEL, SUN 3 WED 8:20 AM TO 10:00 AM

Underwater Imaging

Session Chairs: **Linda Mullen**, Naval Air Warfare Ctr. Aircraft Div. (USA); **Weilin “Will” Hou**, U.S. Naval Research Lab. (USA)

8:20 am: **Beamforming receiver for underwater pulsed laser line scanning**, Walter Britton, Harbor Branch Oceanographic Institute (USA) and Q-P2 LLC (USA) and Edgetech (USA); Fraser R. Dalgleish, Harbor Branch Oceanographic Institute (USA); Hanqi Zhuang, Florida Atlantic Univ. (USA) [10631-23]

8:40 am: **Investigation of compressive line sensing imaging system in a controlled hybrid scattering environment**, Bing Ouyang, Harbor Branch Oceanographic Institute (USA); Weilin Hou, U.S. Naval Research Lab. (USA) [10631-24]

9:00 am: **Object detection and geometric profiling through dirty water media using asymmetry properties of backscattered signals**, Chensheng Wu, Robert Lee, Christopher C. Davis, Univ. of Maryland, College Park (USA) [10631-25]

9:20 am: **Image processing technique for an underwater modulated pulse laser imaging system**, David W. Illig, Naval Air Systems Command (USA); Linda Mullen, Naval Air Warfare Ctr. Aircraft Div. (USA) [10631-26]

9:40 am: **On phytoplankton and zooplankton distributions and biophysical interactions in diverse coastal and limnological environments**, Aditya R. Nayak, Malcolm N. McFarland, Michael S. Twardowski, James M. Sullivan, Harbor Branch Oceanographic Institute (USA) [10631-27]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 7

LOCATION: BALLROOM LEVEL, SUN 3 WED 11:00 AM TO 12:20 PM

Orbital Angular Momentum

Session Chairs: **Brandon Cochenour**, Naval Air Warfare Ctr. Aircraft Div. (USA); **Yongxiang Hu**, NASA Langley Research Ctr. (USA)

11:00 am: **Lidars utilizing vortex laser beams**, Carl Weimer, Ball Aerospace (USA); Yong Hu, NASA Langley Research Ctr. (USA); Jeff T. Applegate, Mike Lieber, Ball Aerospace (USA); Wenbo Sun, David MacDonnell, NASA Langley Research Ctr. (USA) [10631-28]

11:20 am: **An optical vortex transmissometer**, Amanda Alley, Brandon Cochenour, Linda Mullen, Alan Laux, Naval Air Systems Command (USA) [10631-29]

11:40 am: **Analysis of orbital angular momentum laser beams for applications in underwater communication**, Joseph Brugger, Charles Nelson, U.S. Naval Academy (USA) [10631-30]

12:00 pm: **On the change of the underwater volume sensing function when using a laser beam with orbital angular momentum**, Austin W. Jantzi, Clarkson Univ. (USA) [10631-31]

Lunch/Exhibition Break Wed 12:20 pm to 1:30 pm

SESSION 8

LOCATION: BALLROOM LEVEL, SUN 3 WED 1:30 PM TO 3:10 PM

Lidar Sensing I

Session Chairs: **Weilin “Will” Hou**, U.S. Naval Research Lab. (USA); **Damien B. Josset**, U.S. Naval Research Lab. (USA)

1:30 pm: **Development and assessment of lidar inversion algorithm to interpret lidar return from chlorophyll dependent synthetic IOP dataset**, Christopher Strait, Michael S. Twardowski, Fraser R. Dalgleish, Anni K. Vuorenkoski Dalgleish, Harbor Branch Oceanographic Institute (USA); Alberto Tonizzo, GTF, LLC (USA) [10631-32]

1:50 pm: **Global scale whitecaps coverage from CALIPSO lidar measurements**, Damien B. Josset, David Wang, Weilin Hou, U.S. Naval Research Lab. (USA) [10631-33]

2:10 pm: **Sea-ice detection for autonomous underwater vehicles and oceanographic lagrangian platforms by continuous-wave laser polarimetry**, Jose Lagunas-Morales, Takuvik (Canada); Claudie Marec, Édouard Leymarie, Christophe Penkerch, Lab. d’Océanographie de Villefranche (France); Marcel Babin, Takuvik (Canada) [10631-34]

2:30 pm: **Characterization of the spectrofluorescence and reflectance properties of Arctic benthic algae as lidar targets**, Matthieu Huot, Eric Rehm, Takuvik Joint International Lab. (Canada); Fraser R. Dalgleish, Harbor Branch Oceanographic Institute (USA); Michel Piché, Univ. Laval (Canada); Simon Lambert-Girard, Takuvik Joint International Lab. (Canada); Stefania Matteoli, Consiglio Nazionale delle Ricerche (Italy); Philippe Archambault, Univ. Laval (Canada) [10631-35]

2:50 pm: **Underwater target detection performance of a chaotically modulated laser rangefinder**, Luke K. Rumbaugh, Ian Adler, Daniel J. Alles, Adam J. Romlein, William D. Jemison, Clarkson Univ. (USA) [10631-36]

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

CONFERENCE 10631

SESSION 9

LOCATION: BALLROOM LEVEL, SUN 3 WED 3:40 PM TO 4:40 PM

Lidar Sensing II

Session Chairs: **Weilin "Will" Hou**, U.S. Naval Research Lab. (USA);
Damien B. Jossset, U.S. Naval Research Lab. (USA)

3:40 pm: **Comparing fluorescent and differential absorption LIDAR techniques for detecting macroalgal biomass with applications to Arctic substrates**, Eric Rehm, Takuvik (Canada) and Univ. Laval (Canada) and Ctr. National de la Recherche Scientifique (France); Fraser R. Dalgleish, Harbor Branch Oceanographic Institute (USA) and Florida Atlantic Univ. (USA); Matthieu Huot, Takuvik (Canada) and Univ. Laval (Canada) and Ctr. National de la Recherche Scientifique (France); Simon Lambert-Girard, Takuvik (Canada) and Univ. Laval (Canada) and Ctr. National de la Recherche Scientifique (France); Stefania Matteoli, Istituto di Elettronica e di Ingegneria dell'Informazione e delle, Consiglio Nazionale delle Ricerche (Italy); Philippe Archambault, Takuvik (Canada) and Univ. Laval (Canada) and Ctr. National de la Recherche Scientifique (France) [10631-37]

4:00 pm: **Remote characterization of turbid water using a novel Lidar technique**, Andrew Gisler, ASTRALiTe, Inc. (USA); Jeffrey P. Thayer, Univ. of Colorado Boulder (USA) and Atmospheric & Space Technology Research Associates, LLC (USA); Geoffrey Crowley, Atmospheric & Space Technology Research Associates, LLC (USA) [10631-38]

4:20 pm: **Monitoring ocean water level in remote shoreline locations using GPS reflectometry**, Irfan Azeem, Atmospheric & Space Technology Research Associates, LLC (USA); Andrew Gisler, ASTRA (USA); Geoffrey Crowley, Atmospheric & Space Technology Research Associates, LLC (USA); Carol Janzen, Molly McCammon, Alaska Ocean Observing System (USA); Adam Reynolds, Erik Stromberg, Gerald Thompson, ASTRA (USA) . [10631-39]

SESSION 10

LOCATION: BALLROOM LEVEL, SUN 3 WED 4:40 PM TO 5:20 PM

Bioluminescence

Session Chairs: **Michael S. Twardowski**,
Harbor Branch Oceanographic Institute (USA);
Weilin "Will" Hou, U.S. Naval Research Lab. (USA)

4:40 pm: **Development of an AUV-deployed ambient light sensor with active bioluminescence stimulus**, Clifford Pontbriand, Peter H. Wiebe, Dana R. Yoerger, Woods Hole Oceanographic Institution (USA) . . . [10631-40]

5:00 pm: **Propagation of bioluminescent signals in near-surface to mesopelagic waters**, Alberto Tonizzo, GTF, LLC (USA); Brandon J. Russell, James M. Sullivan, Michael S. Twardowski, Harbor Branch Oceanographic Institute (USA) [10631-41]

CONCLUSION AND BEST PAPER AWARD PRESENTATION

LOCATION: BALLROOM LEVEL, SUN 3 5:20 PM TO 5:40 PM

Conference Chairs: **Weilin "Will" Hou**, U.S. Naval Research Lab. (USA)
and **Robert A. Arnone**, The Univ. of Southern Mississippi (USA)

CONFERENCE 10632

LOCATION: BALLROOM LEVEL, SUN 6

Tuesday–Wednesday 17–18 April 2018 • Proceedings of SPIE Vol. 10632

Anomaly Detection and Imaging with X-Rays (ADIX) III

Conference Chairs: **Amit Ashok**, College of Optical Sciences, The Univ. of Arizona (USA); **Joel A. Greenberg**, Duke Univ. (USA); **Michael E. Gehm**, Duke Univ. (USA); **Mark A. Neifeld**, The Univ. of Arizona (USA)

Program Committee: **Mark A. Anastasio**, Washington Univ. in St. Louis (USA); **Ali Bilgin**, The Univ. of Arizona (USA); **Ali Can**, GE Global Research (USA); **Eric W. Clarkson**, The Univ. of Arizona (USA); **Mini Das**, Univ. of Houston (USA); **Edward D. Franco**, Rapiscan Systems Labs. (USA); **Christopher W. Gregory**, Smiths Detection Inc. (USA); **Tim E. Harvey**, EMF Corp. (USA); **Kris Iniewski**, Redlen Technologies (Canada); **Harry E. Martz**, Lawrence Livermore National Lab. (USA); **Joseph A. O'Sullivan**, Washington Univ. in St. Louis (USA); **Sean Pang**, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); **Lei Tian**, Univ. of California, Berkeley (USA); **Laura Waller**, Univ. of California, Berkeley (USA); **Sharene Young**, U.S. Dept. of Homeland Security (USA)

TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SUN 6 TUE 4:00 PM TO 5:45 PM

Deep Learning Techniques in X-ray Screening

Session Chair: **Amit Ashok**,
College of Optical Sciences, The Univ. of Arizona (USA)

4:00 pm: **Potential impact of deep learning on checkpoint and checked bag screening from TSA perspective along with the associated challenges** (*Keynote Presentation*), Eric J. Houser, U.S. Dept. of Homeland Security (USA) [10632-1]

4:35 pm: **Automatic threat recognition of prohibited items at aviation checkpoint with x-ray imaging: a deep learning approach** (*Invited Paper*), Kris Roe, Smiths Detection Inc. (USA); Geert Heilmann, Smiths Heimann GmbH (Germany); Chris Gregory, Souleymane O. Diallo, Smiths Detection Inc. (USA); Kevin Liang, David Carlson, Lawrence Carin, Duke Univ. (USA) [10632-2]

5:05 pm: **Deep learning based sparse view x-ray CT reconstruction for checked baggage screening**, Sagar Mandava, The Univ. of Arizona (USA); Amit Ashok, College of Optical Sciences, The Univ. of Arizona (USA); Ali Bilgin, The Univ. of Arizona (USA) [10632-3]

5:25 pm: **Application of machine learning to x-ray diffraction-based classification**, Bi Zhao, Joel A. Greenberg, Duke Univ. (USA); Scott Wolter, Elon Univ. (USA) [10632-4]

WEDNESDAY 18 APRIL

SESSION 2

LOCATION: BALLROOM LEVEL, SUN 6 WED 8:00 AM TO 10:00 AM

Scatter-based Imaging and Detection I

Session Chair: **Joel A. Greenberg**, Duke Univ. (USA)

8:00 am: **Application of coded aperture x-ray scatter imaging to checkpoint screening** (*Invited Paper*), Edward Franco, Dan A. Strellis, Rapiscan Systems Labs. (USA); Kenneth P. MacCabe, Rapiscan Systems Ltd. (USA) [10632-5]

8:30 am: **Speed up the coherent scattering tomographic imaging** (*Invited Paper*), Sean Pang, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10632-6]

9:00 am: **X-ray diffraction imaging in medical applications** (*Invited Paper*), Anuj J. Kapadia, Duke Univ. Medical Ctr. (USA) [10632-7]

9:30 am: **Towards an x-ray based coded aperture diffraction system for bulk material identification** (*Invited Paper*), Souleymane O. Diallo, Kamilah A. Tadlock, Christopher Gregory, Smiths Detection Inc. (USA); Joel A. Greenberg, Duke Univ. (USA); Kristofer Roe, Smiths Detection Inc. (USA) [10632-8]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 3

LOCATION: BALLROOM LEVEL, SUN 6 WED 11:00 AM TO 12:10 PM

Scatter-based Imaging and Detection II

Session Chair: **Joel A. Greenberg**, Duke Univ. (USA)

11:00 am: **Tensor-based fusion of Compton scatter and attenuation data for limited-view x-ray applications** (*Invited Paper*), Hamideh Rezaee, Brian Tracey, Eric Miller, Tufts Univ. (USA) [10632-9]

11:30 am: **The role of texturing in x-ray diffraction tomography**, Joel A. Greenberg, Jesse Yue, Chris MacGibbon, Brian Keohane, Bi Zhao, Duke Univ. (USA); Scott Wolter, Elon Univ. (USA) [10632-10]

11:50 am: **Fast volumetric x-ray coherent scattering tomography using a low-brilliance table-top source**, Zheyuan Zhu, Sean Pang, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10632-11]

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

SESSION 4

LOCATION: BALLROOM LEVEL, SUN 6 WED 1:30 PM TO 3:30 PM

Systems Analysis and Algorithms

Session Chair: **Amit Ashok**,
College of Optical Sciences, The Univ. of Arizona (USA)

1:30 pm: **Joint reconstruction and material classification in spectral CT** (*Invited Paper*), David A. Castañón, Parisa Babaheidarian, Boston Univ. (USA) [10632-12]

2:00 pm: **Consensus relaxation on materials of interest for adaptive ATR in CT images of bags** (*Invited Paper*), David W. Paglieroni, Hema Chandrasekaran, Christian T. Pechard, Harry E. Martz, Lawrence Livermore National Lab. (USA) [10632-13]

2:30 pm: **An information theoretic approach to system optimization accounting for material variability**, David Coccarelli, Duke Univ. (USA); Jay Voris, Ronan Kerviche, College of Optical Sciences, The Univ. of Arizona (USA); Joel A. Greenberg, Duke Univ. (USA); Amit Ashok, College of Optical Sciences, The Univ. of Arizona (USA); Michael Gehm, Duke Univ. (USA) [10632-14]

2:50 pm: **Low-dose x-ray tomography using photon-counting detector**, Zheyuan Zhu, Sean Pang, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10632-15]

3:10 pm: **X-ray measurement model and information-theoretic system metric incorporating material variability**, Ahmad Masoudi, The Univ. of Arizona (United Kingdom); Jay Voris, College of Optical Sciences, The Univ. of Arizona (USA); David Coccarelli, Joel A. Greenberg, Michael Gehm, Duke Univ. (USA); Amit Ashok, College of Optical Sciences, The Univ. of Arizona (USA) [10632-16]

Coffee Break Wed 3:30 pm to 4:00 pm

CONFERENCE 10632

SESSION 5

LOCATION: BALLROOM LEVEL, SUN 6 WED 4:00 PM TO 6:00 PM

Phase-based Imaging and Detection

Session Chair: **Michael E. Gehm**, Duke Univ. (USA)

4:00 pm: **Development of computed phase-sensitive x-ray imaging technologies for pre-clinical science** (*Invited Paper*), Mark A. Anastasio, Frank Brooks, Sergey Komarov, Yujia Chen, Weimin Zhou, Washington Univ. in St. Louis (USA) [10632-17]

4:30 pm: **The state of grating-based x-ray phase contrast imaging** (*Invited Paper*), Amber L. Dagel, Sandia National Labs. (USA) [10632-18]

5:00 pm: **New systems for computational x-ray phase imaging with conventional sources**, Jonathan C. Petruccelli, Porcelain He, Weiyuan Sun, Laila Hassan, Sean Starr-Baier, Danielle Hayden, Carolyn A. MacDonald, Univ. at Albany (USA) [10632-19]

5:20 pm: **Iterative x-ray phase retrieval based on structured illumination**, Xiaolong Li Sr., Yunhui Zhu, Virginia Polytechnic Institute and State Univ. (USA) [10632-20]

5:40 pm: **Defect detection in foams and encapsulants using grating-based x-ray phase contrast imaging (Rising Researcher Presentation)**, Amber L. Dagel, Christian L. Arrington, Patrick S. Finnegan, Ryan N. Goodner, Andrew E. Hollowell, Sandia National Labs. (USA) [10632-21]

CONFERENCE 10633

LOCATION: BALLROOM LEVEL, OSCEOLA 3

Monday–Wednesday 16–18 April 2018 • Proceedings of SPIE Vol. 10633

Radar Sensor Technology XXII

Conference Chairs: **Kenneth I. Ranney**, U.S. Army Research Lab. (USA); **Armin Doerry**, Sandia National Labs. (USA)

Program Committee: **Fauzia Ahmad**, Temple 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 Research Lab. (USA); **John E. Gray**, Naval Surface Warfare Ctr. Dahlgren Div. (USA); **Majeed Hayat**, The Univ. of New Mexico (USA); **Chandra Kambhamettu**, Univ. of Delaware (USA); **Seong-Hwoon Kim**, Raytheon Space & Airborne Systems (USA); **Marco O. Lanzagorta**, U.S. Naval Research Lab. (USA); **Changzhi Li**, Texas Tech Univ. (USA); **Jenshan Lin**, Univ. of Florida (USA); **Robert Linnehan**, General Atomics Aeronautical Systems, Inc. (USA); **Ronald D. Lipps**, U.S. Naval Research Lab. (USA); **David G. Long**, Brigham Young Univ. (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); **Marius Necsoiu**, Southwest Research Institute (USA); **Lam H. Nguyen**, U.S. Army Research Lab. (USA); **Hector A. Ochoa**, The Univ. of Texas at Tyler (USA); **Thomas Pizzillo**, U.S. Naval Research Lab. (USA); **Zhijun G. Qiao**, The Univ. of Texas–Pan American (USA); **Ann M. Raynal**, Sandia National Labs. (USA); **Jerry Silvius**, U.S. Army Research Lab. (USA); **David Tahmoush**, U.S. Naval Research Lab. (USA); **Russell Vela**, Air Force Research Lab. (USA); **Frank Yakos**, Consultant (USA); **Yan Zhang**, The Univ. of Oklahoma (USA); **Ruolin Zhou**, Western New England Univ. (USA)

MONDAY 16 APRIL

OPENING REMARKS

LOCATION: BALLROOM LEVEL, OSCEOLA 3 8:00 AM TO 8:10 AM

Kenneth I. Ranney, U.S. Army Research Lab. (USA) and
Armin W. Doerry, Sandia National Labs. (USA)

SESSION 1

LOCATION: BALLROOM LEVEL, OSCEOLA 3 MON 8:10 AM TO 10:10 AM

Algorithms and Processing I

Session Chair: **Gregory J. Mazzaro**,
The Citadel–The Military College of South Carolina (USA);
Brian R. Phelan, U.S. Army Research Lab. (USA)

8:10 am: **3D tomography for multistatic GPR subsurface sensing**,
Mauricio Pereira, The Univ. of Vermont (USA); Yu Zhang, Delphi Automotive
Systems, LLC (USA); Dan Orfeo, Dylan Burns, Dryver Huston, Tian Xia, The
Univ. of Vermont (USA) [10633-1]

8:30 am: **Three-dimensional radar imaging using interferometric ISAR**,
Thomas M. Goyette, Jason C. Dickinson, Ryan H. Wetherbee, Jason D. Cook,
Andrew J. Gatesman, Univ. of Massachusetts Lowell (USA); William E. Nixon,
National Ground Intelligence Ctr. (USA) [10633-2]

8:50 am: **SAR target classification: training with small data sets**,
Maxine R. Fox, Ram M. Narayanan, The Pennsylvania State Univ.
(USA) [10633-3]

9:10 am: **Pre-conditioning phase history data for video-SAR autofocus**,
Robert Linnehan, Edward Bishop, General Atomics Aeronautical Systems, Inc.
(USA) [10633-4]

9:30 am: **High-resolution range profiling via weighted SPICE in stepped-
frequency radar**, Jiaying Ren, Jian Li, Univ. of Florida (USA); Lam H. Nguyen,
U.S. Army Research Lab. (USA); John M. M. Anderson, Howard Univ.
(USA) [10633-5]

9:50 am: **Aerostat borne ISAR autofocus imaging based on phase
retrieval**, Hongyin Shi, Saiyue Xia, Yanshan Univ. (China); Zhijun G. Qiao, The
Univ. of Texas Rio Grande Valley (USA) [10633-6]

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

SESSION 2

LOCATION: BALLROOM LEVEL, OSCEOLA 3 MON 10:40 AM TO 12:00 PM

Algorithms and Processing II

Session Chair: **Lam H. Nguyen**, U.S. Army Research Lab. (USA)

10:40 am: **Data quality analysis and improvement for weather
observations of multi-mission airborne radar**, Yan R. Zhang, Ramesh
Nepal, The Univ. of Oklahoma (USA); William Blake, Garmin International, Inc.
(USA) [10633-7]

11:00 am: **Multi-hypothesis post processing for improving track accuracy
for air-to-air radar**, Guoqing Liu, Naiel Askar, Hong Xiong, General Atomics
Aeronautical Systems, Inc. (USA) [10633-8]

11:20 am: **Particle swarm optimization for radar binary phase code
selection**, Bingcheng Li, Lockheed Martin Systems Integration-Owego
(USA) [10633-9]

11:40 am: **Occlusion handling in radar for detection of obstacles using
statistical model of interference**, Shai Segal, Alon Slapak, RODRadar Ltd.
(Israel) [10633-10]

Lunch Break Mon 12:00 pm to 1:30 pm

SESSION 3

LOCATION: BALLROOM LEVEL, OSCEOLA 3 MON 1:30 PM TO 3:10 PM

Algorithms and Processing III

Session Chair: **Ann Marie Raynal**, Sandia National Labs. (USA)

1:30 pm: **Energy allocation for tailored waveform design using the
Taguchi method for clutter suppression and enhanced detection of
targets**, Zacharie I. Idriss, Ram M. Narayanan, The Pennsylvania State Univ.
(USA) [10633-11]

1:50 pm: **RFI mitigation for UWB radar via SPICE**, Jeremy Johnston, Jian Li,
Tianyi Zhang, David Greene, Univ. of Florida (USA); Lam H. Nguyen, U.S. Army
Research Lab. (USA); Jiaying Ren, Univ. of Florida (USA) [10633-12]

2:10 pm: **Signal processing technique for spectrally RF congested and
restricted environments using the U.S. Army Research Laboratory
stepped-frequency ultra-wideband radar**, Lam H. Nguyen, U.S. Army
Research Lab. (USA) [10633-13]

2:30 pm: **Information elasticity in pseudorandom code pulse
compression**, Andrew Z. Liu, Ram M. Narayanan, The Pennsylvania State
Univ. (USA); Muralidhar Rangaswamy, Air Force Research Lab.
(USA) [10633-14]

2:50 pm: **Information elasticity in ultra-wideband target detection
in distributed clutter**, Paul G. Singerman, Ram M. Narayanan, The
Pennsylvania State Univ. (USA); Muralidhar Rangaswamy, Air Force Research
Lab. (USA) [10633-15]

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

CONFERENCE 10633

SESSION 4

LOCATION: BALLROOM LEVEL, OSCEOLA 3 MON 3:40 PM TO 4:40 PM

Micro-Doppler Exploitation

Session Chair: **David Tahmouh**, U.S. Naval Research Lab. (USA)

3:40 pm: **Application of the operator current to polarization radar and three-dimensional rotations**, John E. Gray, U.S. Navy (USA); Stephen R. Addison, Univ. of Central Arkansas (USA) [10633-16]

4:00 pm: **Coherent 24 GHz radar system for micro-Doppler studies**, Duncan A. Robertson, Samiur Rahman, Univ. of St. Andrews (United Kingdom). [10633-17]

4:20 pm: **Data-driven cepstral and neural learning of features for robust micro-doppler classification**, Baris Erol, Villanova Univ. (USA); Mehmet S. Seyfioglu, TOBB ETÜ (Turkey); Sevgi Z. Gürbüz, The Univ. of Alabama (USA); Moeness G. Amin, Villanova Univ. (USA) [10633-18]

SYMPOSIUM-WIDE PLENARY SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6-7 for details.

TUESDAY 17 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, OSCEOLA 3 TUE 8:20 AM TO 10:00 AM

Programs and Systems I

Session Chair: **Seong-Hwoon Kim**, Raytheon Space and Airborne Systems (USA)

8:20 am: **Optimized radar design parameters for synthetic aperture radar with limited swath**, Colin D. Kelly, The Pennsylvania State Univ. (USA); Brian R. Phelan, Traian Dogaru, Kelly D. Sherbondy, U.S. Army Research Lab. (USA); Ram M. Narayanan, The Pennsylvania State Univ. (USA) . . . [10633-19]

8:40 am: **Imaging of satellites in space (IoSiS): Challenges in image processing of ground-based high-resolution ISAR data**, Simon Anger, Matthias Jirousek, Stephan Dill, Eric Schreiber, Markus Peichl, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . . [10633-20]

9:00 am: **Examination of radar imagery from recent data collections using the spectrally agile frequency-incrementing reconfigurable (SAFIRE) radar system**, Brian R. Phelan, Kenneth I. Ranney, Canh Ly, Lam H. Nguyen, Kelly D. Sherbondy, U.S. Army Research Lab. (USA); Ram M. Narayanan, The Pennsylvania State Univ. (USA). . . [10633-22]

9:20 am: **Implementation and enhancement of Hilbert transform based calibration in a K band FMCW radar for high-resolution security applications**, Arya Menon, Thomas Weller, Gokhan Mumcu, Univ. of South Florida (USA). . . [10633-23]

9:40 am: **Ship-relative instant multispectral positioning system**, Dmitry S. Starodubov, Kyle McCormick, Michael Dellosa, FOMS Inc. (USA); Leo Volfson, Torrey Pines Logic, Inc. (USA) . . . [10633-24]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, OSCEOLA 3 TUE 11:00 AM TO 12:00 PM

Single-scan Target Tracking: Keynote Session

Session Chair: **John E. Gray**, Naval Surface Warfare Ctr. Dahlgren Div. (USA)

11:00 am: **A crash course in basic single-scan target tracking (Keynote Presentation)**, David F. Crouse, U.S. Naval Research Lab. (USA). . . [10633-25]

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

SESSION 7

LOCATION: BALLROOM LEVEL, OSCEOLA 3 TUE 1:30 PM TO 3:00 PM

Profiles in Industry I

Session Chairs: **Kenneth I. Ranney**, U.S. Army Research Lab. (USA); **Armin W. Doerry**, Sandia National Labs. (USA)

1:30 pm: **Radars and RF systems at Raytheon (Invited Paper)**, Seong-Hwoon Kim, Raytheon Space and Airborne Systems (USA) . [10633-26]

2:00 pm: **Heartbeats, Group 1 UAS, and explosive hazards, Oh My: Addressing difficult sensing scenarios with radar (Invited Paper)**, Steven Hunt, David Boutte, James Hogg, Allan Hunt, AKELA, Inc. (USA) . . [10633-27]

2:30 pm: **Profiles in industry: General Atomics Aeronautical Systems Inc. (Invited Paper)**, Robert Linnehan, General Atomics Aeronautical Systems, Inc. (USA). . . [10633-28]

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

SESSION 8

LOCATION: BALLROOM LEVEL, OSCEOLA 3 TUE 3:30 PM TO 4:30 PM

Profiles in Industry II

Session Chairs: **Kenneth I. Ranney**, U.S. Army Research Lab. (USA); **Armin W. Doerry**, Sandia National Labs. (USA)

3:30 pm: **ARTEMIS radar systems: modular, multi-band SARs for versatile operations (Invited Paper)**, Evan C. Zaugg, Alexander Margulis, Joshua P. Bradley, ARTEMIS, Inc. (USA). . . [10633-29]

4:00 pm: **The NIITEK ground penetrating radar system (Invited Paper)**, William J. Cummings, Chemring Sensors & Electronics Systems (USA). . . [10633-30]

SESSION 9

LOCATION: BALLROOM LEVEL, OSCEOLA 3 TUE 4:30 PM TO 5:30 PM

Programs and Systems II

Session Chair: **Russell Vela**, Air Force Research Lab. (USA)

4:30 pm: **Detection of radio-frequency electronics by acoustic modulation of radar waves**, Gregory J. Mazzaro, The Citadel-The Military College of South Carolina (USA); Andrew J. Sherbondy, U.S. Army Research Lab. (USA); Matthew R. Judy, The Univ. of Oklahoma (USA); Kyle A. Gallagher, Kelly D. Sherbondy, U.S. Army Research Lab. (USA) . . . [10633-31]

4:50 pm: **Integrated methodology for creating radar systems for medical and agricultural applications**, Yaroslav V. Savenko, National Technical Univ. of Ukraine (Ukraine) . . . [10633-32]

5:10 pm: **Software-defined radios for the implementation of randomized arrays**, Kyle A. Gallagher, Roger Cutitta, David Vance, Abigail Hedden, Charles Dietlein, Stephen Freeman, Kenneth I. Ranney, U.S. Army Research Lab. (USA); Daniel Galanos, Alion Science and Technology Corp. (USA). . . [10633-33]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Radar doppler processing with nonuniform PRF, Armin W. Doerry, Sandia National Labs. (USA) [10633-49]

Measuring channel balance in multi-channel radar receivers, Armin W. Doerry, Douglas Bickel, Sandia National Labs. (USA) [10633-50]

Clutter mitigation scheme in presence of wind-blown foliage for FMCW radar, Eric P. Lam, EPLAM Systems (USA) [10633-51]

Investigating the application of deep learning for electromagnetic simulation prediction, Stanton R. Price, Mississippi State Univ. (USA); Steven R. Price, Mississippi College (USA) [10633-52]

Software-defined wideband doppler radar with digital beamforming for indoor activity monitoring and occupancy sensing, Minjie Jian, Zhenzhong Lu, Victor C. Chen, Ancortek, Inc. (USA) [10633-53]

Height retrieval of buildings from high-resolution SAR images, Junsheng Zheng, Hai Zhang, China Academy of Engineering Physics (China) [10633-54]

UWB 3D near-field imaging with a sparse MIMO SFCW radar for concealed weapon detection, Erman Anadol, Ilgin Seker, Sedat Camlica, Tankut O. Topbas, ASELSAN A.S. (Turkey); Sencer S. Koc, Lale Alatan, Figen S. Oktem, Ozlem Aydin Civi, Middle East Technical Univ. (Turkey) [10633-55]

Software-defined radar: recent experiments and results, Kenneth I. Ranney, Kyle A. Gallagher, U.S. Army Research Lab. (USA); Daniel T. Galanos, Alion Science and Technology Corp. (USA); Roger Cutitta, Abigail S. Hedden, Stephen Freeman, Charles R. Dietlein, U.S. Army Research Lab. (USA) [10633-56]

Wideband directions of arrival estimation of chirp sources using compressive sensing, Arnab Shaw, Wright State Univ (USA); Luay A. Alirakis, Wright State Univ. (USA) [10633-57]

WEDNESDAY 18 APRIL

SESSION 10

LOCATION: BALLROOM LEVEL, OSCEOLA 3 WED 8:20 AM TO 10:00 AM

Algorithms and Processing IV

Session Chair: **Yan R. Zhang**, The Univ. of Oklahoma (USA)

8:20 am: **A thorough analysis of various geometries for a dynamic calibration target for through-wall and through-rubble radar**, Michael J. Harner, Ram M. Narayanan, The Pennsylvania State Univ. (USA); John R. Jendzurski, Nicholas G. Paulter, National Institute of Standards and Technology (USA) [10633-34]

8:40 am: **Characterization of wall structures with microwaves**, Alexander Haas, Markus Peichl, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) [10633-35]

9:00 am: **Imaging radar performance analysis using product dark regions**, Ann Marie Raynal, Sandia National Labs. (USA) [10633-36]

9:20 am: **Aharonov Ansatz as a means for realizing Woodward's synthesis principle for metamaterial designs**, John E. Gray, U.S. Navy (USA); Kahlil R. Gedin, Naval Surface Warfare Ctr. Dahlgren Div. (USA) [10633-37]

9:40 am: **Tunable Vivaldi antenna design for frequency scanning**, Muhammad Talal Ali Khan, Umair Tayyab, Hamza Shahid, King Fahd Univ. of Petroleum & Minerals (Saudi Arabia) [10633-38]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 11

LOCATION: BALLROOM LEVEL, OSCEOLA 3 WED 11:00 AM TO 12:00 PM

Noise Radar

Session Chairs: **Ram M. Narayanan**, The Pennsylvania State Univ. (USA); **Yan R. Zhang**, The Univ. of Oklahoma (USA)

11:00 am: **Analysis of transmission and polarization optimization of counter-small UAS (C-SUAS) radar and jamming**, Yan R. Zhang, Yih-Ru Huang, Charles Thumann, The Univ. of Oklahoma (USA) [10633-39]

11:20 am: **Fault detection imaging system based on ultra-wideband noiselet signals**, Marc D. Navagato, Tae Hee Kim, Ram M. Narayanan, The Pennsylvania State Univ. (USA) [10633-40]

11:40 am: **Ultra-wideband direction-of-arrival considerations for antenna arrays in the presence of mutual coupling**, David B. Alexander, Ram M. Narayanan, The Pennsylvania State Univ. (USA); Brahm Himed, Air Force Research Lab. (USA) [10633-41]

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

SESSION 12

LOCATION: BALLROOM LEVEL, OSCEOLA 3 WED 1:30 PM TO 1:50 PM

Quantum Aspects of Radar Sensing

Session Chair: **Kyle A. Gallagher**, U.S. Army Research Lab. (USA)

1:30 pm: **Combining multi-photon entanglement, hyper-entanglement, and quantum networks for enhanced sensing**, James F. Smith III, U.S. Naval Research Lab. (USA) [10633-42]

SESSION 13

LOCATION: BALLROOM LEVEL, OSCEOLA 3 WED 1:50 PM TO 2:30 PM

Nonlinear and Cognitive Radar

Session Chair: **Kyle A. Gallagher**, U.S. Army Research Lab. (USA)

1:50 pm: **Cognitive radar utilizing multifunctional reconfigurable antennas**, Ali Cafer Gurbuz, Sevgi Z. Gürbüz, The Univ. of Alabama (USA); Bedri Cetiner, Utah State Univ. (USA) [10633-47]

2:10 pm: **Binary time series prediction for cognitive radar**, Jacob A. Kovarskiy, The Pennsylvania State Univ. (USA); Anthony F. Martone, Kyle A. Gallagher, Kelly D. Sherbondy, U.S. Army Research Lab. (USA); Ram M. Narayanan, The Pennsylvania State Univ. (USA) [10633-48]

CONFERENCE 10634

WEDNESDAY LOCATION: BALLROOM LEVEL, CAPTIVA 2

THURSDAY: BALLROOM LEVEL, OSCEOLA 3

Wednesday–Thursday 18–19 April 2018 • Proceedings of SPIE Vol. 10634

Passive and Active Millimeter-Wave Imaging XXI

Conference Chairs: **David A. Wikner**, U.S. Army Research Lab. (USA); **Duncan A. Robertson**, Univ. of St. Andrews (United Kingdom)

Program Committee: **Roger Appleby**, Queen's Univ. Belfast (United Kingdom); **Jeffrey Barber**, U.S. Dept. of Homeland Security (USA);

Erich N. Grossman, National Institute of Standards and Technology (USA); **Arttu R. Luukanen**, Asqella Corp. (Finland);

Markus Peichl, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **David M. Sheen**, Pacific Northwest National Lab. (USA);

Bruce Wallace, Consultant (USA)

WEDNESDAY 18 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, CAPTIVA 2 WED 1:30 PM TO 4:40 PM

MMW and DVE Phenomenology and Sensing

Joint Session with conferences 10642 and 10634

Session Chairs: **Jarvis J. Arthur**, NASA Langley Research Ctr. (USA);
David A. Wikner, U.S. Army Research Lab. (USA)

1:30 pm: **Visualization requirements for DVE systems**, Jack Cross, Sierra Nevada Corp. (USA) [10642-29]

1:50 pm: **DVE system capability classes**, Jack Cross, Sierra Nevada Corp. (USA) [10642-30]

2:10 pm: **Visibility in degraded visual environments (DVE)**, John (Jack) N. Sanders-Reed, Stephen J. Fenley, The Boeing Co. (USA) [10642-31]

2:30 pm: **Advanced radar for autonomous vehicles and degraded visual environments**, Mike Gleaves, Arralis Ltd. (Ireland) [10634-1]

2:50 pm: **A novel wire recognition algorithm for millimeter-wave radar video imagery**, Vincent De Paul Onana, Goleta Star, LLC (USA) ... [10642-32]

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

3:40 pm: **Coded aperture sub-reflector array for high-resolution radar imaging**, Jonathan J. Lynch, Florian G. Herrault, Gabriel I. Virbila, Keerti S. Kona, David L. Hammon, HRL Labs., LLC (USA); Michael D. Wetzel, HRL Labs., LLC (USA); Dean C. Regan, Joel C. Wong, Yan Tang, Eric M. Prophet, Partia Naghibi, Aurelio Lopez, HRL Labs., LLC (USA) [10634-2]

4:00 pm: **Passive millimeter-wave imager for degraded visual environments**, Thomas E. Dillon, Christopher Schuetz, Andrew Wright, Phase Sensitive Innovations, Inc. (USA); Steven Kocazik, EM Photonics, Inc. (USA); Dennis Prather, Univ. of Delaware (USA) [10642-33]

4:20 pm: **Extraction of radar cross section values of helicopter landing zone hazards from 94-GHz ISAR imagery**, David A. Wikner, Jerry L. Silvius, Robert L. Bender, U.S. Army Research Lab. (USA) [10634-3]

THURSDAY 19 APRIL

SESSION 2

LOCATION: BALLROOM LEVEL, OSCEOLA 3 THU 8:20 AM TO 10:20 AM

NOTE ROOM CHANGE

Systems

Session Chair: **David A. Wikner**, U.S. Army Research Lab. (USA)

8:20 am: **220 GHz imaging radar with 1 Hz frame rate using an array of homodyne transceivers**, Tomas Bryllert, Chalmers Univ. of Technology (Sweden); Jan A. Svedin, FOI-Swedish Defence Research Agency (Sweden); Erio Gandini, Nuria Llombart, Technische Univ. Delft (Netherlands) ... [10634-4]

8:40 am: **A reconfigurable millimeter-wave spotlight metasurface aperture integrated with a frequency-diverse microwave imager for security screening**, Okan Yurduseven, Daniel L. Marks, Jonah N. Gollub, David R. Smith, Duke Univ. (USA) [10634-5]

9:00 am: **Aperture synthesis with a monochromatic metasurface imaging system for 3D near-field imaging**, Michael Boyarsky, Timothy Sleasman, Laura Pulido-Mancera, Aaron V. Diebold, Mohammadreza F. Imani, David R. Smith, Duke Univ. (USA) [10634-6]

9:20 am: **Simulation of active cylindrical and planar millimeter-wave imaging systems**, David M. Sheen, Mark Jones, Thomas E. Hall, Pacific Northwest National Lab. (USA) [10634-7]

9:40 am: **The CONSORTIS 16 channel 340 GHz security imaging radar**, Duncan A. Robertson, David G. Macfarlane, Robert I. Hunter, Scott L. Cassidy, Univ. of St. Andrews (United Kingdom); Nuria Llombart, Erio Gandini, Technische Univ. Delft (Netherlands); Tomas Bryllert, Wasa Millimeter Wave AB (Sweden); Mattias Ferndahl, Gotmic AB (Sweden); Hannu Lindström, Jussi Tenhunen, Hannu Vasama, VTT Technical Research Ctr. of Finland Ltd. (Finland); Jouni Huopana, Timo Selkala, Antti-Jussi Vuotikka, Global Boiler Works Oy (Finland) [10634-8]

10:00 am: **Evaluation and performance analysis of stand-off threat detection systems**, Aron Krausz, Daniel Hills, Anthony Clark, Home Office Ctr. for Applied Science and Technology (United Kingdom) [10634-9]

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

SESSION 3

LOCATION: BALLROOM LEVEL, OSCEOLA 3 THU 10:50 AM TO 11:50 AM

Phenomenology

Session Chair: **Jeffrey Barber**,
U.S. Dept. of Homeland Security (USA)

10:50 am: **Review of atmospheric effects on remote sensing by MMW radar and radiometer systems**, Stephan Dill, Simon Anger, Florian Bischeltrieder, Markus Peichl, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) [10634-10]

11:10 am: **Identifying explosives in millimeter-wave imaging systems**, James C. Weatherall, Battelle Memorial Institute (USA); Jeffrey Barber, U.S. Dept. of Homeland Security (USA); Kevin Yam, Battelle Memorial Institute (USA); Peter R. Smith, AASKI Technology (USA); Joseph Greca, Battelle Memorial Institute (USA); Barry T. Smith, U.S. Dept. of Homeland Security (USA) [10634-11]

11:30 am: **Integrating 77 GHz radar and IR camera for first responders**, Lester Kosowsky, Alan Aronoff, Ralph Ferraro, L. H. Kosowsky & Associates, Inc. (USA) [10634-12]

Lunch Break Thu 11:50 am to 1:30 pm

SESSION 4

LOCATION: BALLROOM LEVEL, OSCEOLA 3 THU 1:30 PM TO 2:50 PM

Enabling Technologies I

Session Chair: **Duncan A. Robertson**,
Univ. of St. Andrews (United Kingdom)

1:30 pm: **Optical frequency comb applied optoelectronic oscillator for millimeter-wave signal generation and its application**, Atsushi Kanno, National Institute of Information and Communications Technology (Japan); Golam Kibria M D. Hasanuzzaman, Univ. of Cyprus (Cyprus) and National Institute of Information and Communications Technology (Japan); Naokatsu Yamamoto, National Institute of Information and Communications Technology (Japan); Stavros Iezekiel, Univ. of Cyprus (Cyprus) [10634-13]

1:50 pm: **Dual-band submillimeter-wave kinetic inductance bolometers and an imaging system for contraband object detection**, Juha Hassel, VTT Technical Research Ctr. of Finland Ltd. (Finland); Shahab Oddin Dabironezare, Technische Univ. Delft (Netherlands); Andrey V. Timofeev, VTT Technical Research Ctr. of Finland Ltd. (Finland); Erio Gandini, Technische Univ. Delft (Netherlands); Leif Grönberg, VTT Technical Research Ctr. of Finland Ltd. (Finland); Hannu Sipola, Millimetre Waver Lab. of Finland (Finland); Anssi Rautiainen, Alekski A. Tamminen, Mikko M. Leivo, Arttu R. Luukanen, Asqella Oy (Finland); Nuria Llombart, Technische Univ. Delft (Netherlands) [10634-14]

2:10 pm: **Circuit-electromagnetics co-design: A new paradigm for silicon-based THz systems-on-chip for THz imaging and sensing**, Kaushik Sengupta, Princeton Univ. (USA) [10634-15]

2:30 pm: **A geometric model for stitching millimeter-wave images of people in motion**, Kenneth P. Trofatter, Jonah N. Gollub, David R. Smith, Duke Univ. (USA) [10634-16]

Coffee Break Thu 2:50 pm to 3:20 pm

SESSION 5

LOCATION: BALLROOM LEVEL, OSCEOLA 3 THU 3:20 PM TO 4:40 PM

Enabling Technologies II

Session Chair: **David M. Sheen**,
Pacific Northwest National Lab. (USA)

3:20 pm: **Thin film partial reflectors for generating contrast in millimeter-wave images**, Jeffrey Barber, Transportation Security Lab. (USA); Peter R. Smith, AASKI Technology (USA); Lindsey J. Gray, Ramapo College of New Jersey (USA); Angel Yam, Univ. at Buffalo (USA); Joseph Greca, Kevin Yam, James C. Weatherall, Battelle Memorial Institute (USA); Duane Karns, Aerotek, Inc. (USA); Barry T. Smith, Transportation Security Lab. (USA) [10634-17]

3:40 pm: **Inexpensive and simple MMW imaging using optical detection of light emitted from glow discharge detectors**, Daniel Rozban, Amir Abramovich, Ariel Univ. (Israel); Natan Kopeika, Avihai Aharon, Yitzhak Yitzhaky, Ben-Gurion Univ. of the Negev (Israel) [10634-18]

4:00 pm: **Wideband own generation of the Josephson Junction is principal for the sensitivity of the radiometrical devices, especially matrix**, Alexander G. Denisov, Harbin Institute of Technology (China) [10634-19]

4:20 pm: **Backscattering from a rough, high dielectric constant surface: application for radar sensing of ocean clutter**, Jojit C. Torcedo, Andrew J. Gatesman, Univ. of Massachusetts Lowell (USA); William E. Nixon, National Ground Intelligence Ctr. (USA) [10634-20]

CONFERENCE 10635

LOCATION: BALLROOM LEVEL, OSCEOLA 4 AND BALLROOM LEVEL, MIAMI 3

Monday–Wednesday 16–18 April 2018 • Proceedings of SPIE Vol. 10635

Ground/Air Multisensor Interoperability, Integration, and Networking for Persistent ISR IX

Conference Chairs: **Michael A. Kolodny**, U.S. Army Research Lab. (USA); **Dietrich M. Wiegmann**, U.S. Army Research Lab. (USA); **Tien Pham**, U.S. Army Research Lab. (USA)

Program Committee: **Flavio Bergamaschi**, IBM United Kingdom Ltd. (United Kingdom); **Geeth R. de Mel**, IBM Thomas J. Watson Research Ctr. (USA); **Daniel J. Henry**, Rockwell Collins, Inc. (USA); **Laura Martine Klein**, Sandia National Labs. (USA); **Laura A. McNamara**, Sandia National Labs. (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 Mission Systems (USA); **Igor V. Ternovskii**, Air Force Research Lab. (USA); **Thomas J. Walls**, U.S. Naval Research Lab. (USA); **Robert Williams**, Air Force Research Lab. (USA)

MONDAY 16 APRIL

INTRODUCTION

LOCATION: BALLROOM LEVEL, OSCEOLA 4 8:20 AM TO 8:30 AM

Conference Chair: **Michael A. Kolodny**, U.S. Army Research Lab. (USA)

SESSION 1

LOCATION: BALLROOM LEVEL, OSCEOLA 4 MON 8:30 AM TO 10:00 AM

Internet of Battlefield Things (IOBT) Applications

Session Chair: **Michael A. Kolodny**, U.S. Army Research Lab. (USA)

8:30 am: **Internet of Battlefield Things (IOBT)** (*Invited Paper*), Stephen Russell, U.S. Army Research Lab. (USA) [10635-1]

9:00 am: **On location-based target tracking using social media as sensors**, Tarek Abdelzaher, Prasanna Giridhar, Univ. of Illinois (USA) [10635-2]

9:20 am: **3D ground/air sensor common operating picture**, Damon M. Conover, U.S. Army Research Lab. (USA); John F. Dammann Jr., Booz Allen Hamilton Inc. (USA) [10635-3]

9:40 am: **Role of influence functions in model interpretability**, Supriyo Chakraborty, Jorge Ortiz, IBM Thomas J. Watson Research Ctr. (USA); Simon Julier, Univ. College London (United Kingdom) [10635-4]

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

SESSION 2

LOCATION: BALLROOM LEVEL, OSCEOLA 4 MON 10:30 AM TO 12:00 PM

Operationalizing AI/ML-Infrastructure

Session Chair: **Dietrich Wiegmann**, U.S. Army Research Lab. (USA)

10:30 am: **Project Maven: operationalizing machine learning** (*Invited Paper*), Drew Cukor, U.S. Dept. of Defense (USA) [10635-5]

11:10 am: **Artificial intelligence (AI) and machine learning (ML) for future army applications** (*Keynote Presentation*), John Fossaceca, Stuart H. Young, U.S. Army Research Lab. (USA) [10635-6]

11:40 am: **Collaborative analytics for biological facility characterization**, Elizabeth Jurrus, Defense Threat Reduction Agency (USA) [10635-7]

Lunch Break Mon 12:00 pm to 1:10 pm

SESSION 3

LOCATION: BALLROOM LEVEL, OSCEOLA 4 MON 1:10 PM TO 3:00 PM

Operationalizing AI/ML-Algorithms

Session Chair: **Dietrich Wiegmann**, U.S. Army Research Lab. (USA)

1:10 pm: **Harnessing machine learning to enable global discovery at scale** (*Keynote Presentation*), Mikel Rodriguez, The MITRE Corp. (USA) [10635-8]

1:40 pm: **Cognitive computer-on-watch: Applying artificial intelligence/machine learning to augment human capability**, Sanjeev Mohindra, Arjun Majumdar, Benjamin Smith, MIT Lincoln Lab. (USA) [10635-9]

2:00 pm: **Machine learning in complex systems**, Travis Axtell, U.S. Dept. of Defense (USA); Lucas A. Overbey, Lisa Woerner, Space and Naval Warfare Systems Ctr. Atlantic (USA) [10635-10]

2:20 pm: **Leveraging the AI stack to achieve asymmetric capability**, Shane Shaneman, Andrew W. Moore, Martial Hebert, Carnegie Mellon Univ. (USA) [10635-11]

2:40 pm: **Applying video summarization to aerial surveillance**, Kevin Pitstick, Software Engineering Institute (USA); Xiaodan Liang, Carnegie Mellon Univ. (USA); Edwin Morris, Mark Klein, Software Engineering Institute (USA) [10635-12]

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

SESSION 4

LOCATION: BALLROOM LEVEL, OSCEOLA 4 MON 3:30 PM TO 4:50 PM

Enabling Technologies: Ontology and Information

Session Chair: **Tien Pham**, U.S. Army Research Lab. (USA)

3:30 pm: **An autonomous-sensor architecture for counter-UAS**, Paul A. Thomas, Defence Science and Technology Lab. (United Kingdom); Gillian F. Marshall, QinetiQ Ltd. (United Kingdom); David C. Lugton, Defence Science and Technology Lab. (United Kingdom); David A. Faulkner, QinetiQ Ltd. (United Kingdom); Scott Page, Cubica Technology Ltd. (United Kingdom) [10635-13]

3:50 pm: **A common core-based cyber ontology in support of cross-domain situational awareness**, Brian Donohue, Mark Jensen, Alexander P. Cox, Ronald Rudnicki, CUBRC, Inc. (USA) [10635-14]

4:10 pm: **Cloud-based security architecture supporting the Army Research Laboratory's Collaborative Research Environments**, Kelly W. Bennett, U.S. Army Research Lab. (USA) [10635-15]

4:30 pm: **Problems with prescriptions: disentangling data about actual versus prescribed entities**, Mark Jensen, Alexander P. Cox, Brian Donohue, Ronald Rudnicki, CUBRC, Inc. (USA) [10635-16]

SYMPOSIUM-WIDE PLENARY SESSION
LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

- 5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**
- 5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)
- 5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin
- 6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6–7 for details.

TUESDAY 17 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, OSCEOLA 4 TUE 8:20 AM TO 10:00 AM

Deep Learning and Data Analytics: Learning

Session Chairs: **Tien Pham**, U.S. Army Research Lab. (USA);
Raghuveer M. Rao, U.S. Army Research Lab. (USA)

- 8:20 am: **2020: Faster than real time tactical ISR from the dismount, faster than real time strategic ISR to the dismount**, Richard M. Buchter, U.S. Army Research Lab. (USA) and CISD (USA) [10635-17]
- 8:40 am: **Machine learning for dynamic resource allocation at network edge**, Bong Jun Ko, IBM Thomas J. Watson Research Ctr. (USA); Kin K. Leung, Imperial College London (United Kingdom); Theodoros Salonidis, IBM Thomas J. Watson Research Ctr. (USA) [10635-18]
- 9:00 am: **Characterizing the mutual information of neural-network based distributed machine learning**, Tiffany Tuor, Imperial College London (United Kingdom); Shiqiang Wang, IBM Thomas J. Watson Research Ctr. (USA); Kin K. Leung, Imperial College London (United Kingdom); Bong Jun Ko, IBM Thomas J. Watson Research Ctr. (USA) [10635-19]
- 9:20 am: **Machine learning approaches for small data in sensor fusion applications**, Dinesh Verma, IBM Thomas J. Watson Research Ctr. (USA); Graham Bent, Geeth de Mel, IBM United Kingdom Ltd. (United Kingdom); Chris Simpkin, Cardiff Univ. (United Kingdom) [10635-20]
- 9:40 am: **Resource management in distributed SDN using reinforcement learning**, Liang Ma, Bong Jun Ko, Mudhakar Srivatsa, IBM Thomas J. Watson Research Ctr. (USA); Kin K Leung, Imperial College London (United Kingdom). [10635-21]
- Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, OSCEOLA 4 TUE 11:00 AM TO 12:00 PM

Deep Learning and Data Analytics: Analytics

Session Chairs: **Tien Pham**, U.S. Army Research Lab. (USA);
Raghuveer M. Rao, U.S. Army Research Lab. (USA)

- 11:00 am: **Data-driven uncertainty quantification for multisensor analytics**, David Stracuzzi, Maximillian G. Chen, Michael C. Darling, Matthew G. Peterson, Sandia National Labs. (USA) [10635-22]
- 11:20 am: **An algorithm for model fusion for distributed learning**, Dinesh Verma, Seraphin Calo, Supriyo Chakraborty, IBM Thomas J. Watson Research Ctr. (USA); Simon Julier, Stephen Pasteris, Univ. College London (United Kingdom) [10635-23]
- 11:40 am: **Distributed analytics for audio sensing applications**, Theodoros Salonidis, David Wood, Bong Jun Ko, Shiqiang Wang, IBM Thomas J. Watson Research Ctr. (USA) [10635-24]
- Lunch/Exhibition Break Tue 12:00 pm to 1:30 pm

SESSION 7

LOCATION: BALLROOM LEVEL, OSCEOLA 4 TUE 1:30 PM TO 3:10 PM

Advanced Concepts

Joint Session with conferences 10653 and 10635

Session Chairs: **Timothy P. Hanratty**, U.S. Army Research Lab. (USA); **Michael A. Kolodny**, U.S. Army Research Lab. (USA)

- 1:30 pm: **The machine, data analytics and situational understanding: a perspective your mother was afraid to tell you** (*Invited Paper*), Michael A. Kolodny, U.S. Army Research Lab. (USA) [10635-44]
- 1:55 pm: **From sensors to knowledge: The challenge of training the next generation of data analysts**, Sonya A. H. McMullen, David Ison, Erin Bowen, Troy Henderson, Johnny Young, Embry-Riddle Aeronautical Univ. (USA) [10635-27]
- 2:20 pm: **Reexamining computational support for intelligence analysis: A functional design for a future capability**, James Llinas, Galina Rogova, Univ. at Buffalo (USA); Kevin Barry, Lockheed Martin Corp. (USA); James W. Scrofani, Naval Postgraduate School (USA) [10635-28]
- 2:45 pm: **When data lie: fairness and robustness in contested environments**, Ramya Raghavendra, IBM Thomas J. Watson Research Ctr. (USA); Alun Preece, Federico Cerutti, Cardiff Univ. (United Kingdom). [10635-29]
- Coffee Break Tue 3:10 pm to 3:40 pm

SESSION 8

LOCATION: BALLROOM LEVEL, MIAMI 3 TUE 3:40 PM TO 5:00 PM

NOTE ROOM CHANGE

Advanced Analytics

Joint Session with conferences 10635 and 10653

Session Chairs: **Timothy P. Hanratty**, U.S. Army Research Lab. (USA); **Michael A. Kolodny**, U.S. Army Research Lab. (USA)

- 3:40 pm: **The event tracking dashboard: from multilingual social media feeds to event patterns and anomalies**, Tarek Abdelzaher, Prasanna Giridhar, Univ. of Illinois (USA); Lance Kaplan, U.S. Army Research Lab. (USA) [10635-30]
- 4:00 pm: **The role of motifs in understanding behavior in social and engineered networks**, Diane Felmler, The Pennsylvania State Univ. (USA); Don Towsley, Univ. of Massachusetts Amherst (USA); Roger Whitaker, Cardiff Univ. (United Kingdom); Dave Braines, IBM United Kingdom Ltd. (United Kingdom); Liam Turner, Cardiff Univ. (United Kingdom) [10635-31]
- 4:20 pm: **Customizable fusion of violent event mentions in heterogeneous data**, Justin M. Del Vecchio, CUBRC, Inc. (USA); Timothy K. Perkins, U.S. Army Corps of Engineers (United Kingdom). [10635-32]
- 4:40 pm: **Towards a methodology for lossless data exchange between NoSQL data structures**, Ronald Rudnicki, Brian Donohue, Alexander P. Cox, Mark Jensen, CUBRC, Inc. (USA) [10635-25]

CONFERENCE 10635

WEDNESDAY 18 APRIL

SESSION 9

LOCATION: BALLROOM LEVEL, OSCEOLA 4 WED 8:20 AM TO 10:00 AM

NOTE ROOM CHANGE

Coalition Operations and Interoperability

Session Chair: **Gavin Pearson**,
Defence Science and Technology Lab. (United Kingdom)

8:20 am: **Coalition all-source analytics development activities in the technical cooperation program**, Elizabeth K. Bowman, U.S. Army Research Lab. (USA) [10635-26]

8:40 am: **Evaluation and case studies of OSUS at TTCP CUE 2017 coalition event**, Jacob Tyo, William Hughes, U.S. Army Research Lab. (USA) [10635-27]

9:00 am: **Generation and management of training data for AI based algorithms targeted at coalition operations**, Dinesh Verma, IBM Thomas J. Watson Research Ctr. (USA); Greg Cirincione, Tien Pham, U.S. Army Research Lab. (USA); Bong Jun Ko, IBM Thomas J. Watson Research Ctr. (USA) [10635-28]

9:20 am: **Reasoning and learning services for coalition situational understanding**, Daniel Harborne, Crime and Security Research Institute, Cardiff Univ. (United Kingdom); Ramya Raghavendra, IBM Thomas J. Watson Research Ctr. (USA); Chris Willis, BAE Systems (United Kingdom); Supriyo Chakraborty, IBM Thomas J. Watson Research Ctr. (USA); Alun Preece, Crime and Security Research Institute, Cardiff Univ. (United Kingdom) ... [10635-29]

9:40 am: **Generative policy approach for dynamic collaboration in coalition environments**, Dinesh Verma, IBM Thomas J. Watson Research Ctr. (USA); Elisa Bertino, Purdue Univ. (USA); Seraphin Calo, IBM Thomas J. Watson Research Ctr. (USA); Christopher Williams, Defence Science and Technology Lab. (United Kingdom) [10635-30]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 10

LOCATION: BALLROOM LEVEL, OSCEOLA 4 WED 11:00 AM TO 12:00 PM

Airborne ISR

Session Chair: **Daniel J. Henry**, Rockwell Collins, Inc. (USA)

11:00 am: **System level design considerations in imaging ISR systems**, Daniel J. Henry, Rockwell Collins, Inc. (USA) [10635-31]

11:20 am: **Responding to unmanned aerial swarm saturation attacks with autonomous counter-swarms**, Michael Day, Laura Strickland, Eric Squires, Kevin DeMarco, Charles Pippin, Georgia Tech Research Institute (USA) [10635-32]

11:40 am: **Real-time lidar from ScanEagle UAV**, Roy D. Nelson, Ball Aerospace & Technologies Corp. (USA); Daniel Fuller, Insitu, Inc. (USA) [10635-33]

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

SESSION 11

LOCATION: BALLROOM LEVEL, OSCEOLA 4 WED 1:20 PM TO 3:00 PM

Optimization of Information Sources: The Magic Rabbits

Session Chair: **Michael A. Kolodny**, U.S. Army Research Lab. (USA)

1:20 pm: **MINI-DASS: an innovative approach to maximizing the utility of information sources**, Michael A. Kolodny, U.S. Army Research Lab. (USA) [10635-34]

1:40 pm: **Exploiting the diversity of information sources for enhanced information collection**, Anne-Claire Boury-Brisset, Defence Research and Development Canada, Valcartier (Canada); Michael A. Kolodny, U.S. Army Research Lab. (USA) [10635-35]

2:00 pm: **What do you need to know? Specifying information requirements with clarity**, Britt Bray, Morris Nelson & Associates, LLC (USA) [10635-36]

2:20 pm: **Matching requirements to means using meaning**, Steve Hookway, Joe Gorman, Brad Rosenberg, Charles River Analytics, Inc. (USA) [10635-37]

2:40 pm: **Lexicon and schema development for domain understanding and ontology design**, Julie A. Skipper, Wright State Univ. (USA); Steve Hookway, Joe Gorman, Charles River Analytics, Inc. (USA) ... [10635-38]

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

SESSION 12

LOCATION: BALLROOM LEVEL, OSCEOLA 4 WED 3:30 PM TO 5:30 PM

Enabling Technologies: Hardware and Sensing

Session Chair: **Dietrich Wiegmann**, U.S. Army Research Lab. (USA)

3:30 pm: **A search for the optimal file transfer protocol from surfaced UAVs to UAV relays and beyond**, Scott Cutler, SPAWAR Systems Ctr. Pacific (USA) [10635-39]

3:50 pm: **Sensor operators as technology consumers: What do users really think about that radar?**, Laura A. McNamara, Sandia National Labs. (USA) [10635-40]

4:10 pm: **Measurement and representation of small-vehicle acoustic signatures**, Danney Glaser, David K. Wilson, U.S. Army Engineer Research and Development Ctr. (USA); Jordan M. Hodge, Bonnie J. Jones, John J. Gagnon, U.S. Army Corps of Engineers (USA) [10635-41]

4:30 pm: **Cost effective FPGA implementation of high bandwidth communication through slip ring using circular waveguide**, Miroslav Peric, Dragana Peric, VLATACOM Institute Ltd. (Serbia) [10635-42]

4:50 pm: **Modeling RF and acoustic signal propagation in complex environments**, D. Keith Wilson, Daniel J. Breton, Wesley M. Barnes, Michael B. Muhlestein, U.S. Army Engineer Research and Development Ctr. (USA); Vladimir E. Ostashev, US Army Engineer Research and Development Ctr. (USA) [10635-43]

5:10 pm: **Can multimodal sensing detect and localize transient events?**, Archan Misra, Kasthuri Jayarajah, Vigneshwaran Subbaraju, Singapore Management Univ. (Singapore) [10635-45]

CONFERENCE 10636

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2

Tuesday–Wednesday 17–18 April 2018 • Proceedings of SPIE Vol. 10636

Laser Radar Technology and Applications XXIII

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**, MIT Lincoln Labs. (USA); **Thomas J. Karr**, Defense Advanced Research Projects Agency (USA); **Lori A. Magruder**, Applied Research Labs., The Univ. of Texas at Austin (USA); **Vasyl Molebny**, National Taras Shevchenko Univ. of Kyiv (Ukraine); **C. Russell Philbrick**, North Carolina State Univ. (USA); **Upendra N. Singh**, NASA Langley Research Ctr. (USA); **Ove Steinvall**, FOI-Swedish Defence Research Agency (Sweden); **Grady H. Tuell**, 3D Ideas, LLC (USA); **Douglas G. Youmans**, Parsons Corp. (USA)

TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 TUE 8:40 AM TO 10:00 AM

Airborne Target Detection and Characterization

Session Chair: **Gary W. Kamerman**, FastMetrix, Inc. (USA)

8:40 am: **Laser profiling for airborne target classification**, Ove Steinvall, Michael Tuldahl, Folke Berglund, Lars Allard, FOI-Swedish Defence Research Agency (Sweden) [10636-1]

9:00 am: **Identifying drone based terrorist attacks by innovative laser based payload identification system**, Mohamed A.A. Ismail, Andreas Bierig, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) . . [10636-2]

9:20 am: **Aerial and surface security applications using LiDAR**, Philip M. Church, Justin Matheson, Brett Owens, Neptec Technologies Corp. (Canada) [10636-3]

9:40 am: **Potential of LiDAR sensors for the detection of UAVs**, Marcus Hammer, Marcus Hebel, Björn Borgmann, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Martin Laurentz, Institut Franco-Allemand de Recherches de Saint-Louis (France); Michael Arens, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10636-4]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 2

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 TUE 11:00 AM TO 12:00 PM

Laser Radar Enabling Technologies and Techniques I

Session Chair: **Lori A. Magruder**, Applied Research Labs., The Univ. of Texas at Austin (USA)

11:00 am: **An optical scanner based on beam switching method fabricated on silicon photonics circuit**, Daisuke Inoue, Tadashi Ichikawa, Akari Kawasaki, Tatsuya Yamashita, Toyota Central R&D Labs., Inc. (Japan) [10636-5]

11:20 am: **Optimum procedure of the stray light analysis of the laser radar system of modulated design**, Jinsuk Hong, Samsung Thales Co., Ltd. (Korea, Republic of) [10636-6]

11:40 am: **Dark non-uniformity correction and characterization of a 3D flash LIDAR camera**, Andrew Reinhardt, Univ. of Dayton (USA); Drake Miller, Adam Lee, Voxel, Inc. (USA); Cullen P. Bradley, Univ. of Dayton Research Institute (USA); Paul F. McManamon, Univ. of Dayton (USA) [10636-7]

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

SESSION 3

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 TUE 2:00 PM TO 3:20 PM

Laser Radar Enabling Technologies and Techniques II

Session Chair: **Lori A. Magruder**, Applied Research Labs., The Univ. of Texas at Austin (USA)

2:00 pm: **Atmospheric effects and impact on target classification for synthetic aperture Ladar (SAL) imagery**, Rose Rustowicz, Jacob Ross, Lawrence J. Barnes, Air Force Research Lab. (USA); Brian D. Rigling, Wright State Univ. (USA); Edward A. Watson, Univ. of Dayton Research Institute (USA); Brett L. Keaffaber, Air Force Research Lab. (USA) [10636-8]

2:20 pm: **In-house PIV system based on a laser sensor for measuring the velocity of liquids**, Abraham Sierra-Calderon, Jose Alfredo Alvarez-Chavez, Gabriel Plascencia-Barrera, Ctr. de Investigación e Innovación Tecnológica (Mexico) [10636-9]

2:40 pm: **Study on the effects on time-domain pulsed echo laser profile based on fluidic lens**, Jie Cao, Yang Cheng, Fanghua Zhang, Yuqing Xiao, Qun Hao, Beijing Institute of Technology (China) [10636-10]

3:00 pm: **Temporally multiplexed multispectral ladar with raman-based waveforms**, Luke A. Ausley, Air Force Research Lab. (USA); Christian Keyser, Air Force Research Lab (USA); Richard Martin, Air Force Institute of Technology (USA) [10636-30]

Coffee Break Tue 3:20 pm to 3:50 pm

SESSION 4

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 TUE 3:50 PM TO 5:20 PM

Compact Laser Radar Systems

Session Chair: **Monte D Turner**, Air Force Research Lab. (USA)

3:50 pm: **Automotive LiDAR based on Geiger-mode sensors** (*Invited Paper*), Mark Itzler, Princeton Lightwave, Inc. (USA) [10636-11]

4:20 pm: **MEMS-scanned ladar for small unmanned air vehicles**, Barry L. Stann, John F. Dammann, Mark M. Giza, William C. Ruff, U.S. Army Research Lab. (USA) [10636-12]

4:40 pm: **Ultra compact solid state laser**, Bhabana Pati, Eric D. Park, Q-Peak, Inc. (USA) [10636-13]

5:00 pm: **An ultrasmall 3D lidar for small autonomous drone based on an integrated 2-axis MEMS scanner**, Dingkan Wang, Zaid Tasneem, Stephan Strassle, Sanjeev Koppal, Huikai Xie, Univ. of Florida (USA) [10636-14]

CONFERENCE 10636

WEDNESDAY 18 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 WED 8:10 AM TO 10:00 AM

Atmospheric Lidar Applications

Session Chair: **Ove Steinvall**,

FOI-Swedish Defence Research Agency (Sweden)

8:10 am: **NASA Langley Airborne Coherent Wind Lidar Science Campaigns and Technology Advancement Program** (*Invited Paper*), Upendra N. Singh, Michael J. Kavaya, NASA Langley Research Ctr. (USA); George D. Emmitt, Simpson Weather Associates, Inc. (USA); Ramesh K. Kakar, NASA Headquarters (USA) [10636-15]

8:40 am: **A Langley extrapolation technique applied to atmospheric aerosol LIDARs**, Christopher R. Valenta, John M. Stewart, Chase Johnston, Georgia Tech Research Institute (USA) [10636-16]

9:00 am: **Lidar detection of small aerosol size distribution**, Hans D. Hallen, C. Russell Philbrick, North Carolina State Univ. (USA) [10636-17]

9:20 am: **Compact Lidar for continuous monitoring of atmospheric extinction**, David M. Sonnenfroh, Robert Minelli, Joseph Goodwin, Terry Rawlins, Physical Sciences Inc. (USA) [10636-18]

9:40 am: **Using a bistatic camera Lidar to profile aerosols influenced by a local source of pollution**, Amin Kabir, Univ. of The Bahamas (Bahamas); Nimmi C. Sharma, Central Connecticut State Univ. (USA); John E. Barnes, NOAA Earth Systems Research Lab. (USA); Jalal Butt, Central Connecticut State Univ. (USA); Mauricio Bridgewater, Univ. of The Bahamas (Bahamas) [10636-19]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 WED 11:00 AM TO 12:00 PM

Advanced Data Processing and Exploitation I

Session Chair: **Monte D Turner**, Air Force Research Lab. (USA)

11:00 am: **Noisy LIDAR point clouds: impact on information extraction in high-precision LIDAR surveying**, Andreas Ullrich, Martin Pfennigbauer, RIEGL Laser Measurement Systems GmbH (Austria) [10636-20]

11:20 am: **Total propagated uncertainty for coastal zone mapping and imaging Lidar (CZMIL)**, Vinod Ramnath, Teledyne Optech (USA); Peter Friess, Independent Consultant (Germany); Hieu Duong, Viktor Feygels, Teledyne Optech (USA); Yuri I. Kopilevich, ITMO Univ. (Russian Federation) [10636-21]

11:40 am: **Random forest classifier based road network detection in forest regions**, Gizem Aktas, Öner Ayhan, Nigar Şen, SDT Uzay & Savunma Teknolojileri (Turkey) [10636-22]

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

SESSION 7

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 WED 2:00 PM TO 3:00 PM

Advanced Data Processing and Exploitation II

Session Chair: **Vasyl Molebny**,

National Taras Shevchenko Univ. of Kyiv (Ukraine)

2:00 pm: **Large scale public Lidar and satellite image benchmark for urban semantic labeling**, Gordon Christie, Andrea Leichtman, Sean Wang, Hirsh Goldberg, Marc Bosch, Myron Z. Brown, Johns Hopkins Univ. Applied Physics Lab., LLC (USA) [10636-23]

2:20 pm: **Superresolution textured digital surface model formation using aerial texel images taken from a low-cost, small unmanned aerial system**, Bikalpa Khatiwada, Scott E. Budge, Utah State Univ. (USA) [10636-24]

2:40 pm: **Improving accuracy of pulsed-laser range finding based on differential optical path**, Fanghua Zhang, Jie Cao, Yuqing Xiao, wYingbo Wang, Qun Hao, Beijing Institute of Technology (China) . . . [10636-25]

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

SESSION 8

LOCATION: BALLROOM LEVEL, TALLAHASSEE 2 WED 3:30 PM TO 5:10 PM

Space-based Laser Radar Applications

Session Chair: **Richard M. Heinrichs**, Defense Advanced Research Projects Agency (USA)

3:30 pm: **Space-based photon-counting laser altimetry for global applications**, Lori A. Magruder, Holly W. Leigh, Katherine Pitts, Amy L. Neuenschwander, Applied Research Labs., The Univ. of Texas at Austin (USA) [10636-26]

3:50 pm: **Component-level selection and qualification for the GEDI laser altimeter transmitter**, Paul R. Stysley, Barry B. Coyle, Michael J. Hersh, NASA Goddard Space Flight Ctr. (USA); Erich Frese, ASRC Federal Space and Defense (USA); Furqan Chiragh, Pinnacle Solutions (USA); Demetrios Poullos, Greg B. Clarke, American Univ. (USA); Cynthia Kirchner, NASA Goddard Space Flight Ctr. (USA); Kristen Washington, ASRC Federal Space and Defense (USA); Gordon Blalock, Kevin Smith, Genesis Engineering Solutions, Inc. (USA); Joe Thomes, NASA Goddard Space Flight Ctr. (USA); Robert Switzer, ASRC Federal Space and Defense (USA); Aleksey A. Vasilyev, Andrew Shekells, Trident Vantage (USA) [10636-27]

4:10 pm: **Qualification of the solid-state laser systems for the GEDI Altimeter Mission**, Paul R. Stysley, Barry B. Coyle, NASA Goddard Space Flight Ctr. (USA); Erich Frese, ASRC Federal Space and Defense (USA); Furqan Chiragh, Pinnacle Engineering & Management Solutions, LLC (USA); Michael J. Hersh, NASA Goddard Space Flight Ctr. (USA); Demetrios Poullos, Greg B. Clarke, American Univ. (USA); Cynthia Kirchner, NASA Goddard Space Flight Ctr. (USA); Kristen Washington, ASRC Federal Space and Defense (USA); Gordon Blalock, Kevin Smith, Genesis Engineering Solutions, Inc. (USA); Joe Thomes, NASA Goddard Space Flight Ctr. (USA); Robert Switzer, ASRC Federal Space and Defense (USA); Robert Chalmers, Amandeep Kaur, NASA Goddard Space Flight Ctr. (USA); Robert Taminelli, Science Systems and Applications, Inc. (USA); Peter Morey, Ball Aerospace (USA); Juan Lander, Fibertek, Inc. (USA); Traci Rosnack, Orbital ATK (USA) [10636-28]

4:30 pm: **A mission-enabling UV laser with continuously selectable output for in situ planetary exploration**, Paul R. Stysley, Barry B. Coyle, NASA Goddard Space Flight Ctr. (USA); Demetrios Poullos, Greg B. Clarke, American Univ. (USA); Ricardo Arevalo, Univ. of Maryland, College Park (USA) [10636-29]

4:50 pm: **Laser-Induced damage properties of 355nm space coatings**, Kesheng Guo, Jianda Shao, Yangzhi Wang, Meiping Zhu, Jia Liu, Ruiyi Chen, Kui Yi, Hongbo He, Shanghai Institute of Optics and Fine Mechanics (China) [10636-31]

CONFERENCE 10637

LOCATION: BALLROOM LEVEL, SUN BALLROOM A

Tuesday–Wednesday 17–18 April 2018 • Proceedings of SPIE Vol. 10637

Laser Technology for Defense and Security XIV

Conference Chairs: **Mark Dubinskiy**, U.S. Army Research Lab. (USA); **Timothy C. Newell**, Air Force Research Lab. (USA)

Program Committee: **Patrick A. Berry**, Air Force Research Lab. (USA); **Scott Christensen**, IPG Photonics Corp. (USA); **Christopher Ebert**, Coherent/DILAS Lasers (USA); **Lawrence Grimes**, High Energy Joint Technology Office (USA); **Albert A. Ogozo**, Naval Postgraduate School (USA); **Craig A. Robin**, U.S. Army Space and Missile Defense Command (USA)

TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SUN BALLROOM A TUE 8:40 AM TO 10:00 AM

Fiber Lasers:

Fiber Development and CW Power Scaling I

Session Chair: **Craig A. Robin**,

U.S. Army Space and Missile Defense Command (USA)

8:40 am: **Progress on high-power Yb, Tm and Raman fiber lasers**, Patrick Roumayah, Alex Sincore, Justin Cook, Joshua Bradford, Jose Antonio-Lopez, Dong Jin Shin, Ali Q. Abdulfattah, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Lawrence Shah, Luminar Technologies, Inc. (USA) and CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Rodrigo Amezcua Correa, Axel Schülzgen, Martin Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10637-1]

9:00 am: **Advanced packaging and power scaling of narrow linewidth fiber amplifiers**, Daniel J. Creeden, Mitchell Underwood, Tiffanie G. D'Alberto, Tony Tero, David Hosmer, Ronald Basque, Joshua Galipeau, Jill Sears, David Paquette, Coherent | Nuferr (USA) [10637-2]

9:20 am: **Recent advances in holmium doped fibers for high-energy lasers**, Colin C. Baker, U.S. Naval Research Lab. (USA); E. Joseph Friebele, Sotera Defense Solutions, Inc. (USA); Ashley A. Burdett, Univ. Research Foundation (USA); L. Brandon Shaw, Steven R. Bowman, Woohong Kim, Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA); John M. Ballato, Courtney Kucera, Amber Vargas, Clemson Univ. (USA); Alexander V. Hemming, Nikita Simikov, John Haub, Defence Science and Technology Group (Australia) [10637-3]

9:40 am: **Resonantly-pumped Er-nanoparticle-doped silica-based fibers: a pathway to a kW-class eye-safer fiber laser**, Jun Zhang, Radha K. Pattnaik, U.S. Army Research Lab. (USA); Colin C. Baker, E. Joseph Friebele, U.S. Naval Research Lab. (USA); Ashley A. Burdett, Univ. Research Foundation (USA); Daniel L. Rhonehouse, Woohong Kim, Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA); Mark Dubinskiy, U.S. Army Research Lab. (USA) [10637-4]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 2

LOCATION: BALLROOM LEVEL, SUN BALLROOM A TUE 11:00 AM TO 12:10 PM

Fiber Lasers:

Fiber Development and CW Power Scaling II

Session Chair: **Craig A. Robin**,

U.S. Army Space and Missile Defense Command (USA)

11:00 am: **New schemes and regimes of CW and pulsed Raman fiber lasers (Invited Paper)**, Sergey A. Babin, Institute of Automation and Electrometry (Russian Federation) [10637-5]

11:30 am: **Fiber laser power scaling based on 'crystalline-core/crystalline-cladding' fiber designs**, Mark Dubinskiy, Jun Zhang, Viktor Fromzel, U.S. Army Research Lab. (USA); Claire Luo, General Opto Solutions, LLC (USA) [10637-6]

11:50 am: **5W 1950nm Brillouin-free efficient single clad TDFA**, Clément Romano, Robert E. Tench, Jean-Marc Delavaux, Cybel LLC (USA) [10637-7]

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

SESSION 3

LOCATION: BALLROOM LEVEL, SUN BALLROOM A TUE 1:40 PM TO 3:20 PM

Laser Diode Source Development I

Session Chair: **Christopher Ebert**, Coherent, Inc. (USA)

1:40 pm: **Narrow-band and low SWaP diodes in tough environments**, Joseph Braker, David Irwin, Lukas Gruber, Najj Barakat, Tina Guiney, Dean Stapleton, DILAS Diode Laser, Inc. (USA); Chris Ebert, Coherent, Inc. (USA) [10637-8]

2:00 pm: **Auto-locking diode laser system for lidar and magnetometric applications**, Alexander Pouliot, Hermina C. Beica, York Univ. (Canada); Adam Carew, Fluidigm Canada, Inc. (Canada); Andrew Vorozcovs, InvoDane Engineering Ltd. (Canada); Gehrig Carlse, York Univ. (Canada); Brynle Barrett, Institut d'Optique Graduate School (France) [10637-9]

2:20 pm: **Band I DIRCM laser based on GaSb direct diode technology**, Edgaras Dvinelis, Greta Naujokaite, Mindaugas Greibus, Donatas Buivydas, Augustinas Trinkunas, Kristijonas Vizbaras, Augustinas Vizbaras, Brolis Semiconductors UAB (Lithuania) [10637-10]

2:40 pm: **Thermal imaging of back-irradiance in high-power laser diodes**, Chen Li, Kevin Pipe, Univ. of Michigan (USA); Steve Smith, Jason Helmrich, Devin Crawford, Prabhu Thiagarajan, Lasertel, Inc. (USA); David Pope, Larry Platz, Matthew Boisselle, Mike Runkel, Robert Deri, Paul Leisher, Lawrence Livermore National Lab. (USA) [10637-11]

3:00 pm: **High-temperature diode laser pumps for low SWaP directed energy lasers**, Manoj Kanskar, Ling Bao, Zhigang Chen, Mark DeVito, Mike Grimshaw, Xinguo Guan, Marty Hemenway, Rob Martinsen, Wolfram Urbanek, Jim Zhang, Shiguo Zhang, nLIGHT, Inc. (USA) [10637-12]

Coffee Break Tue 3:20 pm to 3:50 pm

SESSION 4

LOCATION: BALLROOM LEVEL, SUN BALLROOM A TUE 3:50 PM TO 4:50 PM

Laser Diode Source Development II

Session Chair: **Christopher Ebert**, Coherent, Inc. (USA)

3:50 pm: **Diode arrays for high-temperature operation in military environments**, Jeremy Junghans, Ryan Feeler, Wade Collins, Northrop Grumman Cutting Edge Optronics (USA) [10637-13]

4:10 pm: **High-power and high-efficiency diode lasers emitting at 15xx nm wavelength**, Jenna Campbell, Isabella Gonzalez, Keith Guinn, Paul O. Leisher, Brian Maertz, Henry Garrett, Milan Mashanovitch, Daniel Renner, Freedom Photonics, LLC (USA) [10637-14]

4:30 pm: **Megawatt-class peak power laser diode pump sources**, John Goings, Prabhu Thiagarajan, Brian Caliva, Robert Walker, Devin Crawford, Steve Smith, Lasertel, Inc. (USA) [10637-15]

CONFERENCE 10637

SESSION 5

LOCATION: BALLROOM LEVEL, SUN BALLROOM A TUE 4:50 PM TO 5:50 PM

Fiber Lasers: Pulsed

Session Chair: **Mark Dubinskii**, U.S. Army Research Lab. (USA)

4:50 pm: **Design trades for optimized second harmonic conversion efficiency of high-peak power Er: fiber source**, Julia R Limongelli, Katherine Snell, Andrew Radl, Erik Spahr, Scott D. Setzler, BAE Systems (USA) [10637-16]

5:10 pm: **700 μ J, 100 ns 20 kHz pulses from a 1.5 m Thulium-doped fiber amplifier**, Ali Q. Abdulfattah, Alex Sincore, Joshua Bradford, Nathan Bodnar, Justin Cook, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Lawrence Shah, Lumina Technologies, Inc. (USA); Martin Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10637-17]

5:30 pm: **High-energy wavelength tunable dual-channel Tm:YLF laser**, Evan R. Hale, Ivan Divliansky, Leonid Glebov, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10637-18]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Performance improvement of broadly tunable InGaAsP/InP asymmetric multiple quantum well laser diodes: Doping effect and thermal stability, Hesham M. Enshasy, King Faisal Univ. (Saudi Arabia) [10637-38]

Deep ultraviolet Raman spectroscopy for eyesafe standoff chemical threat detection, Justin Cooper, Andor Technology Ltd. (USA) [10637-39]

Characterization of laser propagation over a long path through atmospheric turbulence, Diego Lozano, Vinod Kumar, The Univ. of Texas at El Paso (USA); V.S. Rao Gudimetla, Air Force Research Lab. (USA) . [10637-42]

Measurement of potassium 5P, 4D5/2 and 6S1/2 level relaxation cross-sections induced by methane, Matthew D. Rotondaro, Boris V. Zhdanov, Michael K. Shaffer, Randall J. Knize, U.S. Air Force Academy (USA) [10637-43]

Towards high-power bound state in continuum lasers, Wanwoo Noh, Ashok Kodigala, Abdoulaye Ndao, Babak Bahari, Chi-Hsin Huang, Boubacar Kanté, Univ. of California, San Diego (USA) [10637-44]

Mid-IR unstable resonator diode lasers, Chi Yang, Alan H Paxton, Chunte A Lu, Timothy C Newell, Ron Kaspi, Air Force Research Lab (USA) [10637-46]

WEDNESDAY 18 APRIL

SESSION 6

LOCATION: BALLROOM LEVEL, SUN BALLROOM A WED 8:40 AM TO 10:00 AM

Laser Systems, Laser Materials, and Applications I

Session Chair: **Scott Christensen**, IPG Photonics Corp. (USA)

8:40 am: **The High Energy Laser Joint Technology Office: A historical perspective**, Lawrence E. Grimes, High Energy Laser Joint Technology Office (USA) [10637-19]

9:00 am: **Particulate and contamination-induced failure of high power optics**, Joseph J. Talghader, Univ. of Minnesota, Twin Cities (USA) . [10637-20]

9:20 am: **Growth of crystalline claddings on single crystal fiber**, L. Brandon Shaw, Shyam S. Bayya, Woohong Kim, Jason D. Myers, U.S. Naval Research Lab. (USA); Charles G. Askins, John R. Peele, Daniel L. Rhonehouse, Rajesh Thapa, Sotera Defense Solutions, Inc. (USA); Daniel Gibson, Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA) [10637-21]

9:40 am: **Spinel window technology development for HEL application**, Shyam S. Bayya, Woohong Kim, Guillermo Villalobos, Michael Hunt, U.S. Naval Research Lab. (USA); Ishwar D. Aggarwal, KEYW Corp. (USA); Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA); Bryan Sadowski, KEYW Corp. (USA) [10637-22]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 7

LOCATION: BALLROOM LEVEL, SUN BALLROOM A WED 11:00 AM TO 12:00 PM

Laser Systems, Laser Materials, and Applications II

Session Chair: **Scott Christensen**, IPG Photonics Corp. (USA)

11:00 am: **Optical ceramic materials for high-energy lasers at NRL**, Woohong Kim, Colin C. Baker, Guillermo Villalobos, L. Brandon Shaw, Shyam S. Bayya, Jesse A. Frantz, Michael Hunt, U.S. Naval Research Lab. (USA); Bryan Sadowski, Sotera Defense Solutions, Inc. (USA); Steven R. Bowman, U.S. Naval Research Lab. (USA); Ashley A. Burdett, Univ. Research Foundation (USA); E. Joseph Friebele, Ishwar D. Aggarwal, Sotera Defense Solutions, Inc. (USA); Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA) [10637-23]

11:20 am: **Fabrication of magneto-optic YIG ceramics**, Clay French, Matthew Julian, Roman I. Grigorev, Axel Schülzgen, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10637-24]

11:40 am: **Low excess noise InAs/AISb type II superlattice avalanche photodiodes**, Seunghyun Lee, Alireza Kazemi, Sri Harsha Kodati, Sen Mathews, Theodore J. Ronningen, The Ohio State Univ. (USA); Martin Winslow, Christoph H. Grein, Univ. of Illinois at Chicago (USA); Joe C. Campbell, Univ. of Virginia (USA); Sanjay Krishna, The Ohio State Univ. (USA) [10637-25]

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

SESSION 8

LOCATION: BALLROOM LEVEL, SUN BALLROOM A WED 1:30 PM TO 2:10 PM

Laser Systems, Laser Materials, and Applications III

Session Chair: **Scott Christensen**, IPG Photonics Corp. (USA)

1:30 pm: **Large-aperture, high-precision, high-speed potassium tantalate niobate (KTN) beam deflectors and their applications to high-energy lasers**, Shizhuo Yin, Ju-Hung Chao, Wenbin Zhu, Chang-Jiang Chen, The Pennsylvania State Univ. (USA); Mark Dubinskii, Robert Hoffman, U.S. Army Research Lab. (USA) [10637-26]

1:50 pm: **Design and performance evaluation of a SWaP-optimized short-range fully fibered monostatic laser rangefinder in various climatic conditions**, Gwenn Pallier, SensUp (France); Guillaume Canat, Keopsys SA (France); Alexandre Burini, Augustin Portalis, SensUp (France); Frederic Chiquet, Keopsys SA (France); Patrick Auffray, SensUp (France); Marc Le Flohic, Keopsys SA (France) [10637-27]

SESSION 9

LOCATION: BALLROOM LEVEL, SUN BALLROOM A WED 2:10 PM TO 5:00 PM

Mid-IR Lasers and Laser Materials

Session Chair: **Patrick A. Berry**, Air Force Research Lab. (USA)

2:10 pm: **Chalcogenide fibers for improved reliability of active infrared sensing systems**, Justin Cook, Alex Sincore, Felix Tan, Ahmed El Halawany, Anthony Riggins, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Lawrence Shah, Luminar Technologies, Inc. (USA) and CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Ayman F. Abouraddy, Martin Richardson, Kenneth L. Schepler, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . [10637-28]

2:30 pm: **Status of CdSiP2 development for scaling mid-infrared laser power**, F. Kenneth Hopkins, Carl M. Liebig, Shekhar Guha, Kent L. Averett, Air Force Research Lab. (USA); Kevin T. Zawilski, Peter G. Schunemann, BAE Systems (USA); Elizabeth M. Scherrer, Nancy C. Giles, Air Force Institute of Technology (USA); Larry E. Halliburton, West Virginia Univ. (USA) . . [10637-29]

2:50 pm: **Recent progress in mid-IR materials and lasers based on Cr and Fe doped chalcogenides**, Sergey B. Mirov, The Univ. of Alabama at Birmingham (USA) and IPG Photonics - Mid-Infrared Lasers (USA); Igor Moskalev, Sergey Vasilyev, Viktor Smolski, Mike Mirov, IPG Photonics - Mid-Infrared Lasers (USA); Vladimir Fedorov, Dmitri Martyshev, The Univ. of Alabama at Birmingham (USA) and IPG Photonics - Mid-Infrared Lasers (USA); Andrey Zakrevsky, IPG Photonics - Mid-Infrared Lasers (USA); Ozarfar Gafarov, The Univ. of Alabama at Birmingham (USA); Jeremy Peppers, IPG Photonics - Mid-Infrared Lasers (USA); Valentin Gapontsev, IPG Photonics Corp. (USA) [10637-30]

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

3:40 pm: **Performance evaluation of CO₂: CdTe as an optical gain medium**, Eric J. Turner, KBRWyle (USA) and Air Force Research Lab. (USA); Jonathan Evans, Air Force Research Lab. (USA) [10637-31]

4:00 pm: **Infrared absorption and fluorescence properties of Holmium doped Potassium Lanthanum Chloride**, Ei Brown, Zackery D. Fleischman, Larry D. Merkle, U.S. Army Research Lab. (USA); Emmanuel Rowe, Arnold Burger, Fisk Univ. (USA); Stephen Payne, Lawrence Livermore National Lab. (USA); Mark Dubinskiy, U.S. Army Research Lab. (USA) [10637-32]

4:20 pm: **A 4.1 micron emitting cryogenically-cooled mode-locked Fe:ZnSe laser**, Andrew P. Ongstad, Andreas Schmitt-Sody, Air Force Research Lab. (USA); Evan M. Lang, EMCORE Corp. (USA); Erica Hoeffner, Leidos, Inc. (USA) [10637-33]

4:40 pm: **Dual-phase Er:Y2O3/MgO nanocomposites for mid-Infrared solid state lasers**, Zackery D. Fleischman, Victoria L. Blair, Larry D. Merkle, Nicholas Ku, U.S. Army Research Lab. (USA) [10637-34]

SESSION 10

LOCATION: BALLROOM LEVEL, SUN BALLROOM A WED 5:00 PM TO 6:00 PM

Bulk Solid State Lasers and DPAL

Session Chair: **Albert A. Ogloza**,
Naval Surface Warfare Ctr. Port Hueneme Div. (USA)

5:00 pm: **Potassium diode pumped alkali laser performance study using He, Ar, CH₄ and C₂H₆ as buffer gas**, Boris V. Zhdanov, Matthew D. Rotondaro, Michael K. Shaffer, Randall J. Knize, U.S. Air Force Academy (USA) [10637-35]

5:20 pm: **High brightness, sub-nanosecond, and compact passively Q-switched laser with intracavity volume Bragg gratings**, Evan R. Hale, Ivan Divliansky, Leonid Glebov, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10637-36]

5:40 pm: **Efficient room temperature Ho-doped fluoride lasers**, Bradley DeShano, KBRWyle (USA); Gary Cook, Air Force Research Lab. (USA); Tom Harris, Azimuth Corp. (USA) [10637-37]

CONFERENCE 10638

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3

Monday–Thursday 16–19 April 2018 • Proceedings of SPIE Vol. 10638

Ultrafast Bandgap Photonics III

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

Program Committee: **Jason M. Auxier**, U.S. Naval Research Lab. (USA); **Sophia Economou**, Virginia Polytechnic Institute and State Univ. (USA); **Matt W. Graham**, Oregon State Univ. (USA); **Stefan Kaiser**, Max-Planck-Institut für Festkörperforschung (Germany); **Stefan Mathias**, Georg-August-Univ. Göttingen (Germany); **Igor Pastirk**, Coherent, Inc. (USA); **Joseph R. Peñano**, U.S. Naval Research Lab. (USA)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 MON 8:00 AM TO 9:15 AM

Metastability of Transient States

Session Chair: **Rolf Binder**,
College of Optical Sciences, The Univ. of Arizona (USA)

8:00 am: **Ultrafast bandgap photonics: metastability of transient states** (*Invited Paper*), Michael K. Rafailov, Univ. of Alberta (Canada) [10638-1]

8:25 am: **Coherent order parameter oscillations in the ground state of the photo-excited excitonic insulator Ta_2NiSe_5** (*Invited Paper*), Stefan Kaiser, Daniel Werdehausen, Steinn Agustsson, MinJae Kim, Parmida Shabestari, Tomohiro Takayama, Hidenori Takagi, Max-Planck-Institut für Festkörperforschung (Germany) [10638-2]

8:50 am: **A momentum-space view on ultrafast band-gap dynamics using HHG time-, spin-, and angle-resolved photoemission spectroscopy** (*Invited Paper*), Stefan Mathias, Georg-August-Univ. Göttingen (Germany) [10638-3]

SESSION 2

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 MON 9:15 AM TO 11:45 AM

Ultrafast Carrier Dynamics

Session Chair: **Stefan Kaiser**, Max-Planck-Institut für Festkörperforschung (Germany)

9:15 am: **Ultrafast structural dynamics in topological Weyl semimetals** (*Keynote Presentation*), Aaron M. Lindenberg, Stanford Univ. (USA) [10638-4]

9:45 am: **From stripes to excitons: ultrafast snapshots of emergent electronic and vibrational order** (*Invited Paper*), Robert A. Kaindl, Lawrence Berkeley National Lab (USA) [10638-5]

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

10:30 am: **Theory of nonresonant pump/probe electronic Raman scattering** (*Invited Paper*), James Freericks, Georgetown Univ. (USA); Oleh Matveev, Andriy Shvaika, Institute for Condensed Matter Physics (Ukraine); Thomas Devereaux, Stanford Univ. (USA) and SLAC National Accelerator Lab. (USA) [10638-6]

10:55 am: **Ab-initio simulations for ultrashort laser-pulse irradiation on nanomaterials** (*Invited Paper*), Kazuhiro Yabana, Univ. of Tsukuba (Japan) [10638-7]

11:20 am: **Quantum chaos and quantum Lyapunov exponent in optically driven “Floquet Materials”** (*Invited Paper*), Victor Galitski, Univ. of Maryland, College Park (USA) [10638-8]

Lunch Break Mon 11:45 am to 12:45 pm

SESSION 3

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 MON 12:45 PM TO 2:05 PM

Ultrafast Carrier Dynamics: Quantum Dots

Session Chair: **Jason M. Auxier**, U.S. Naval Research Lab. (USA)

12:45 pm: **Auger interactions and solar photoconversion with engineered quantum dots** (*Keynote Presentation*), Victor I. Klimov, Los Alamos National Lab. (USA) [10638-9]

1:15 pm: **Time-resolved optical studies of Perovskite polycrystalline films, single crystals, and their surfaces** (*Invited Paper*), Matthew C. Beard, National Renewable Energy Lab. (USA) [10638-10]

1:40 pm: **Electronic and optical properties of lead halide perovskite nanocrystals** (*Invited Paper*), Alexander L. Efros, U.S. Naval Research Lab. (USA) [10638-11]

SESSION 4

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 MON 2:05 PM TO 4:30 PM

Ultrafast Dynamics: Lowering the Dimensions

Session Chairs: **Jason M. Auxier**, U.S. Naval Research Lab. (USA); **Igor Pastirk**, Sydor Technologies (USA)

2:05 pm: **Ultrafast photocurrent generation in van der Waals heterostructures** (*Invited Paper*), Sufei Shi, Rensselaer Polytechnic Institute (USA) [10638-13]

2:30 pm: **Metastable interlayer electrons in twisted and stacked van der Waals materials** (*Invited Paper*), Matt W. Graham, Oregon State Univ. (USA) [10638-14]

Coffee Break. Mon 2:55 pm to 3:15 pm

3:15 pm: **Hydrogen-assisted graphene transfer: surface engineering for chemical, electronic, and biological applications** (*Invited Paper*), Keith Whitener, Woo-Kyung Lee, Thomas O’Shaughnessy, Jeremy T. Robinson, Paul E. Sheehan, U.S. Naval Research Lab. (USA) [10638-15]

3:40 pm: **Growth, characterization, and ultrafast carrier dynamics of WS_2 /graphene heterostructures** (*Invited Paper*), Stiven Forti, Center for Nanotechnology Innovation IIT@NEST (Italy); Antonio Rossi, Ctr. for Nanotechnology Innovation IIT@NEST (Italy); Camilla Coletti, Center for Nanotechnology Innovation IIT@NEST (Italy); Isabella Gierz, Sven Aeschlimann, Razvan Krause, Max Planck Institute for the Structure and Dynamics of Matter (Germany) [10638-16]

4:05 pm: **Ultrafast photonics in coherently coupled III-V semiconductor nanostructures** (*Invited Paper*), Mirco Kolarczik, Bastian Herzog, Nicolai B. Große, Nina Owschimikow, Ulrike Woggon, Technische Univ. Berlin (Germany) [10638-17]

SYMPOSIUM-WIDE PLENARY SESSION LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. “Trey” Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6–7 for details.

TUESDAY 17 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 TUE 8:00 AM TO 10:10 AM

Ultrafast Dynamics of Solar Materials

Session Chair: **Matt W. Graham**, Oregon State Univ. (USA)

8:00 am: **Ultrafast dynamics in lead halide perovskites probed via two-dimensional electronic spectroscopy** (*Keynote Presentation*), Carlos Silva, Georgia Tech Research Institute (USA) [10638-18]

8:30 am: **Influence of Rashba splitting on carrier dynamics in organic-inorganic perovskites** (*Invited Paper*), Kimberley C. Hall, Seth B. Todd, Ajan Ramachandran, Charlotte Clegg, Drew B. Riley, Ali Binai-Motlagh, Dalhousie Univ. (Canada); Constantinos C. Stoumpos, Northwestern Univ. (USA); Samuel A. March, Dalhousie Univ. (Canada); Mercouri G. Kanatzidis, Northwestern Univ. (USA); Ian G. Hill, Dalhousie Univ. (Canada) [10638-19]

8:55 am: **Nonlinear spectroscopy in perovskite quantum dots** (*Invited Paper*), Gabriel Nagamine, Luiz Gustavo Bonato, Juan Andrés Castañeda, Emre Yassitepe, Ana Flavia Nogueira, Carlos H. Brito Cruz, Lazaro Padilha, Univ. Estadual de Campinas (Brazil) [10638-20]

9:20 am: **Probing the emerging self-organizing behavior and metastability in ultrafast photoinduced phase transitions in correlated electron crystals** (*Invited Paper*), Chong-Yu Ruan, Faran Zhou, Joseph Williams, Michigan State Univ. (USA) [10638-21]

9:45 am: **Shedding light on surface effects: nonlinear probes of complex materials** (*Invited Paper*), Tessa R. Calhoun, Brianna R. Watson, The Univ. of Tennessee Knoxville (USA); Benjamin Doughty, Oak Ridge National Lab. (USA) [10638-22]

Coffee Break and Dedicated Exhibition Time Tue 10:10 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 TUE 11:00 AM TO 12:20 PM

Ultrafast Dynamics: 2D

Session Chair: **Matt W. Graham**, Oregon State Univ. (USA)

11:00 am: **Ultrafast carrier transport in van der Waals heterostructures** (*Keynote Presentation*), Hui Zhao, The Univ. of Kansas (USA) [10638-23]

11:30 am: **Optical 2D coherent spectroscopy of valley dynamics in monolayer transition metal dichalcogenide** (*Invited Paper*), Hebin Li, Florida International Univ. (USA) [10638-24]

11:55 am: **Long-lived spin/valley dynamics of resident electrons and holes in 2D semiconductors** (*Invited Paper*), Luyi Yang, Univ. of Toronto (Canada) [10638-25]

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

SESSION 7

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 TUE 1:20 PM TO 3:35 PM

Transient Metamaterials

Session Chair: **Matt W. Graham**, Oregon State Univ. (USA)

1:20 pm: **Terahertz-light quantum-tuning of metastable correlated phases** (*Keynote Presentation*), Ilias E. Perakis, The Univ. of Alabama at Birmingham (USA); Martin Mootz, The Univ. of Alabama (USA); Jigang Wang, Iowa State Univ. of Science and Technology (USA) and Ames Lab. (USA) [10638-26]

1:50 pm: **Quantum Terahertz lightwave electronics** (*Invited Paper*), Jigang Wang, Iowa State Univ. of Science and Technology (USA) [10638-27]

2:15 pm: **Depth-dependent studies of electron and phonon ultrafast dynamics in femtosecond laser induced transient states of matter** (*Keynote Presentation*), Norman Tolk, Halina Krzyzanowska, Zina J. Cinkler, Joy Garnett, Andrey Baydin, Jimmy L. Davidson, Vanderbilt Univ. (USA) [10638-28]

2:45 pm: **Strained relations: optical tuning of electronic dynamics in nanoparticle and molecular systems using ultrafast spectroscopy** (*Invited Paper*), Vanessa Huxter, The Univ. of Arizona (USA) [10638-29]

3:10 pm: **Time-resolved near-field investigation of the insulator to metal transition in vanadium dioxide** (*Invited Paper*), Aaron Sternbach, Columbia University (USA) [10638-30]

Coffee Break Tue 3:35 pm to 4:05 pm

SESSION 8

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 TUE 4:05 PM TO 6:40 PM

Transient Optic Effects

Session Chair: **Jason M. Auxier**, U.S. Naval Research Lab. (USA)

4:05 pm: **Spin and orbital-angular momentum effects in controllable polariton patterns** (*Keynote Presentation*), Rolf Binder, College of Optical Sciences, The Univ. of Arizona (USA); Samuel M. H. Luk, The Univ. of Arizona (USA); Nai H. Kwong, College of Optical Sciences, The Univ. of Arizona (USA); Przemyslaw Lewandowski, Stefan Schumacher, Univ. Paderborn (Germany); Omblin Lafont, Ctr. National de la Recherche Scientifique (France) and Ecole Normale Supérieure (France); Emmanuel Baudin, Ecole Normale Supérieure (France) and Ctr. National de la Recherche Scientifique (France); Jerome Tignon, Ecole Normale Supérieure (France) and Ctr. National de la Recherche Scientifique (France); Chris K. P. Chan, Pui-tang Leung, The Chinese Univ. of Hong Kong (Hong Kong, China) [10638-31]

4:35 pm: **Extremely nondegenerate nonlinear refraction and dispersion in semiconductors** (*Invited Paper*), Peng Zhao, David Hagan, Eric Van Stryland, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10638-32]

5:00 pm: **Measurement of the ultrafast dynamics of nonlinear refraction and absorption of highly doped semiconductors at epsilon-near-zero** (*Invited Paper*), Sepehr Benis, Peng Zhao, David J. Hagan, Eric W. Van Stryland, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10638-33]

5:25 pm: **Nonlinear chirped soliton: self-formation at Gaussian pulse propagation in a medium with non-instantaneous nonlinear response** (*Invited Paper*), Vyacheslav A. Trofimov, Tatiana Lysak, Irina Zakharova, M.V. Lomonosov Moscow State Univ. (Russian Federation) [10638-34]

5:50 pm: **Ultrafast carrier dynamics and reststrahlen band tuning in wide bandgap semiconductors** (*Invited Paper*), Jeffrey C. Owrutsky, Roderick Davidson III, Adam D. Dunkelberger, Ioannis Chatzakis, David Storm, Scott Katzer, Brad B. Pate, Tatyana Feygelson, Daniel Ratchford, U.S. Naval Research Lab. (USA); Joshua D. Caldwell, Vanderbilt Univ. (USA) [10638-35]

6:15 pm: **Ultrafast dynamics of semiconductor quantum dots relevant to solar fuels production** (*Invited Paper*), Todd D. Krauss, Nicole Cogan, Cunming Liu, Fen Qiu, Rebeckah Burke, Univ. of Rochester (USA) [10638-12]

WEDNESDAY 18 APRIL

SESSION 9

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 WED 8:00 AM TO 10:10 AM

Ultrafast Magnetism: Spin and Orbital Control

Session Chair: **Stefan Mathias**, Georg-August-Univ. Göttingen (Germany)

8:00 am: **Non-equilibrium magnon condensation and magnetic pattern formation** (*Keynote Presentation*), Hermann A. Dürr, SLAC National Accelerator Lab. (USA) and Uppsala Univ. (Sweden) [10638-36]

8:30 am: **Terahertz magnon-polaritons in antiferromagnets** (*Invited Paper*), Rostislav V. Mikhaylovskiy, Radboud Univ. (Netherlands) [10638-37]

8:55 am: **Transient enhancement of the charge density wave amplitude in elemental chromium** (*Invited Paper*), Andrej Singer, Cornell Univ. (USA); Sheena Patel, Eric Fullerton, Oleg Shpyrko, Univ. of California, San Diego (USA) [10638-38]

9:20 am: **Ultrafast laser-induced spin dynamics in ultrathin metallic films in vicinity of spin reorientation transition** (*Invited Paper*), Alexandra Kalashnikova, Ioffe Institute (Russian Federation) [10638-39]

9:45 am: **Heat-induced and coherent effects in the magnetization dynamics of ferromagnets and ferrimagnets** (*Invited Paper*), Hans Christian Schneider, Technische Univ. Kaiserslautern (Germany) [10638-40]

Coffee Break and Dedicated Exhibition Time Wed 10:10 am to 10:40 am

CONFERENCE 10638

SESSION 10

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 WED 10:40 AM TO 12:25 PM

Optical Control of Spin in Solids

Session Chair: **Sophia E. Economou**,
Virginia Polytechnic Institute and State Univ. (USA)

10:40 am: **Picosecond pulse shaping of single photons using quantum dots** (*Keynote Presentation*), Sam G. Carter, Brennan C. Pursley, Bumsu Lee, U.S. Naval Research Lab. (USA); Sophia E. Economou, Virginia Polytechnic Institute and State Univ. (USA); Michael K. Yakes, Allan S. Bracker, Dan Gammon, U.S. Naval Research Lab. (USA) [10638-41]

11:10 am: **Coherent optical control of single spin qubits in diamond** (*Invited Paper*), Brian Zhou, The Univ. of Chicago (USA); Christopher Yale, The Univ. of Chicago (USA) and Sandia National Labs. (USA); F. J. Heremans, Paul Jerger, The Univ. of Chicago (USA); Alexandre Baksic, Hugo Ribeiro, McGill Univ. (Canada); Aashish Clerk, The Univ. of Chicago (USA) and McGill Univ. (Canada); Adrian Auer, V. O. Shkolnikov, Guido Burkard, Univ. Konstanz (Germany); David Awschalom, The Univ. of Chicago (USA) [10638-42]

11:35 am: **HD quantum optics** (*Rising Researcher Presentation*) (*Invited Paper*), Matthew Reichert, Hugo Defienne, Jason W. Fleischer, Princeton Univ. (USA) [10638-43]

12:00 pm: **Generating parametric oscillation with third-order nonlinear media** (*Invited Paper*), Paulo A. Nussenzeveig, Marcelo Martinelli, Univ. de Sao Paulo (Brazil); Carlos González, Álvaro Montaña, Univ. de Sao Paulo (Brazil) [10638-44]

Lunch/Exhibition Break Wed 12:25 pm to 1:25 pm

SESSION 11

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 WED 1:25 PM TO 3:25 PM

Optics of Topological Materials

Session Chair: **Sophia E. Economou**,
Virginia Polytechnic Institute and State Univ. (USA)

1:25 pm: **Graphene/semiconductor hybrids: optoelectronic properties and applications** (*Invited Paper*), Yong P. Chen, Purdue Univ. (USA) [10638-45]

1:45 pm: **Plasmonic nanocavities for ultrafast photonics** (*Invited Paper*), Maiken H. Mikkelsen, Duke Univ. (USA) [10638-46]

2:10 pm: **Optically active quantum dots in atomically thin FETs** (*Invited Paper*), Ajit Srivastava, Xin Lu, Xiaotong Chen, Sudipta Dubey, Qiang Yao, Emory Univ. (USA) [10638-47]

2:35 pm: **Tuning properties of deep defects in hexagonal boron nitride layers: an ab-initio study** (*Invited Paper*), Pratibha Dev, Olasunbo Z. Farinre, Howard Univ. (USA); Evan C. Folk, Univ. of Nebraska at Kearney (USA) [10638-48]

3:00 pm: **Harmonic generation via excitation of surface states formed from spatially separated electrons and holes in nanocomposites** (*Invited Paper*), Oleg Khasanov, Olga M. Fedotova, Grigory Rusetsky, Scientific-Practical Materials Research Ctr. (Belarus); Tatiana Smirnova, International Sakharov Environmental Univ. (Belarus); Vladimir Gayvoronsky, Institute of Physics (Ukraine); Sergey Pokutnyi, The National Academy of Sciences of Ukraine (Ukraine); Eugenijus Gaizauskas, Vilnius Univ. (Lithuania) . . [10638-49]

Coffee Break Wed 3:25 pm to 3:55 pm

SESSION 12

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 WED 3:55 PM TO 6:40 PM

Lasers for Ultrafast Dynamic Control

Session Chair: **Igor Pastirk**, Sydor Technologies (USA)

3:55 pm: **Singly- and doubly-resonant femtosecond optical parametric oscillators for precision spectroscopy from the near- to mid-infrared** (*Keynote Presentation*), Derryck T. Reid, Heriot-Watt Univ. (United Kingdom) [10638-50]

4:25 pm: **Femtosecond mid-IR laser sources based on Cr²⁺:ZnS oscillators and sub-harmonic OPOs** (*Invited Paper*), Sergey B. Mirov, The Univ. of Alabama at Birmingham (USA) and IPG Photonics Corp. (USA); Sergey Vasilyev, IPG Photonics - Mid-Infrared Lasers (USA); Viktor Smolski, Jeremy Peppers, Mike Mirov, IPG Photonics Corp. (USA); Andrey Muraviev, Konstantin Vodopyanov, Univ. of Central Florida (USA); Valentin Gapontsev, Igor Moskalev, IPG Photonics Corp. (USA) [10638-51]

4:50 pm: **Modelocked thin-disk lasers and their potential for high-power THz generation** (*Keynote Presentation*), Frank Meyer, Negar Hekmat, Felix Fobbe, Samira Mansourzadeh, Clara J. Saraceno, Ruhr-Univ. Bochum (Germany) [10638-52]

5:20 pm: **Novel applications of tabletop-scale extreme-UV and x-ray sources** (*Keynote Presentation*), Henry C. Kapteyn, Margaret M. Murnane, JILA, Univ. of Colorado Boulder (USA) and Kapteyn-Murnane Labs., Inc. (USA) [10638-53]

5:50 pm: **Nonlinear spectroscopy in the extreme ultraviolet region** (*Invited Paper*), Lap Van Dao, Swinburne Univ. of Technology (Australia) . . [10638-54]

6:15 pm: **Solid-state high-order harmonics driven by long-wavelength lasers** (*Invited Paper*), Michael Chini, Univ. of Central Florida (USA) . [10638-55]

THURSDAY 19 APRIL

SESSION 13

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 THU 8:00 AM TO 10:20 AM

Propagation of Intense Ultrashort Pulses: Atmosphere

Session Chair: **Joseph R. Peñano**, U.S. Naval Research Lab. (USA)

8:00 am: **Simulation of LWIR TW ultrashort pulses over kilometer ranges in the atmosphere** (*Keynote Presentation*), Jerome V. Moloney, Paris Panagiotopoulos, Phil Rosenow, Miroslav Kolesik, College of Optical Sciences, The Univ. of Arizona (USA); Stephan W. Koch, Philipps-Univ. Marburg (Germany) [10638-56]

8:30 am: **Atmospheric propagation and impact on solids of short-intense laser pulses** (*Keynote Presentation*), Jean-Claude M. Diels, Ali Rastegari, Brian Kamer, The Univ. of New Mexico (USA); Matthias Lenzner, Lenzner Research, LLC (USA); Kristen Peterson, Southwest Sciences, Inc. (USA); Ladan Arissian, The Univ. of New Mexico (USA) [10638-57]

9:00 am: **Generation of a centimeter diameter self-guided light channel in air using a TW CO₂ laser** (*Invited Paper*), Sergei Tochitsky, Eric Welch, Chan Joshi, Univ. of California, Los Angeles (USA); Misha Polynskiy, Igor Pogorelsky, Brookhaven National Lab. (USA); Jerome Moloney, The Univ. of Arizona (USA) [10638-58]

9:20 am: **The effect of noise on atmospheric laser propagation** (*Invited Paper*), Joshua Isaacs, Phillip Sprangle, Univ. of Maryland, College Park (USA) [10638-59]

9:40 am: **Self-channeling of ultrashort laser pulses in distributed, long-range atmospheric turbulence** (*Invited Paper*), Michael H. Helle, Gregory DiComo, U.S. Naval Research Lab. (USA); Samantha Gregory, The Univ. of Alabama in Huntsville (USA); Aliaksandr Mamonau, U.S. Naval Research Lab. (USA); Scott Melis, Georgetown Univ. (USA); Richard Fischer, Dmitri Kaganovich, U.S. Naval Research Lab. (USA); Joseph Penano, U. S. Naval Research Lab. (USA) [10638-60]

10:00 am: **Ultrafast high-power mid-IR OPCPA** (*Invited Paper*), Robert Max Schwartz, Daniel Woodbury, Howard M. Milchberg, Univ. of Maryland, College Park (USA) [10638-72]

Coffee Break Thu 10:20 am to 10:45 am

SESSION 14

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 THU 10:45 AM TO 12:55 PM

Propagation of Intense Ultrashort Pulses: Solids

Session Chair: **Joseph R. Peñano**, U.S. Naval Research Lab. (USA)

10:45 am: **Laser beam filamentation: Overview and recent results** (*Keynote Presentation*), Robert W. Boyd, Univ. of Ottawa (Canada). [10638-61]

11:15 am: **Spatio-temporal localization of powerful femtosecond pulses in Kerr media and light bullet regimes** (*Invited Paper*), Olga M. Fedotova, National Academy of Sciences of Belarus (Belarus); Oleg Khasanov, Scientific-Practical Materials Research Ctr. (Belarus); Grigory Rusetsky, National Academy of Sciences of Belarus (Belarus); Tatiana Smirnova, International Sakharov Environmental Univ. (Belarus); Viktor Kadan, The Institute of Physics (Ukraine); Eugenijus Gaižauskas, Vilnius Univ. (Lithuania) [10638-62]

11:40 am: **Ultrafast laser induced hot carriers and transport** (*Invited Paper*), Lay Kee Ang, Singapore Univ. of Technology & Design (Singapore) [10638-63]

12:05 pm: **Surface structuring with mid-IR femtosecond laser pulses** (*Invited Paper*), Enam A. Chowdhury, Noah Talisa, Kevin Werner, Shler Irani, Drake Austin, The Ohio State Univ. (USA) [10638-64]

12:30 pm: **Generation of high-average power, ultra-broadband, infrared radiation** (*Invited Paper*), Zachary Epstein, Univ. of Maryland, College Park (USA); Bahman Hafizi, Joseph Peñano, U.S. Naval Research Lab. (USA); Phillip Sprangle, Univ. of Maryland, College Park (USA) [10638-65]

Lunch Break Thu 12:55 pm to 2:00 pm

SESSION 15

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 THU 2:00 PM TO 5:35 PM

Frequency Comb:

Concurrent-Joint Session with conferences 10639 and 10638

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

2:00 pm: **Massively parallel sensing of trace molecules and their isotopologues with broadband mid-IR frequency combs produced via optical subharmonic generation** (*Keynote Presentation*), Konstantin L. Vodopyanov, Andrey Muraviev, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Zachary Loparo, Univ. of Central Florida (USA); Sergey Vasilyev, IPG Photonics - Mid-Infrared Lasers (USA); Sergey B. Mirov, The Univ. of Alabama at Birmingham (USA) . . [10639-102]

2:30 pm: **Optical frequency comb stabilization of a gigahertz semiconductor disk laser** (*Keynote Presentation*), Nayara Jornod, Kutan Gürel, Valentin J. Wittwer, Pierre Brochard, Sargis Hakobyan, Stéphane Schilt, Univ. de Neuchâtel (Switzerland); Dominik Waldburger, Ursula Keller, ETH Zurich (Switzerland); Thomas Südmeyer, Univ. de Neuchâtel (Switzerland) [10638-71]

3:00 pm: **Towards independent controls of optical comb frequencies and comb spacing of 3-section AlGaInAs multiple quantum-well laser diodes** (*Invited Paper*), Abdullah M. Zaman, Univ. of Central Florida (USA); Peter J. Delfyett, Mina Bayat, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10638-66]

Coffee Break Thu 3:25 pm to 3:55 pm

3:55 pm: **Stable electro-optic frequency comb generation using an ultrahigh finesse etalon filtered optoelectronic oscillator** (*Invited Paper*), Michael E. Plascak, Ricardo Bustos Ramirez, Peter J. Delfyett Jr., CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10638-67]

4:20 pm: **Reduction of axial mode linewidth and stabilization of the repetition rate of a chip-scale high-speed MLL via COEO multi-tone injection locking** (*Invited Paper*), Ricardo Bustos Ramirez, Michael E. Plascak, Kristina Bagnell, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Ashish Bhardwaj, James Ferrara, Gloria E. Hoefler, Fred A. Kish, Infinera Corp. (USA); Ming C. Wu, Univ. of California, Berkeley (USA); Peter J. Delfyett, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10638-68]

4:45 pm: **Standoff detection from diffusely scattering surfaces using dual quantum cascade laser comb spectroscopy** (*Invited Paper*), Joel M. Hensley, Justin M. Brown, Mark G. Allen, Physical Sciences Inc. (USA); Markus Geiser, Pitt Allmendinger, Markus Mangold, Andreas Hugi, IRsweep GmbH (Switzerland); Pierre Juoy, Jérôme Faist, ETH Zurich (Switzerland) [10638-69]

5:10 pm: **Self-starting harmonic frequency comb generation in quantum cascade lasers** (*Invited Paper*), Marco Piccardo, Dmitry Kazakov, Harvard Univ. (USA); Yongrui Wang, Texas A&M Univ. (USA); Paul Chevalier, Harvard Univ. (USA); Tobias S Mansuripur, Pendar Technologies (USA); Kevin Lascola, Thorlabs Quantum Electronics (USA); Henry Yuan, Joseph Kimchi, Teledyne Judson Technologies (USA); Alexey Belyanin, Texas A&M Univ. (USA); Federico Capasso, Harvard Univ. (USA) [10638-70]

CONFERENCE 10639

LOCATION: SEE INDIVIDUAL SESSIONS



Sunday–Thursday 15–19 April 2018 • Proceedings of SPIE Vol. 10639

Micro- and Nanotechnology Sensors, Systems, and Applications X

Conference Chairs: **Thomas George**, SaraniaSat Inc. (USA); **Achyut K. Dutta**, Banpil Photonics, Inc. (USA); **M. Saif Islam**, Univ. of California, Davis (USA)

Program Committee: **Roger Appleby**, Queen's Univ. Belfast (United Kingdom); **Michael P. Buric**, National Energy Technology Lab. (USA); **Richard Conroy**, National Institutes of Health (USA); **Ertugrul Cubukcu**, Univ. of Pennsylvania (USA); **Ann Darrin**, Johns Hopkins Univ. Applied Physics Lab., LLC (USA); **Nibir K. Dhar**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Wolfgang Fink**, The Univ. of Arizona (USA); **Durdu O. Guney**, Michigan Technological Univ. (USA); **Grace M. Hwang**, Johns Hopkins Univ. Applied Physics Lab., LLC (USA); **Shouleh Nikzad**, Jet Propulsion Lab. (USA); **William D. Nothwang**, U.S. Army Research Lab. (USA); **Michael K. Rafailov**, Univ. of Alberta (Canada), Univ. of Alberta (Canada); **Jhonathan P. Rojas**, King Abdullah Univ. of Science and Technology (Saudi Arabia); **Noriko Satake**, UC Davis Medical Ctr. (USA); **Brian Satterfield**, Lockheed Martin Corp. (USA); **Behrouz Shabestari**, National Institutes of Health (USA); **Carlos M. Torres Jr.**, SPAWAR Systems Ctr. Pacific (USA); **Christopher C. Wilcox**, U.S. Naval Research Lab. (USA); **Eui-Hyeok Yang**, Stevens Institute of Technology (USA)

SUNDAY 15 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, OSCEOLA 6 SUN 8:30 AM TO 10:20 AM

Hybrid Integrated Quantum Photonics

Session Chair: **Carlos M. Torres Jr.**, SPAWAR Systems Ctr. Pacific (USA)

8:30 am: **Quantum optics using quantum-dot single-photons in integrated photonic circuits** (Keynote Presentation), Anthony Bennett, Cardiff Univ. (United Kingdom) [10639-1]

9:00 am: **Quantum emitters in 2D materials** (Invited Paper), Igor Aharonovich, Univ. of Technology, Sydney (Australia) [10639-2]

9:20 am: **Cavity integrated layered material devices** (Invited Paper), Arka Majumdar, Univ. of Washington (USA) [10639-3]

9:40 am: **Controlling spin with light using nanophotonics** (Invited Paper), Edo Waks, Univ. of Maryland, College Park (USA) [10639-4]

10:00 am: **Towards scalable solid state quantum information processors for quantum communications and computing** (Invited Paper), Dirk R. Englund, Massachusetts Institute of Technology (USA) [10639-5]

Coffee Break Sun 10:20 am to 10:40 am

SESSION 2

LOCATION: BALLROOM LEVEL, OSCEOLA 6 SUN 10:40 AM TO 12:00 PM

Imaging with Subwavelength Pixels

Session Chairs: **Durdu O. Guney**, Michigan Technological Univ. (USA); **Ertugrul Cubukcu**, Univ. of California, San Diego (USA)

10:40 am: **Plasmonic heterodimensional resonance for subwavelength imaging** (Invited Paper), Michael S. Shur, Rensselaer Polytechnic Institute (USA) [10639-6]

11:00 am: **Diffraction optics approach towards subwavelength pixels** (Invited Paper), Viktor A. Podolskiy, Bo Fan, Univ. of Massachusetts Lowell (USA); Sandeep Inampudi, Northeastern Univ. (USA) [10639-7]

11:20 am: **Subwavelength imaging challenges in the Infrared and THz wavebands** (Invited Paper), Alain Bergeron, Linda E. Marchese, Marc Terroux, Michel Doucet, Nathalie Blanchard, Denis Dufour, Loïc Le Noc, Martin Otis, Michel Jacob, François Duchesne, Marc Girard, Luc Mercier, Lucie Gagnon, Bruno Fissette, Mathieu Tremblay, Bruno Tremblay, Pascal Bourqui, INO (Canada) [10639-8]

11:40 am: **Subdiffraction imaging enhanced with plasmon injection scheme** (Invited Paper), Durdu O. Guney, Michigan Technological Univ. (USA) [10639-9]

Lunch Break Sun 12:00 pm to 1:20 pm

SESSION 3

LOCATION: BALLROOM LEVEL, OSCEOLA 6 SUN 1:20 PM TO 3:10 PM

Origami and Kirigami-based Technologies

Session Chair: **Jhonathan Prieto Rojas**, King Fahd Univ. of Petroleum & Minerals (Saudi Arabia)

1:20 pm: **Designing materials and devices to revolutionize and engineer the future of electronics and photonics through computationally led and data-driven approaches** (Keynote Presentation), John Schlueter, The National Science Foundation (USA) [10639-10]

1:50 pm: **Reconfigurable electronics** (Invited Paper), Muhammad M. Hussain, Nouha Alcheikh, Nadeem Qaiser, Maha Nour, Galo Torres Sevilla, King Abdullah Univ. of Science and Technology (Saudi Arabia) [10639-11]

2:10 pm: **Foldable, buildable, and responsive metamaterials** (Invited Paper), Shu Yang, Univ. of Pennsylvania (USA) [10639-12]

2:30 pm: **Folding and stretching a thermoelectric generator** (Invited Paper), Jhonathan Prieto Rojas, Mutee Rehman, King Fahd Univ. of Petroleum & Minerals (Saudi Arabia); David Conchouso, Arpys Arevalo, Devendra Singh, King Abdullah Univ. of Science and Technology (Saudi Arabia); Ian Foulds, The Univ. of British Columbia Okanagan (Canada); Muhammad M. Hussain, King Abdullah Univ. of Science and Technology (Saudi Arabia) [10639-13]

2:50 pm: **Pixelated polymers: directed self-assembly of liquid crystalline elastomers** (Invited Paper), Timothy J. White, Ben Kowalski, Air Force Research Lab. (USA) [10639-14]

Coffee Break Sun 3:10 pm to 3:40 pm

SESSION 4

LOCATION: BALLROOM LEVEL, OSCEOLA 6 SUN 3:40 PM TO 5:10 PM

Micro/Nano-structures for Enhancing Control of Light-matter Interactions for Advanced Microsystems

Session Chair: **M. Saif Islam**, Univ. of California, Davis (USA)

3:40 pm: **Overcoming integrated photonics challenges to enable next-generation optical microsystems** (Keynote Presentation), Gordon A. Keeler, Defense Advanced Research Projects Agency (USA) [10639-15]

4:10 pm: **Opto-plasmonic devices: controlling light with electrons**, Bahram Nabet, Drexel Univ. (USA) [10639-16]

4:30 pm: **Black holes enabled light bending and trapping in ultrafast silicon photodetectors**, M. Saif Islam, Hilal Cansizoglu, Yang Gao, Soroush Ghandiparsi, Cesar Bartolo Perez, Hasina Mamtaz, Univ. of California, Davis (USA); Toshishige Yamada, Univ. of California, Santa Cruz (USA); Ekaterina Ponzovskaya Devine, Univ. of California, Davis (USA); Aly Elrefaie, Shih-Yuan Wang, W&WSens Devices, Inc. (USA) [10639-17]

4:50 pm: **Microstructured devices for hybrid optothermal memory**, Michelle L. Povinelli, Ahmed Morsy, The Univ. of Southern California (USA) [10639-18]

MONDAY 16 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, OSCEOLA 6 MON 8:00 AM TO 11:40 AM

Flatland Photonics for Wave Shaping, Imaging, and Sensing

Session Chairs: **Junsuk Rho**, Pohang Univ. of Science and Technology (Korea, Republic of); **Yongmin Liu**, Northeastern Univ. (USA)

8:00 am: **Challenges, trends, and prospects for photonic materials, metamaterials, and metasurfaces** (*Keynote Presentation*), Miriam Deutsch, The National Science Foundation (USA) [10639-19]

8:30 am: **Bio-inspired uncooled multispectral infrared imaging with mK range temperature resolution** (*Invited Paper*), Debashish Chanda, Univ. of Central Florida (USA) [10639-20]

8:50 am: **Hyperbolic metamaterial-based plasmoelectronic nanodevices for infrared detection and energy harvesting** (*Rising Researcher Presentation*) (*Invited Paper*), Pai-Yen Chen, Wayne State Univ. (USA) [10639-21]

9:10 am: **Thermal metasurfaces** (*Invited Paper*), Zubin Jacob, Purdue Univ. (USA) [10639-22]

9:30 am: **Geometric phase and nonlinear photonic metasurfaces** (*Invited Paper*), Guixin Li, Southern Univ. of Science and Technology of China (China); Shumei Chen, The Univ. of Birmingham (United Kingdom) [10639-23]

9:50 am: **Holographic camera and display using a flat diffusive layer** (*Invited Paper*), YongKeun Park, KAIST (Korea, Republic of) [10639-24]

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

10:40 am: **Structured surfaces: imaging, security print, and beyond** (*Rising Researcher Presentation*) (*Invited Paper*), Cheng-Wei Qiu, National Univ. of Singapore (Singapore) [10639-25]

11:00 am: **Ensemble plasmonic coupling in disordered arrays and applications in biosensing and super-resolution histopathology** (*Invited Paper*), Wei-Chuan Shih, Univ. of Houston (USA) [10639-26]

11:20 am: **Silicon metasurface holograms in visible wavelengths** (*Invited Paper*), Junsuk Rho, Inki Kim, Gwanho Yoon, Pohang Univ. of Science and Technology (Korea, Republic of) [10639-28]

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

SESSION 6

LOCATION: BALLROOM LEVEL, OSCEOLA 6 MON 1:00 PM TO 2:40 PM

Synthesis, Analysis, and Applications of 2D Materials

Session Chair: **Eui-Hyeok Yang**, Stevens Institute of Technology (USA)

1:00 pm: **Controlled growth of 2D heterostructures and prevention of TMD oxidation** (*Invited Paper*), Eui-Hyeok Yang, Stevens Institute of Technology (USA) [10639-29]

1:20 pm: **Hybridized graphene materials** (*Invited Paper*), Jeremy Robinson, U.S. Naval Research Lab. (USA) [10639-30]

1:40 pm: **Excitonic properties and dynamics in 2D heterostructures consisting of boron nitride and monolayer tungsten diselenide** (*Invited Paper*), Arash Rahimi-Iman, Lorenz Maximilian Schneider, Jan Kuhnert, Dylan Renaud, Wolfram Heimbrod, Obafunso Ajayi, Philipps-Univ. Marburg (Germany); Young Duck Kim, Kyung Hee Univ. (Korea, Republic of); James Hone, Columbia Univ. (USA); Eui-Hyeok Yang, Stevens Institute of Technology (USA); KyungNam Kang, Stevens Institute of Technology (USA) [10639-31]

2:00 pm: **Application of quantum dot sensitization on two-dimensional semiconductors for improved light harvesting** (*Invited Paper*), Chang-Yong Nam, Brookhaven National Lab. (USA) [10639-32]

2:20 pm: **Synthesis and applications of peptoid-based membrane-mimetic 2D nanomaterials** (*Invited Paper*), Chun-Long Chen, Pacific Northwest National Lab. (USA) [10639-33]

SESSION 7

LOCATION: BALLROOM LEVEL, OSCEOLA 6 MON 2:40 PM TO 4:50 PM

Novel Harsh Environment Sensors for Energy Applications

Session Chair: **Michael P. Buric**, National Energy Technology Lab. (USA)

2:40 pm: **Transformational fossil energy power generation: disruptive technologies, sensors, and controls** (*Keynote Presentation*), Briggs White, National Energy Technology Lab. (USA) [10639-34]

3:10 pm: **Raman spectroscopy of oxygen carrier particles in harsh environments** (*Invited Paper*), Hergen Eilers, John Kirtley, Victoria Leichner, Washington State Univ. (USA) [10639-35]

Coffee Break Mon 3:30 pm to 3:50 pm

3:50 pm: **High temperature monitoring using a novel fiber optic ultrasonic sensing system** (*Invited Paper*), Jingcheng Zhou, Xu Guo, Cong Du, Nan Wu, Univ. of Massachusetts Lowell (USA); Tong Ma, Yuqian Liu, Chengyu Cao, Univ. of Connecticut (USA); Xingwei Wang, Univ. of Massachusetts Lowell (USA) [10639-36]

4:10 pm: **Real-time monitoring of thermal and chemical profiles of solid oxide fuel cells with -mm spatial resolution** (*Invited Paper*), Kevin P. Chen, Aidong Yan, Rongtao Cao, Ran Zou, Univ. of Pittsburgh (USA); Michael Buric, Shiwoo Lee, National Energy Technology Lab. (USA) [10639-37]

4:30 pm: **Multi-point fiber optic sensors for real-time monitoring of the temperature distribution on transformer cores** (*Invited Paper*), Aidong Yan, Shuo Li, Zhaoqiang Peng, Ran Zou, Univ. of Pittsburgh (USA); Paul Ohodnicki, Ping Lu, Kevin Byerly, National Energy Technology Lab. (USA); Ming-Jun Li, Corning Incorporated (USA); Kevin P. Chen, Univ. of Pittsburgh (USA) [10639-38]

SYMPOSIUM-WIDE PLENARY SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services
Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6-7 for details.

CONFERENCE 10639

TUESDAY 17 APRIL

SESSION 8

LOCATION: BALLROOM LEVEL, OSCEOLA 6 TUE 8:00 AM TO 10:30 AM

Remote Sensing Techniques and Applications

Session Chair: **Christopher C. Wilcox**,
U.S. Naval Research Lab. (USA)

8:00 am: **ESTO investments in innovative sensor technologies for remote sensing** (*Keynote Presentation*), Sachidananda R. Babu, NASA Goddard Space Flight Ctr. (USA) [10639-39]

8:30 am: **Hyperspectral data analysis of the world's leading agricultural crops** (*Invited Paper*), Prasad S. Thenkabil, U.S. Geological Survey (USA) [10639-40]

8:50 am: **High areal rate longwave-infrared hyperspectral imaging for environmental remote sensing** (*Invited Paper*), David M. Tratt, Eric R. Keim, Jeffrey L. Hall, Kerry N. Buckland, Tamara L. Volquarts, Katherine M. Saad, The Aerospace Corp. (USA) [10639-41]

9:10 am: **Applications of hyperspectral image analysis for precision agriculture** (*Invited Paper*), Stan Martin, Bayer CropScience LP (USA) [10639-42]

9:30 am: **A hyperspectral imaging camera for coastal observing from stratospheric platforms** (*Invited Paper*), John Fisher, Daniel Guerin, Jeffrey Julian, Zachary Burns, Brandywine Photonics, LLC (USA) . . [10639-43]

9:50 am: **Novel interferometric hyperspectral imaging instruments for remote-sensing applications** (*Invited Paper*), Ronald J. Glumb, Michael Lapsley, Peter Mantica, Harris Corp. (USA) [10639-44]

10:10 am: **An ultra-compact hyperspectral imaging system for use with a UAV with smartphone-sensor technology** (*Invited Paper*), Christopher C. Wilcox, Marcos Montes, Michael Yetzbacher, Jason Edelberg, U.S. Naval Research Lab. (USA); Joseph Schlupf, Alaire Technologies, Inc. (USA) [10639-45]

Coffee Break and Dedicated Exhibition Time Tue 10:30 am to 11:30 am

Lunch/Exhibition Break Tue 11:30 am to 1:00 pm

SESSION 9

LOCATION: BALLROOM LEVEL, OSCEOLA 6 TUE 1:00 PM TO 2:50 PM

Wearable, Flexible Devices for Personalized Health and Performance

Session Chairs: **Benjamin J. Leever**, Air Force Research Lab. (USA);
Richard Conroy, National Institutes of Health (USA)

1:00 pm: **Soldier safety and performance through wearable devices** (*Keynote Presentation*), Richard Murdock, Josh Hagen, Air Force Research Lab. (USA) [10639-46]

1:30 pm: **Emerging wearable technologies for personalized health and performance monitoring** (*Invited Paper*), Sam Emaminejad, Univ. of California, Los Angeles (USA) [10639-47]

1:50 pm: **A manufacturable smart dressing with oxygen delivery and sensing capability for chronic wound management** (*Invited Paper*), Babak Ziaie, Purdue Univ. (USA) [10639-48]

2:10 pm: **Advanced sensing for continuous real time monitoring of biomarkers in sweat**, Gavi Begtrup, Eccrine Systems, Inc. (USA) . . [10639-49]

2:30 pm: **FHE strategies for cost-effective, comfortable, conformable wearable electronics for health and safety** (*Invited Paper*), Nancy C. Stoffel, Emad Andarawis, Azar Alizadeh, GE Global Research (USA); Duncan Boyce, Infinite Corridor Technology (USA); Mark Poliks, Binghamton Univ. (USA) [10639-50]

SESSION 10

LOCATION: BALLROOM LEVEL, OSCEOLA 6 TUE 2:50 PM TO 5:30 PM

Brain/Human Computer Interface Technology for Health Applications

Session Chair: **Grace M. Hwang**, Johns Hopkins Univ. Applied Physics Lab., LLC (USA)

2:50 pm: **DoD Blast Injury Research Program Coordinating Office: perspective on brain/human computer interface technologies for injury prevention and diagnosis** (*Keynote Presentation*), Sidney Hinds, U.S. Army Medical Research and Material Command (USA); Chandler Sours, Booz Allen Hamilton Inc. (USA) [10639-51]

Coffee Break Tue 3:20 pm to 3:50 pm

3:50 pm: **Brain imaging for neural tissue health assessment** (*Invited Paper*), David W. Blodgett, Grace Hwang, Johns Hopkins Univ. Applied Physics Lab., LLC (USA); Austen Lefebvre, The Johns Hopkins Hospital (USA); Marek Mirski, Johns Hopkins Univ. (USA); Carissa Rodriguez, Johns Hopkins Univ. Applied Physics Lab., LLC (USA) [10639-52]

4:10 pm: **Holographic neural interfaces: scaling from single neuron resolution to the whole brain** (*Invited Paper*), Shy Shoham, NYU Langone Medical Ctr. (USA) [10639-53]

4:30 pm: **Electrical and ultrasonic neuromodulation for enhanced military performance, health, and gaming** (*Invited Paper*), William Tyler, Arizona State Univ. (USA) [10639-54]

4:50 pm: **Wearable host-based health readiness and threat exposure monitoring** (*Invited Paper*), Christian Whitchurch, Defense Threat Reduction Agency (USA) [10639-55]

5:10 pm: **Detecting biomarkers of brain injury** (*Invited Paper*), Charles Young, Johns Hopkins Univ. Applied Physics Lab., LLC (USA) [10639-56]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Highly selective infrared detection using plasmonic perfect absorbers, Jarrett Vella, Air Force Research Lab. (USA); John Goldsmith, KBRwyle (USA); Shivashankar Vangala, Azimuth Corp. (USA); Mohammad I. Vakil, Justin Cleary, Joshua R. Hendrickson, Air Force Research Lab. (USA) [10639-90]

Indium bump deposition for flip-chip micro-array image sensing and display applications, Mohamed Bah, Alexander Manasson, Craig Outten, David Konopka, Ryan O'Malley, Richard Wang, Julius Abiva, Denton Vacuum Inc. (USA); Matthew Robinson, Chen Zhang, National Institute of Standards and Technology (USA) [10639-91]

Sensor fusion for 3D+T motion detection and target tracking, Jean-Pierre Leduc, Reliance Core Consulting (USA) [10639-92]

Time-delay beamforming for optical nano-antenna arrays, Pedram Johari, Amit Sangwan, Mona Nafari, Josep M. Jornet, Univ. at Buffalo (USA) [10639-93]

Si-on-AIN mid-infrared photonic chips for real-time and label-free chemical monitoring, Pao Lin, Texas A&M Univ. (USA) [10639-94]

Thin-film coating of vibro-fluidized microparticles via rf magnetron sputtering, Nicholas Hudak, Benjamin Garrett, Mathew Zablocki, Univ. of Delaware (USA); Timothy A. Creazzo, Ahmed S. Sharkawy, Lumilant, Inc. (USA); Brendan G. DeLacy, U.S. Army Edgewood Chemical Biological Ctr. (USA); Mark S. Mirotnik, Univ. of Delaware (USA) [10639-95]

Monolithic integration of quantum cascade lasers onto a lattice-mismatched substrate. Rowel Go, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Hubert Krysiak, Matthew Fetters, IQE Inc. (USA); Pedro Figueiredo, Matthew Suttinger, Jason Leshin, Univ. of Central Florida (USA); Xiao-Ming Fang, Joel Fastenau, Dmitri Lubyshev, Amy Liu, Andreas Eisenbach, IQE Inc. (USA); Mark Furlong, IQE (United Kingdom); Arkadiy A. Lyakh, Univ. of Central Florida (USA). [10639-98]

ZnO nanoflakes-based mediator free flexible biosensors for the selective detection of ethyl glucuronide (EtG) and lactate. Fahmida Alam, Ahmed Hasnain Jalal, Raju Sinha, Yogeswaran Umasankar, Shekhar Bhansali, Nezhil Pala, Florida International Univ. (USA). [10639-99]

Liquid sensor based on optical surface plasmon resonance in a dielectric waveguide. Thamer Tabbakh, Patrick Likamwa, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA). [10639-100]

Compact long-wave infrared ring resonator for sensing applications. Claudio Augusto Barreto Saunders Filho, Michael F. Finch, Brian A. Lail, Florida Institute of Technology (USA) [10639-101]

WEDNESDAY 18 APRIL

SESSION 11

LOCATION: BALLROOM LEVEL, OSCEOLA 6 WED 9:00 AM TO 10:20 AM

Advanced Imaging: Gain, Polarization, and Metamaterials Integration I

Session Chair: **Shouleh Nikzad**, Jet Propulsion Lab. (USA)

9:00 am: **Introduction: science and technology perspectives** (*Invited Paper*), Shouleh Nikzad, Jet Propulsion Lab. (USA) [10639-57]

9:20 am: **Deploying electron multiplying CCDs in photon starved coronagraph and spectrograph instruments for WFIRST** (*Invited Paper*), Leon K. Harding, Jet Propulsion Lab. (USA) [10639-62]

9:40 am: **Single-electron and single-photon sensitivity with a silicon Skipper CCD** (*Invited Paper*), Javier Tiffenberg, Fermi National Accelerator Lab. (USA). [10639-61]

10:00 am: **New methods for ultra-sensitive and fast SWIR imaging** (*Invited Paper*), Hooman Mohseni, Northwestern Univ. (USA). [10639-59]

Coffee Break and Dedicated Exhibition TimeWed 10:20 am to 10:50 am

SESSION 12

LOCATION: BALLROOM LEVEL, OSCEOLA 6 WED 10:50 AM TO 11:40 AM

Advanced Imaging: Gain, Polarization and Metamaterials Integration II

Session Chair: **Shouleh Nikzad**, Jet Propulsion Lab. (USA)

10:50 am: **Advanced imaging capabilities by incorporating plasmonics and metamaterials in detectors** (*Invited Paper*), John Hennessy, Jet Propulsion Lab. (USA) [10639-60]

11:10 am: **Quanta imaging sensors: achieving single-photon counting without avalanche gain** (*Keynote Presentation*), Eric R. Fossum, Dartmouth College (USA) [10639-58]

PANEL DISCUSSION

LOCATION: BALLROOM LEVEL, OSCEOLA 6 WED 11:40 AM TO 12:10 PM

Panel Discussion: Advanced Imaging: Gain, Polarization, and Metamaterials Integration

Moderator: **Shouleh Nikzad**, Jet Propulsion Lab.

The Keynote and Invited Speakers for the sessions on Advanced Imaging: Gain, Polarization and Metamaterials Integration will participate on a discussion panel and provide an opportunity for the conference attendees to have one-on-one interactions with them. Discussions will cover the current state-of-the-art and exciting future directions for Advanced Imaging Technology as well as new applications that are enabled by it.

Lunch/Exhibition BreakWed 12:10 pm to 1:20 pm

SESSION 13

LOCATION: BALLROOM LEVEL, OSCEOLA 6 WED 1:20 PM TO 3:20 PM

Deep Learning and Neuromorphic Sensing/ Computing for Small Autonomous Systems

Session Chairs: **Brian Satterfield**, Lockheed Martin Corp. (USA); **William D. Nothwang**, U.S. Army Research Lab. (USA)

1:20 pm: **Army Research Laboratory essential research area: AI and ML** (*Keynote Presentation*), Brian Henz, Tien Pham, U.S. Army Research Lab. (USA) [10639-63]

1:50 pm: **Multi-target tracking with an event-based vision sensor and the GMPHD filter** (*Invited Paper*), Benjamin Foster, Lockheed Martin Rotary and Mission Systems-Advanced Technology Labs. (USA); Qiulin Chen, Dong Ye, Purdue Univ. (USA) [10639-64]

2:10 pm: **A large-scale multi-modal event-based dataset for neuromorphic deep learning applications** (*Invited Paper*), Jared Shmwell, Sarah Leung, Chris Maxey, U.S. Army Research Lab. (USA) [10639-65]

2:30 pm: **An event based bottom-up attention system for UAVs saliency mapping** (*Invited Paper*), Jacopo Tani, ETH Zurich (Switzerland); Brian Satterfield, Lockheed Martin Advanced Technology Labs. (USA) [10639-66]

2:50 pm: **Autonomous agile vision-controlled drones: from frame to event vision** (*Keynote Presentation*), Davide Scaramuzza, Univ Zürich (Switzerland) and ETH Zurich (Switzerland) [10639-67]

Coffee Break. Wed 3:20 pm to 3:40 pm

SESSION 14

LOCATION: BALLROOM LEVEL, SANIBEL 3 WED 3:40 PM TO 5:50 PM

NOTE ROOM CHANGE

Autonomous C4ISR Systems of the Future: Autonomous Decision-Making Approaches

Joint Session with Conferences 10639 and 10651

Session Chairs: **Wolfgang Fink**, The Univ. of Arizona (USA); **Raja Suresh**, General Dynamics Mission Systems (USA)

3:40 pm: **The Stratollite: a navigable and persistent flight vehicle for research, commercial, and defense applications** (*Keynote Presentation*), Tom Pirrone, World View Enterprises, Inc. (USA). [10639-68]

4:10 pm: **Integrated air and missile defence under spatial grasp technology** (*Invited Paper*), Peter Sapaty, The National Academy of Sciences of Ukraine (Ukraine) [10651-18]

4:30 pm: **A hierarchical approach to lidar-based autonomous robotic navigation** (*Invited Paper*), Alexander J. W. Brooks, Wolfgang Fink, Mark A. Tarbell, The Univ. of Arizona (USA) [10639-69]

4:50 pm: **An artificial intelligence platform for prediction and decision making in natural disasters** (*Invited Paper*), Shankar Sankararaman, One Concern, Inc. (USA) [10639-70]

5:10 pm: **Anomaly detection and target prioritization in planetary imagery performed by the automated global feature analyzer (AGFA): a driver for autonomous C4ISR missions** (*Invited Paper*), Wolfgang Fink, Alexander J. W. Brooks, Mark A. Tarbell, The Univ. of Arizona (USA) [10639-71]

5:30 pm: **Mobile node networks model for the generation of knowledge** (*Invited Paper*), Manuel Alejandro Diaz-Casco, Blanca Esther Carvajal-Gámez, Instituto Politécnico Nacional (Mexico) [10651-19]

CONFERENCE 10639

THURSDAY 19 APRIL

SESSION 15

LOCATION: BALLROOM LEVEL, OSCEOLA 6 THU 8:30 AM TO 12:10 PM

QCL and THz Detection I

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

8:30 am: **Advances in fast tunable laser spectroscopy in the infrared** (*Keynote Presentation*), C. Kumar N. Patel, Rodolfo Barron-Jimenez, Ilya Dunayevskiy, Pranalytica, Inc. (USA); Mariano Troccoli, AdTech Optics, Inc. (USA) [10639-72]

9:00 am: **Standoff detection of explosives, CWAs, and industrial chemicals using quantum cascade laser arrays** (*Invited Paper*), Mark F. Witinski, Pendar Technologies (USA) [10639-73]

9:20 am: **Towards 20-watt continuous wave quantum cascade lasers** (*Invited Paper*), Arkadiy A. Lyakh, Matthew Suttinger, Univ. of Central Florida (USA); Rowel Go, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Pedro Figueiredo, Univ. of Central Florida (USA); Hong Shu, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Jason Leshin, Univ. of Central Florida (USA) [10639-74]

9:40 am: **Monolithic quantum cascade lasers** (*Invited Paper*), Kwok Keung Law, Naval Air Warfare Ctr. Weapons Div. (USA) [10639-75]

10:00 am: **Recent results on performance optimization of QCLs for high peak and average power and broad spectral coverage** (*Invited Paper*), Richard Maulini, Ilija Sergachev, Stéphane Blaser, Tobias Gresch, Antoine Müller, Alpes Lasers SA (Switzerland) [10639-76]

10:20 am: **Spectral data collection from dried droplets** (*Invited Paper*), William J. De Costa, DRS Daylight Solutions (USA) [10639-77]

Coffee Break. Thu 10:40 am to 11:10 am

11:10 am: **Advances in standoff surface contaminant detector platform: developmental test results** (*Invited Paper*), Julia R. Dupuis, Jay P. Giblin, John P. Dixon, Joel M. Hensley, David J. Mansur, William J. Marinelli, Physical Sciences Inc. (USA) [10639-78]

11:30 am: **A system for rapid chemical identification based on infrared signatures** (*Invited Paper*), Christopher A. Kendziora, Christopher J. Breshnike, Robert Furstenberg, Michael R. Papantonakis, Viet Nguyen, Jeff Byers, R. A. McGill, U.S. Naval Research Lab. (USA) [10639-79]

11:50 am: **Application of rapidly swept external cavity quantum cascade lasers for standoff chemical sensing** (*Invited Paper*), Brian E. Brumfield, Pacific Northwest National Lab. (USA) [10639-80]

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

SESSION 16

LOCATION: BALLROOM LEVEL, OSCEOLA 6 THU 1:30 PM TO 4:40 PM

QCL and THz Detection II

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

1:30 pm: **Plasmonic detectors and Sources for THz Communication and sensing** (*Keynote Presentation*), Michael S. Shur, Rensselaer Polytechnic Institute (USA) [10639-81]

2:00 pm: **Future THz spectroscopic instruments for earth and planetary science** (*Invited Paper*), Adrian J. Tang, Jet Propulsion Lab. (USA) [10639-83]

2:20 pm: **Overcoming the challenges of active THz / MM-wave imaging: an optics perspective** (*Invited Paper*), Linda E. Marchese, Marc Terroux, Michel Doucet, Nathalie Blanchard, Martin Otis, Michel Jacob, Luc Mercier, François Duchesne, Marc Girard, Lucie Gagnon, Martin Massicote, Bruno Fiset, Mathieu Tremblay, Bruno Tremblay, Pascal Bourqui, Martin Briand, Cleophae Akitegetse, Alain Bergeron, INO (Canada) [10639-84]

2:40 pm: **New method of substance detection and identification using the substance emission frequency up-conversion in the THz frequency range** (*Invited Paper*), Vyacheslav A. Trofimov, Irina Zakharova, Dmitry Zagursky, Svetlana Varentsova, M.V. Lomonosov Moscow State Univ. (Russian Federation) [10639-85]

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

3:30 pm: **Chemical detection using broadband femtosecond optical parametric oscillators in the 6-12-micron spectral fingerprint region** (*Keynote Presentation*), Derryck T. Reid, Heriot-Watt Univ. (United Kingdom) [10639-86]

4:00 pm: **100W-level peak power laser system tunable in the LWIR applied to detection of persistent chemical agents** (*Invited Paper*), Francois Guty, Arnaud Grisard, Christian Larat, Dominique Papillon, Muriel Schwarz, Eric Lallier, Thales Research & Technology (France); Hans D. Tholl, Franz Münzhuber, Diehl Defence GmbH & Co. KG (Germany); Jürgen Kunz, Diehl BGT Defence GmbH & Co. KG (Germany); Michael Raab, Diehl Defence GmbH & Co. KG (Germany); Marcel Rattunde, Stefan Hugger, Fraunhofer-Institut für Angewandte Festkörperphysik (Germany); Mariusz Kasteck, Tadeusz Piatkowski, Wojskowa Akademia Techniczna im. Jaroslawa Dabrowskiego (Poland); François Brygo, Cédric Awanzino, Bertin Technologies (France); Frank Wilsenack, Wehrwissenschaftliches Institut für Schutztechnologien - ABC-Schutz (Germany) [10639-87]

4:20 pm: **Mid-IR broadly tunable cw and ultrafast lasers sources based on Cr and Fe doped chalcogenides, subharmonic OPOs and potential quantum cascade - Fe:II-VI hybrid platforms** (*Invited Paper*), Sergey B. Mirov, The Univ. of Alabama at Birmingham (USA) and IPG Photonics Corp. (USA); Igor Moskalev, Sergey Vasilyev, Viktor Smolski, Mike Mirov, IPG Photonics Corp. (USA); Vladimir Fedorov, Dmitri Martyshekin, The Univ. of Alabama at Birmingham (USA) and IPG Photonics Corp. (USA); Valentin Gapontsev, IPG Photonics Corp. (USA) [10639-88]

SESSION 17

LOCATION: BALLROOM LEVEL, TALLAHASSEE 3 THU 2:00 PM TO 5:35 PM

NOTE ROOM CHANGE

Frequency Comb

Concurrent-Joint Session with conferences 10639 and 10638

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

2:00 pm: **Massively parallel sensing of trace molecules and their isotopologues with broadband mid-IR frequency combs produced via optical subharmonic generation** (*Keynote Presentation*), Konstantin L. Vodopyanov, Andrey Muraviev, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Zachary Loparo, Univ. of Central Florida (USA); Sergey Vasilyev, IPG Photonics - Mid-Infrared Lasers (USA); Sergey B. Mirov, The Univ. of Alabama at Birmingham (USA) [10639-102]

2:30 pm: **Optical frequency comb stabilization of a gigahertz semiconductor disk laser** (*Keynote Presentation*), Nayara Jornod, Kutun Gürel, Valentin J. Wittwer, Pierre Brochard, Sargis Hakobyan, Stéphane Schilt, Univ. de Neuchâtel (Switzerland); Dominik Waldburger, Ursula Keller, ETH Zurich (Switzerland); Thomas Südmeyer, Univ. de Neuchâtel (Switzerland) [10638-71]

3:00 pm: **Towards independent controls of optical comb frequencies and comb spacing of 3-section AlGaInAs multiple quantum-well laser diodes** (*Invited Paper*), Abdullah M. Zaman, Univ. of Central Florida (USA); Peter J. Delfyett, Mina Bayat, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10638-66]

Coffee Break. Thu 3:25 pm to 3:55 pm

3:55 pm: **Stable electro-optic frequency comb generation using an ultrahigh finesse etalon filtered optoelectronic oscillator** (*Invited Paper*), Michael E. Plascak, Ricardo Bustos Ramirez, Peter J. Delfyett Jr., CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10638-67]

4:20 pm: **Reduction of axial mode linewidth and stabilization of the repetition rate of a chip-scale high-speed MLL via COEO multi-tone injection locking** (*Invited Paper*), Ricardo Bustos Ramirez, Michael E. Plascak, Kristina Bagnell, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Ashish Bhardwaj, James Ferrara, Gloria E. Hoefler, Fred A. Kish, Infinera Corp. (USA); Ming C. Wu, Univ. of California, Berkeley (USA); Peter J. Delfyett, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10638-68]

4:45 pm: **Standoff detection from diffusely scattering surfaces using dual quantum cascade laser comb spectroscopy** (*Invited Paper*), Joel M. Hensley, Justin M. Brown, Mark G. Allen, Physical Sciences Inc. (USA); Markus Geiser, Pitt Allmendinger, Markus Mangold, Andreas Hugi, IRsweep GmbH (Switzerland); Pierre Juoy, Jérôme Faist, ETH Zurich (Switzerland) [10638-69]

5:10 pm: **Self-starting harmonic frequency comb generation in quantum cascade lasers** (*Invited Paper*), Marco Piccardo, Dmitry Kazakov, Harvard Univ. (USA); Yongrui Wang, Texas A&M Univ. (USA); Paul Chevalier, Harvard Univ. (USA); Tobias S Mansuripur, Pendar Technologies (USA); Kevin Lascola, Thorlabs Quantum Electronics (USA); Henry Yuan, Joseph Kimchi, Teledyne Judson Technologies (USA); Alexey Belyanin, Texas A&M Univ. (USA); Federico Capasso, Harvard Univ. (USA) [10638-70]

CONFERENCE 10640

LOCATION: BALLROOM LEVEL, NAPLES 1 AND
THURSDAY: BALLROOM LEVEL, SANIBEL 3

Tuesday–Thursday 17–19 April 2018 • Proceedings of SPIE Vol. 10640



DEFENSE + SECURITY

Unmanned Systems Technology XX

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); **Hoa G. Nguyen**, Space and Naval Warfare Systems Ctr. Pacific (USA)

Program Committee: **Jonathan A. Bornstein**, U.S. Army Research Lab. (USA); **Jared Giesbrecht**, Defence Research and Development Canada, Suffield (Canada); **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); **Dilip G. Patel**, General Dynamics Robotic Systems (USA); **Brian K. Skibba**, U.S. Air Force Civil Engineer Ctr. (USA)

TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, NAPLES 1 TUE 1:20 PM TO 3:00 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)

1:20 pm: **Near-infrared deep convolution neural network for detecting lead vehicle using the VANE**, Justin Carrillo, Javier E. Osorio, Stephanie E. Robert, Phillip J. Durst, U.S. Army Engineer Research and Development Ctr. (USA) [10640-1]

1:40 pm: **An approach to robust homing with stereovision**, Damian Lyons, Fuqiang Fang, Fordham Univ. (USA) [10640-2]

2:00 pm: **Autonomous runway debris detection through deep learning**, John S. Harchanko, Polaris Sensor Technologies, Inc. (USA) [10640-4]

2:20 pm: **Automated, near real-time inspection of imagery using commercial sUAS**, Chris Kawatsu, Benjamin Purman, Aaron Zhao, Andy Gillies, Mike Jeffers, Paul Sheridan, Soar Technology, Inc. (USA) [10640-5]

2:40 pm: **Automated data interpretation, tasking, and coordination of UAS imaging**, Sandra M. Klute, Evan M. Lally, Christopher Dusold, Cody McClintock, TORC Robotics (USA) [10640-6]

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

SESSION 2

LOCATION: BALLROOM LEVEL, NAPLES 1 TUE 3:30 PM TO 5:30 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)

3:30 pm: **A translation architecture for the Joint Architecture for Unmanned Systems (JAUS)**, Scott Cutler, SPAWAR Systems Ctr. Pacific (USA) [10640-7]

3:50 pm: **MAD-VR: Machine learning, analysis, and design in virtual reality**, Joshua Rubini, Naval Air Systems Command (USA) [10640-8]

4:10 pm: **DRESH: DRone EnSnaring mesH**, David Erickson, Doug Forrest, Matthew Serge, Defence Research and Development Canada, Suffield (Canada) [10640-9]

4:30 pm: **blindBike: an assistive bike navigation system for low-vision persons**, Lynne L. Grewe, William Overell, Chris Lagali, California State Univ., East Bay (USA) [10640-10]

4:50 pm: **A mobility game with detection uncertainty**, Paul L. Muench, David Bednarz, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA) [10640-11]

5:10 pm: **Improving unmanned vehicle (UV) behavior explanation through identification and scoring of critical episodes**, John D. Zaiantz, Robert Marinier, Brady Vaughn, Kyle Aron, Soar Technology, Inc. (USA) [10640-12]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C ... TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Automatic voice control system for UAV-based accessories, Filip Rezac, Jakub Safarik, Erik Gresak, Miroslav Voznak, Jan Rozhon, CESNET z.s.p.o. (Czech Republic) [10640-26]

Improving autonomy capabilities with temporal world models, Philip R. Osteen, Jason L. Owens, Brian Kaukeinen, Christopher J. Robison, Robert St. Amant, U.S. Army Research Lab. (USA); Michael A. DiBlasi, Engility Corp. (USA) [10640-27]

The study of the vortex trace of unmanned multicopters, Alla Kuzmenko, Southern Federal Univ. (Russian Federation); Valery Asovsky, PANH Helicopters (Russian Federation) [10640-29]

Stopped random walks and control of uncertain systems, Xinjia Chen, Northwestern State Univ. (USA) [10640-30]

Confidence regions with application to sensing and control, Xinjia Chen, Northwestern State Univ. (USA) [10640-31]

WEDNESDAY 18 APRIL

SESSION 3

LOCATION: BALLROOM LEVEL, NAPLES 1 WED 8:30 AM TO 10:10 AM

Robotics CTA

Session Chairs: **Dilip Patel**, General Dynamics Robotic Systems (USA); **Stuart H. Young**, U.S. Army Research Lab. (USA)

8:30 am: **Robotics collaborative technology alliance (RCTA) program overview**, Stuart H. Young, U.S. Army Research Lab. (USA); Dilip Patel, General Dynamics Robotic Systems (USA) [10640-13]

8:50 am: **An experiment to evaluate robotic grasping of occluded objects**, Arnon Hurwitz, Marshal Childers, U.S. Army Research Lab. (USA); Andrew Dornbush, Dhruv Saxena, Maxim Likhachev, Carnegie Mellon Univ. (USA); Craig Lennon, U.S. Army Research Lab. (USA) [10640-14]

9:10 am: **Modeling and traversal of pliable materials for wheeled robot navigation**, Camilo Ordonez, Ryan Alicea, Florida State Univ. (USA); Brandon Rothrock, Jet Propulsion Lab. (USA); Kyle Ladyko, Mario Harper, Florida State Univ. (USA); Sisir Karumanchi, Jet Propulsion Lab. (USA); Larry Matthies, Florida State Univ. (USA) [10640-15]

CONFERENCE 10640

9:30 am: **When does a human replan? Exploring intent-based replanning in multi-objective path planning**, Meher T. Shaikh, Michael A. Goodrich, Brigham Young Univ. (USA) [10640-16]

9:50 am: **Parallel approach to motion planning in uncertain environments**, Mario Harper, Camilo Ordonez, Gordon Erlebacher, Emmanuel Collins, Florida State Univ. (USA) [10640-17]

Coffee Break and Dedicated Exhibition Time Wed 10:10 am to 11:00 am

SESSION 4

LOCATION: BALLROOM LEVEL, NAPLES 1 WED 11:00 AM TO 12:00 PM

Navigation

Session Chairs: **Hoa G. Nguyen**, SPAWAR Systems Ctr. Pacific (USA); **Paul L. Muench**, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA)

11:00 am: **Brain emotional learning-based intelligent path planning and coordination control of networked unmanned autonomous systems**, Hao Xu, Univ. of Nevada, Reno (USA) [10640-18]

11:20 am: **Image-aided inertial navigation for an Octocopter**, Baheerathan Sivalingam, Ove Kent Hagen, Norwegian Defence Research Establishment (Norway) [10640-20]

11:40 am: **UAV vision-based localization techniques using high-altitude image and barometric altimeter**, Koichiro Yawata, Tomonori Yamamoto, Jun-ichiro Watanabe, Yuki Nishikawa, Hitachi, Ltd. (Japan) [10640-21]

THURSDAY 19 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, SANIBEL 3 THU 8:00 AM TO 10:20 AM

NOTE ROOM CHANGE

Collaborative Robotic Teams

Joint Session with conferences 10640 and 10651

Session Chairs: **Robert E. Karlson**, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); **Raja Suresh**, General Dynamics Mission Systems (USA)

8:00 am: **Advances in autonomous underwater vehicles and the move to network centric persistent subsea capabilities** (*Invited Paper*), Thomas Altshuler, Clayton Jones, Robert G. Melvin II, Daniel Shropshire, Joseph Borden, Teledyne Marine (USA) [10651-20]

8:30 am: **Swarm of autonomous unmanned aerial vehicles with 3-D deconfliction** (*Invited Paper*), Zbigniew Bogdanowicz, U.S. Army Armament Research, Development and Engineering Ctr. (USA) [10651-21]

9:00 am: **Removing the bottleneck: Utilizing autonomy to manage multiple UAS sensors from inside a cockpit**, Thomas Alicia, Grant S. Taylor, U.S. Army (USA); Terry Turpin, Turpin Technologies (USA); Amit Surana, United Technologies Research Ctr. (USA) [10640-22]

9:20 am: **Real-time Inspection of 3D features using sUAS with low-cost sensor suites**, Benjamin Purman, Chris Kawatsu, Mike Jeffers, Paul Sheridan, Aaron Zhao, Soar Technology, Inc. (USA) [10640-23]

9:40 am: **Benchmarking a LIDAR obstacle perception system for aircraft autonomy**, Adam Stambler, Hugh Cover, Kyle Strabala, Near Earth Autonomy, Inc. (USA) [10640-24]

10:00 am: **Cooperative cognitive electronic warfare UAV game modeling for frequency hopping radar**, Mark D. Rahmes, Dave Chester, Rich Clouse, Jodie Hunt, Tom Ottoson, Harris Corp. (USA) [10640-25]

CONFERENCE 10641

LOCATION: BALLROOM LEVEL, OSCEOLA 5

Monday–Tuesday 16–17 April 2018 • Proceedings of SPIE Vol. 10641

Sensors and Systems for Space Applications XI

Conference Chairs: **Khanh D. Pham**, Air Force Research Lab. (USA); **Genshe Chen**, Intelligent Fusion Technology, Inc. (USA)

Program Committee: **Trevor J. Bihl**, Air Force Institute of Technology (USA); **Erik P. Blasch**, Air Force Research Lab. (USA); **Yu Chen**, Binghamton Univ. (USA); **Joseph L. Cox**, LinQuest (USA); **Sarah T. Crites**, Institute of Space and Astronautical Science (Japan); **Thomas George**, SaraniaSat Inc. (USA); **Ping Hagler**, Missile Defense Agency (USA); **Richard T. Howard**, NASA Marshall Space Flight Ctr. (USA); **Uttam Kumar Majumder**, Air Force Research Lab. (USA); **Brian K. McComas**, Raytheon Missile Systems (USA); **Tien M. Nguyen**, The Aerospace Corp. (USA); **Andre Samberg**, Sec-Control Finland Ltd. (Finland); **Dan Shen**, Intelligent Fusion Technology, Inc. (USA); **Ryan M. Weisman**, Air Force Research Lab. (USA); **Henry Zmuda**, Univ. of Florida (USA)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, OSCEOLA 5 MON 8:00 AM TO 10:00 AM

Instrument and Sensor Architecture and Design for Space Applications

Session Chair: **Henrique R. Schmitt**, U.S. Naval Research Lab. (USA)

8:00 am: **Modelling of celestial backgrounds**, Duncan L. Hickman, Moira I. Smith, Tektonex Ltd. (United Kingdom); Jae-Wan Lim, Yun-Ho Jeon, Agency for Defense Development (Korea, Republic of) [10641-1]

8:20 am: **Compact midwave imaging system (CMIS) for weather satellite applications**, Michael A. Kelly, Arnold C. Goldberg, John Boldt, Johns Hopkins Univ. Applied Physics Lab., LLC (USA); Dong L. Wu, NASA Goddard Space Flight Ctr. (USA); Andrew Heidinger, National Oceanic and Atmospheric Administration (USA); Jeng H. Yee, Kyle J. Ryan, John P. Wilson, Jacob M. Greenberg, Charles Hibbits, Johns Hopkins Univ. Applied Physics Lab., LLC (USA) [10641-2]

8:40 am: **Multi-band optical photometry of geosynchronous satellites**, Henrique R. Schmitt, U.S. Naval Research Lab. (USA) [10641-3]

9:00 am: **Research on camera on orbit radial calibration based on black body and infrared calibration stars**, Yudu Wang, Ping Cai, Xiaofeng Su, FanSheng Chen, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China) [10641-4]

9:20 am: **Optical design of space cameras for automated rendezvous and docking systems**, Xiang Zhu, Neptec Design Group Ltd. (Canada) . . [10641-5]

9:40 am: **Realization of imaging infrared spectrometer for Lunar Mission**, Arup Banerjee, Shaunak R. Joshi, Amiya Biswas, Sunil Bhati, Sami Ur Rehman, Ankush Kumar, Pradeep Soni, J.C. Karelia, Anish R. Saxena, Arup Roy Chowdhury, Space Applications Ctr. (India) [10641-6]

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

SESSION 2

LOCATION: BALLROOM LEVEL, OSCEOLA 5 MON 10:30 AM TO 11:50 AM

Emerging Systems and Architectures for Space Applications

Session Chair: **Yiran Xu**, Intelligent Fusion Technology, Inc. (USA)

10:30 am: **DDDAS technology for space applications**, Erik Blasch, Khanh D. Pham, Air Force Research Lab. (USA); Dan Shen, Genshe Chen, Intelligent Fusion Technology, Inc. (USA) [10641-7]

10:50 am: **Investigation of the dynamic enhanced cubature Kalman filter**, Bin Jia, Intelligent Fusion Technology, Inc. (USA); Khanh D. Pham, Erik Blasch, Air Force Research Lab. (USA); Genshe Chen, Intelligent Fusion Technology, Inc. (USA) [10641-8]

11:10 am: **Adaption from LWIR to visible wavebands of methods to describe the population of GEO belt debris**, Jeremy Murray-Krezan, Kevin Meng, Air Force Research Lab. (USA); Patrick Seitzer, Chris H. Lee, Univ. of Michigan (USA) [10641-9]

11:30 am: **Analysis of three-dimensionally proliferated sensor architectures for flexible SSA**, Phillip M. Cunio, Air Force Research Lab. (USA); Brien R. Flewelling, ExoAnalytic Solutions, Inc. (USA) [10641-10]

Lunch Break Mon 11:50 am to 1:30 pm

SESSION 3

LOCATION: BALLROOM LEVEL, OSCEOLA 5 MON 1:30 PM TO 3:10 PM

Perception and Autonomy for Aerospace Applications

Session Chair: **Dan Shen**, Intelligent Fusion Technology, Inc. (USA)

1:30 pm: **Markov logic network based complex event detection under uncertainty**, Jingyang Lu, Bin Jia, Genshe Chen, Intelligent Fusion Technology, Inc. (USA); Erik Blasch, Khanh D. Pham, Air Force Research Lab. (USA) [10641-11]

1:50 pm: **Multitask assessment of roads and vehicles network (MARVN)**, Fang Yang, Meng Yi, Yiran Cai, Temple Univ. (USA); Erik Blasch, Carolyn Sheaff, Air Force Research Lab. (USA); Genshe Chen, Intelligent Fusion Technology, Inc. (USA); Haibin Ling, Temple Univ. (USA); Nichole Sullivan, Intelligent Fusion Technology (USA) [10641-12]

2:10 pm: **A robotic orbital emulator with lidar-based SLAM and AMCL for multiple entity pose estimation**, Dan Shen, Intelligent Fusion Technology, Inc. (USA); Khanh D. Pham, Air Force Research Lab. (USA); Erik Blasch, Air Force Office of Scientific Research (USA); Genshe Chen, Xingyu Xiang, Bin Jia, Zhonghai Wang, Intelligent Fusion Technology, Inc. (USA) . . [10641-13]

2:30 pm: **Using multiple IMUs in a stacked filter configuration with relative updates for calibration and fine alignment**, Aly El-Osery, New Mexico Institute of Mining and Technology (USA); Stephen Bruder, Embry-Riddle Aeronautical Univ. (USA); Kevin Wedeward, New Mexico Institute of Mining and Technology (USA) [10641-14]

2:50 pm: **Finding common ground by unifying autonomy indices to understand needed capabilities**, Trevor J. Bihl, Air Force Institute of Technology (USA); Chad Cox, KEYW Corp. (USA); Todd Jenkins, Air Force Research Lab. (USA) [10641-15]

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

SESSION 4

LOCATION: BALLROOM LEVEL, OSCEOLA 5 MON 3:40 PM TO 4:40 PM

Emerging Concepts for Space Communications

Session Chair: **Yu Chen**, Binghamton Univ. (USA)

3:40 pm: **An anti-jamming GPS receiver antenna testing system**, Zhonghai Wang, Xing-Ping Lin, Bin Jia, Xingyu Xiang, Intelligent Fusion Technology, Inc. (USA); Eric Fisher, James Savarese, U.S. Army Electronic Proving Ground (USA); Khanh D. Pham, Erik Blasch, Air Force Research Lab. (USA); Genshe Chen, Intelligent Fusion Technology, Inc. (USA) [10641-16]

4:00 pm: **Link establishment criterion for mixed inter-satellite communications with both RF and laser crosslinks**, Lun Li, Sixiao Wei, Xin Tian, Li-Tse Hsien, Intelligent Fusion Technology, Inc. (USA); Khanh D. Pham, Air Force Research Lab. (USA); Genshe Chen, Intelligent Fusion Technology, Inc. (USA) [10641-17]

4:20 pm: **Intelligent path loss prediction engine design using machine learning in the urban outdoor environment**, Ruichen Wang, Jingyang Lu, Yiran Xu, Dan Shen, Genshe Chen, Intelligent Fusion Technology, Inc. (USA) [10641-18]

CONFERENCE 10641

SYMPOSIUM-WIDE PLENARY SESSION LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C MON 5:00 PM TO 7:00 PM

- 5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**
- 5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)
- 5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin
- 6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)
- See pages 6–7 for details.*

TUESDAY 17 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, OSCEOLA 5 TUE 8:20 AM TO 10:00 AM

Optical Detection and Analysis for Free Space Laser Communications

Session Chair: **Thomas C. Farrell**, Air Force Research Lab. (USA)

- 8:20 am: **Space qualification of InGaAs photodiodes and photoreceivers**, Abhay M. Joshi, Shubhashish Datta, Discovery Semiconductors, Inc. (USA); Narasimha S. Prasad, NASA Langley Research Ctr. (USA) [10641-19]
- 8:40 am: **Sources of background light on space based laser communication links**, Thomas C. Farrell, Air Force Research Lab. (USA) [10641-20]
- 9:00 am: **Quantum limited performance of optical receivers**, Thomas C. Farrell, Air Force Research Lab. (USA) [10641-21]
- 9:20 am: **Predicting the performance of linear optical detectors in free space laser communication links**, Thomas C. Farrell, Air Force Research Lab. (USA) [10641-22]
- 9:40 am: **The performance of Geiger mode avalanche photo-diodes in free space laser communication links**, Thomas C. Farrell, Air Force Research Lab. (USA) [10641-23]
- Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, OSCEOLA 5 TUE 11:00 AM TO 11:40 AM

Space Sensors and Mission Options I

Session Chair: **Kevin Meng**, Air Force Research Lab. (USA)

- 11:00 am: **Assemble and alignment of the reflective Korsch type 3 mirror optical system with all silicon carbide structure**, Jinsuk Hong, Youngsoo Kim, Hanwha Systems Co., Ltd. (Korea, Republic of) [10641-24]
- 11:20 am: **Low-cost, compact, and robust gas abundance sensor package (GASP)**, Dat Tran, The Catholic Univ. of America (USA) . . . [10641-25]
- Lunch/Exhibition Break Tue 11:40 am to 1:10 pm

SESSION 7

LOCATION: BALLROOM LEVEL, OSCEOLA 5 TUE 1:10 PM TO 2:50 PM

Space Sensors and Missions Options II

Session Chair: **Phillip M. Canio**, U.S. Air Force Research Lab. (USA)

- 1:10 pm: **Backside illuminated CMOS-TDI line scan sensor for space applications**, Omer Cohen, Oren Ofer, Nimrod Ben-Ari, Gil Abramovich, Gal Gershon, SCD Semiconductor Devices (Israel) [10641-26]
- 1:30 pm: **Think the way to measure the Earth Radiation Budget and the Total Solar Irradiance with a small satellites constellation**, Mustapha Meftah, Philippe Keckhut, Slimane Bekki, Alain Sarkissian, LATMOS (France) [10641-27]
- 1:50 pm: **A federated capability-based access control mechanism for internet of things (IoT)**, Yu Chen, Ronghua Xu, Binghamton Univ. (USA); Erik Blasch, Air Force Research Lab. (USA); Genshe Chen, Intelligent Fusion Technology, Inc. (USA) [10641-29]
- 2:10 pm: **Facility for orbital fiber processing**, Dmitry S. Starodubov, Kyle McCormick, Michael Dellosa, FOMS Inc. (USA); Emery Erdelyi, FOMS, Inc. (USA); Leo Volfson, Torrey Pines Logic, Inc. (USA) [10641-30]
- 2:30 pm: **Characterization of detector performance via wavelength-shifted hygroscopic scintillator emission**, Hayley D. Suits, Los Alamos National Lab. (United States) [10641-31]

CONFERENCE 10642

LOCATION: BALLROOM LEVEL, CAPTIVA 2

Tuesday–Wednesday 17–18 April 2018 • Proceedings of SPIE Vol. 10642

Situation Awareness in Degraded Environments 2018

Conference Chairs: **John (Jack) N. Sanders-Reed**, The Boeing Co. (USA); **Jarvis (Trey) J. Arthur III**, NASA Langley Research Ctr. (USA)
Program Committee: **Brendan W. Blanton**, The Boeing Co. (USA); **Michael P. Browne**, SA Photonics (USA); **Daniel D. Desjardins**, Air Force Research Lab. (USA); **Gary W. Jones**, NanoQuantum Sciences, Inc. (USA); **Shanalyn A. Kemme**, Sandia National Labs. (USA); **Jim E. Melzer**, Thales Visionix, Inc. (USA); **Thomas R. Muensterer**, HENSOLDT Sensors GmbH (Germany); **Niklas Peinecke**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Kalluri R. Sarma**, Honeywell Technology (USA); **Carlo L. Tiana**, Rockwell Collins, Inc. (USA)

TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, CAPTIVA 2 TUE 8:00 AM TO 10:00 AM

Displays and Human Performance I

Session Chairs: **Michael P. Browne**, SA Photonics, Inc. (USA); **James E. Melzer**, Thales Visionix, Inc. (USA)

8:00 am: **Determination of 256 just noticeable color gray levels for improved color palette**, Daniel D. Desjardins, Patrick Gardner, Western Carolina Univ. (USA); James C. Byrd, Aeronautical Systems Ctr./Displays Branch (retired) (USA)..... [10642-1]

8:20 am: **HMD see-through symbology: color discrimination modeling**, Thomas H. Harding, U.S. Army Aeromedical Research Lab. (USA); Jeffery K. Hovis, Univ. of Waterloo (Canada); Clarence E. Rash, Oak Ridge Institute for Science and Education (USA); Michael K. Smolek, Morris R. Lattimore, U.S. Army Aeromedical Research Lab. (USA).... [10642-2]

8:40 am: **Modeling the effect of macular pigment enhancement on vision in degraded visual environments (DVE)**, Leonard A. Temme, U.S. Army Aeromedical Research Lab. (USA); Kevin J. O'Brien, U.S. Army Aeromedical Research Lab. (USA) and Oak Ridge Institute for Science and Education (USA); Paul M. St. Onge, U.S. Army Aeromedical Research Lab. (USA) and Laulima Government Solutions, LLC (USA); Brigid K. Byrd, U.S. Army Aeromedical Research Lab. (USA) and Oak Ridge Institute for Science and Education (USA) [10642-3]

9:00 am: **Review of sensor-to-eye latency effects in degraded visual environment mitigations**, Thomas Schnell, The Univ. of Iowa (USA); Thomas R. Münsterer, HENSOLDT Sensors GmbH (Germany) [10642-4]

9:20 am: **Color and impact to HMD design**, Bobby D. Foote, Rockwell Collins, Inc. (USA)..... [10642-5]

9:40 am: **Predicting depth discrimination performance under hyper-stereoscopic display conditions**, Charles J. Lloyd, Visual Performance, LLC (USA)..... [10642-6]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 2

LOCATION: BALLROOM LEVEL, CAPTIVA 2 TUE 11:00 AM TO 12:00 PM

Displays and Human Performance II

Session Chair: **John (Jack) N. Sanders-Reed**, The Boeing Co. (USA)

11:00 am: **AFRL alternative night/day imaging technologies (ANIT) program (Invited Paper)**, Darrel G. Hopper, Air Force Research Lab. (USA)..... [10642-7]

11:40 am: **Visibility of color symbology in head-up and head-mounted displays in daylight environments**, Michael P. Browne, SA Photonics, Inc. (USA)..... [10642-8]

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

SESSION 3

LOCATION: BALLROOM LEVEL, CAPTIVA 2 TUE 1:30 PM TO 3:10 PM

Systems and Processing I

Session Chairs: **Niklas Peinecke**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Daniel D. Desjardins**, Air Force Research Lab. (USA)

1:30 pm: **360-degree top view inside a helmet mounted display providing obstacle awareness for helicopter operations**, Lars Ebrecht, Johannes M. Ernst, Sven Schmerwitz, Hans-Ullrich Döhler, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) [10642-9]

1:50 pm: **Synthetic vision on a head-worn display supporting helicopter offshore operations**, Johannes M. Ernst, Lars Ebrecht, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); Stefan Erdmann, Technische Univ. Braunschweig (Germany)..... [10642-10]

2:10 pm: **Real-time sonic boom prediction with flight guidance**, Laura M. Smith-Velazquez, Rockwell Collins, Inc. (USA); Erik Theunissen, Informatie Systemen Delft Leiderdorp (Netherlands) [10642-12]

2:30 pm: **High-fidelity simulation research to evaluate virtual day-VMC displays for airplane state awareness**, Lawrence J. Prinzel, Kyle K. E. Ellis, Jarvis J. Arthur, Daniel K. Kiggins, Stephanie N. Nicholas, Renee C. Lake, Kathryn Ballard, NASA Langley Research Ctr. (USA) [10642-13]

2:50 pm: **Vision systems for rotorcraft: regulatory and technology update**, Philippe Salmon, Rockwell Collins France (France); Carlo L. Tiana, Rockwell Collins, Inc. (USA)..... [10642-14]

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

SESSION 4

LOCATION: BALLROOM LEVEL, CAPTIVA 2 TUE 3:40 PM TO 5:00 PM

Phenomenology and Sensing

Session Chairs: **Gary W. Jones**, NanoQuantum Sciences, Inc. (USA); **Shanalyn A. Kemme**, Sandia National Labs. (USA)

3:40 pm: **Passive EO imaging sensor assessment methodology**, Rhys Jones, Defence Science and Technology Lab. (United Kingdom)..... [10642-15]

4:00 pm: **Advanced, low-swap lidar imager for degraded visual environments**, Jason Seely, Arete Associates (USA) [10642-16]

4:20 pm: **Ongoing work and improvements at the Sandia Fog Facility**, Jeremy B. Wright, John D. van der Laan, Andres Sanchez, Sandia National Labs. (USA)..... [10642-17]

4:40 pm: **NIAG DVE flight test results of LiDAR based DVE support systems**, Thomas R. Münsterer, HENSOLDT Sensors GmbH (Germany); Bernhard Singer, HENSOLDT Optronics GmbH (Germany); Michael Zimmermann, Martin Gestwa, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany)..... [10642-18]

CONFERENCE 10642

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind at the close of the poster session will be considered unwanted and will be discarded. SPIE assumes no responsibility for posters left up after the end of each poster session.

Improving AVHRR-based NDVI data using a statistical technique for global climate studies, Mohammed Z. Rahman, LaGuardia Community College (USA) [10642-19]

Stitching image using RDHW based on multivariate student's T distribution, Yingying Kong, Yingying Chen, Nanjing Univ. of Aeronautics and Astronautics (China); Shiyu Xing, Leung Henry, Univ. of Calgary (Canada) [10642-33]

Research vibrating magnetic sources for penetrating sensing and low-bitrate communication, Dryver R. Huston, Daniel Orfeo, Robert Farrell, Dylan Burns, The Univ. of Vermont (USA); Guoan Wang, Univ. of South Carolina (USA); Tian Xia, The Univ. of Vermont (USA) [10642-34]

Research on spatial situation sensing technology based on VR miniature satellite, XiaoKang Zhou, Shanghai Univ. (China); Peng Rao, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences (China); Qiuyu Zhu, Shanghai Univ. (China) [10642-35]

WEDNESDAY 18 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, CAPTIVA 2 WED 8:20 AM TO 9:20 AM

Systems and Processing II

Session Chair: **Thomas R. Münsterer**, HENSOLDT Sensors GmbH (Germany)

8:20 am: **Integrating legacy ESVS displays in the unity game engine**, Niklas Peinecke, Johannes M. Ernst, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany) [10642-20]

8:40 am: **Team-centric motion planning in unfamiliar environments**, Cory Hayes, Matthew Marge, Claire Bonial, Clare Voss, Susan G. Hill, U.S. Army Research Lab. (USA) [10642-22]

9:00 am: **Rotorcraft pinnacle landing situational awareness system**, Brendan W. Blanton, Katherine S. Gresko, Robert C. Allen, Eric H. Lieberman, The Boeing Co. (USA) [10642-23]

SESSION 6

LOCATION: BALLROOM LEVEL, CAPTIVA 2 WED 9:20 AM TO 10:00 AM

Displays and Human Performance III

Session Chair: **Niklas Peinecke**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany)

9:20 am: **Feeling a little blue: Problems with the symbol color blue for see-through displays and an alternative color solution**, Michael P. Browne, SA Photonics, Inc. (USA) [10642-24]

9:40 am: **INVC-BA: providing dismounted 24/7 DVE capability and enabling the digital battlefield**, Joseph E. Straub, Sage Technologies Ltd. (USA) [10642-25]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 7

LOCATION: BALLROOM LEVEL, CAPTIVA 2 WED 11:00 AM TO 11:40 AM

GPS Denied Environments

Session Chair: **Brendan W. Blanton**, The Boeing Co. (USA)

11:00 am: **Relative visual localization (RVL) for UAV navigation**, Andy Couturier, Moulay A. Akhlooufi, Univ. de Moncton (Canada) [10642-28]

11:20 am: **Location and head orientation tracking in GPS-denied environments**, James E. Melzer, Ashutosh Morde, Thales Visionix, Inc. (USA) [10642-26]

Lunch/Exhibition Break Wed 11:40 pm to 1:30 pm

SESSION 8

LOCATION: BALLROOM LEVEL, CAPTIVA 2 WED 1:30 PM TO 4:40 PM

MMW and DVE Phenomenology and Sensing

Joint Session with conferences 10642 and 10634

Session Chairs: **Jarvis J. Arthur**, NASA Langley Research Ctr. (USA); **David A. Wikner**, U.S. Army Research Lab. (USA)

1:30 pm: **Visualization requirements for DVE systems**, Jack Cross, Sierra Nevada Corp. (USA) [10642-29]

1:50 pm: **DVE system capability classes**, Jack Cross, Sierra Nevada Corp. (USA) [10642-30]

2:10 pm: **Visibility in degraded visual environments (DVE)**, John (Jack) N. Sanders-Reed, Stephen J. Fenley, The Boeing Co. (USA) [10642-31]

2:30 pm: **Advanced radar for autonomous vehicles and degraded visual environments**, Mike Gleaves, Arralis Ltd. (Ireland) [10634-1]

2:50 pm: **A novel wire recognition algorithm for millimeter-wave radar video imagery**, Vincent De Paul Onana, Goleta Star, LLC (USA) . . . [10642-32]

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

3:40 pm: **Coded aperture sub-reflector array for high-resolution radar imaging**, Jonathan J. Lynch, Florian G. Herrault, Gabriel I. Virbila, Keerti S. Kona, David L. Hammon, HRL Labs., LLC (USA); Michael D. Wetzel, HRL Labs., LLC (USA); Dean C. Regan, Joel C. Wong, Yan Tang, Eric M. Prophet, Partia Naghibi, Aurelio Lopez, HRL Labs., LLC (USA) [10634-2]

4:00 pm: **Passive millimeter-wave imager for degraded visual environments**, Thomas E. Dillon, Christopher Schuetz, Andrew Wright, Phase Sensitive Innovations, Inc. (USA); Steven Kocazik, EM Photonics, Inc. (USA); Dennis Prather, Univ. of Delaware (USA) [10642-33]

4:20 pm: **Extraction of radar cross section values of helicopter landing zone hazards from 94-GHz ISAR imagery**, David A. Wikner, Jerry L. Silvius, Robert L. Bender, U.S. Army Research Lab. (USA) . [10634-3]

CONFERENCE 10643

LOCATION: BALLROOM LEVEL, MIAMI 1

Monday–Wednesday 16–18 April 2018 • Proceedings of SPIE Vol. 10643

Autonomous Systems: Sensors, Vehicles, Security and the Internet of Everything

Conference Chairs: **Michael C. Dudzik**, IQM Research Institute (USA); **Jennifer C. Ricklin**, Carnegie Mellon Univ.—Software Engineering Institute (USA)

Program Committee: **John Audia**, Naval Postgraduate School (USA); **Andrew Dallas**, Soar Technology, Inc. (USA); **Mark Donofrio**, Southern Research (USA); **Brian Hibbeln**, Naval Postgraduate School (USA); **Robert A. Hummel**, National Geospatial-Intelligence Agency (USA); **Herbert W. Klumpe III**, Air Force Research Lab. (USA); **John Marx**, Air Force Research Lab. (USA); **Brad McNett**, U.S. Army TARDEC (USA); **Matt Mickelson**, The MITRE Corp. (USA); **Frank Prautzsch**, Velocity Technology Partners, LLC (USA); **Jeremy Salinger**, General Motors Co. (USA); **Shawn Taylor**, Sandia National Labs. (USA); **Andrew Williams**, Air Force Research Lab. (USA)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, MIAMI 1 MON 8:45 AM TO 12:00 PM

Cyber and Software Security for Autonomous Operations

Session Chairs: **Michael C. Dudzik**, IQM Research Institute (USA); **Jennifer C. Ricklin**, Carnegie Mellon Univ.—Software Engineering Institute (USA)

8:45 am: **Tactical comms, Software, MI/AI, embedded HPC, and big data analytics: OSD vision for future defense system requirements (Keynote Presentation)**, Richard W. Linderman, Office of the Assistant of the Secretary of Defense (USA) [10643-1]

9:30 am: **Safety enforcement for the verification of autonomous systems**, Dionisio de Niz, Bjorn Andersson, Gabriel Moreno, Carnegie Mellon Univ.—Software Engineering Institute (USA) [10643-2]

9:50 am: **Autonomous vehicles and cybersecurity: a paradigm for problem and solution assessment and a sensing approach to problem detection**, Jeremy Straub, North Dakota State Univ. (USA) [10643-3]

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

10:40 am: **Adopting cyber security practices in internet of things: A review**, Priti Maheshwary, Timothy Malche, AISECT Univ. (India); Christos Grecos, Central Washington Univ. (USA); Mukul V. Shirvaikar, The Univ. of Texas at Tyler (USA) [10643-5]

11:00 am: **Maintaining trusted platform in a cyber-contested environment**, David Hadcock, Matthew Britton, Bruce Frantz, Michael Lynch, Alion Science and Technology Corp. (USA) [10643-6]

11:20 am: **Certificates, code signing and digital signatures**, Michael Anderson, The PTR Group (USA) [10643-7]

Lunch Break Mon 11:40 pm to 1:20 pm

SESSION 2

LOCATION: BALLROOM LEVEL, MIAMI 1 MON 1:20 PM TO 4:10 PM

Object Sensing for Detection, Classification, and Autonomous Operations

Session Chairs: **Richard W. Linderman**, Office of the Assistant Secretary of Defense (USA); **Michael C. Dudzik**, IQM Research Institute (USA)

1:20 pm: **CNN-based thermal infrared person detection by domain adaptation**, Christian Herrmann, Miriam Ruf, Jürgen Beyerer, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10643-8]

1:40 pm: **Evaluation of a logarithmic HDR sensor for an image-based navigation system**, Marco Tektonidis, Mateusz Pietrzak, David Monnin, Institut Franco-Allemand de Recherches de Saint-Louis (France) . . . [10643-9]

2:00 pm: **Improved video change detection for UAVs**, Thomas Müller, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10643-11]

2:20 pm: **Unattended sensor using deep machine learning techniques for rapid response applications**, Alfred Mayalu, Kevin Kochersberger, Virginia Polytechnic Institute and State Univ. (USA) [10643-12]

2:40 pm: **Enhanced pedestrian safety awareness at crosswalks via networked lidar, thermal imaging, and sensors**, Zachary A. Weingarten, Luke Nichols, Ryan Integlia, Faezeh Haghighat Mesbahi, Michelle Holzemer, Marshall Bassford, Joseph Prine, Bradley Trowbridge, Florida Polytechnic Univ. (USA) [10643-13]

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

3:30 pm: **Hydra: A modular, universal multisensor data collection system**, Madelyn Davis, Lucas Cagle, Courtney Morgan, John E. Ball, Derek T. Anderson, Cindy L. Bethel, Yucheng Liu, Mississippi State Univ. (USA) [10643-14]

3:50 pm: **Low-cost 3D security camera**, Robert Bock, R-DEX Systems, Inc. (USA) [10643-15]

SYMPOSIUM-WIDE PLENARY SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. “Trey” Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6–7 for details.

CONFERENCE 10643

TUESDAY 17 APRIL

SESSION 3

LOCATION: BALLROOM LEVEL, MIAMI 1 TUE 8:35 AM TO 10:00 AM

Networks and the IOT for Autonomous Systems I

Session Chairs: **Jeremy Salinger**, General Motors Co. (USA);
Brad McNett, U.S. Army TARDEC (USA)

8:35 am: **Trust in autonomy: From self-driving cars to big data analytics (Keynote Presentation)**, Stephen M. Jameson, Defense Advanced Research Projects Agency (USA) [10643-16]

9:20 am: **A history and overview of mobility modeling for autonomous unmanned ground vehicles**, Phillip J. Durst, U.S. Army Engineer Research and Development Ctr. (USA); Derek T. Anderson, Cindy L. Bethel, Mississippi State Univ. (USA) [10643-17]

9:40 am: **Evaluating the efficacy of mobile data collector nodes for wireless sensor networks**, Karanam Dayananda, Jeremy Straub, North Dakota State Univ. (USA) [10643-18]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 4

LOCATION: BALLROOM LEVEL, MIAMI 1 TUE 11:00 AM TO 12:00 PM

Networks and the IOT of Autonomous Systems II

Session Chairs: **Jeremy Salinger**, General Motors Co. (USA);
Brad McNett, U.S. Army TARDEC (USA)

11:00 am: **Mission critical decentralized resilient and intelligent control for networked heterogeneous unmanned autonomous systems**, Hao Xu, Univ. of Nevada, Reno (USA) [10643-19]

11:20 am: **Acoustic data communication by wireless sensor network on plate-like structures for autonomous structural health monitoring of aerovehicles**, Tonmo Fepuussi, Illinois Institute of Technology (USA) and Univ. of Maryland Eastern Shore (USA); Yuanwei Jin, Univ. of Maryland Eastern Shore (USA); Yang Xu, Illinois Institute of Technology (USA) [10643-20]

11:40 am: **Ku and Ka band 8-bit true time-delay electronic beam steered array architecture for concurrent multibeam w/ spatial null generation supporting "on-the-move" wireless communications in heavy RF congestion**, Charles Kryzak, Alion Science and Technology Corp. (USA); Joe Iannotti, GE Global Research (USA) [10643-21]

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

SESSION 5

LOCATION: BALLROOM LEVEL, MIAMI 1 TUE 1:40 PM TO 4:10 PM

Autonomous Operations, Artificial Intelligence, and Navigation I

Session Chairs: **Robert A. Hummel**, National Geospatial-Intelligence Agency (USA); **Michael C. Dudzik**, IQM Research Institute (USA)

1:40 pm: **Dynamic deep feature fusion for person re-identification in aerial images**, Arne Schumann, Jürgen Metzler, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10643-22]

2:00 pm: **Probabilistic models for assured position, navigation and timing**, Andres Molina-Markham, The MITRE Corp. (USA) [10643-24]

2:20 pm: **Intelligent resource selection for sensor-task assignment: the story so far**, Geeth R. de Mel, IBM United Kingdom Ltd. (United Kingdom); Tien Pham, U.S. Army Research Lab. (USA) [10643-25]

2:40 pm: **UAVs for wildland fires**, Moulay A. Akhloufi, Andy Couturier, Univ. de Moncton (Canada) [10643-23]

Coffee Break Tue 3:00 pm to 3:30 pm

3:30 pm: **A robust abnormal detection method for complex structures in UAV images for autonomous O&M system**, Yu Zhao, Jun-ichiro Watanabe, Hitachi, Ltd. (Japan) [10643-27]

3:50 pm: **Automatic tuning of neural network hyperparameters**, Jakub Safarik, CESNET z.s.p.o. (Czech Republic) [10643-28]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

The performance analysis for the subspace projection adaptive method under different subarray structure, Dan Wang, Wichita State Univ. (USA); Guanglei Zhang, Harbin Institute of Technology (China) [10643-26]

1.5mm precision liquid level measurement using impedance spectroscopy, Bhuwan Kashyap, Iowa State Univ. of Science and Technology (USA); Charles Sestok, Anand Dabak, Srinath Ramaswamy, Texas Instruments Inc. (USA); Ratnesh Kumar, Iowa State Univ. of Science and Technology (USA) [10643-36]

Autonomous power generation system for low-power applications as public lighting systems in Puerto Rico, Miguel A. Goenaga-Jimenez, Oscar A. Faura-Molina, Xavier G. Lopez-Correa, Univ. del Turabo (USA) .. [10643-37]

The float round-off error analysis for linear minimum variance adaptive beamforming, Dan Wang, Wichita State Univ. (USA); Guanglei Zhang, Harbin Institute of Technology (China) [10643-38]

The subarray division for the phase array radar, Dan Wang, Wichita State Univ. (USA); Hang Hu, Harbin Institute of Technology (USA) [10643-39]

Multi-objective optimization for subarray structure of the phase array radar, Dan Wang, Wichita State Univ. (USA); Hang Hu, Harbin Institute of Technology (China) [10643-40]

Adaptive monopulse for direction of arrival estimation under mainlobe interference, Dan Wang, Wichita State Univ. (USA); Hang Hu, Harbin Institute of Technology (China) [10643-41]

Advanced spatial spectrum estimation at subarray level for phase array radar, Dan Wang, Wichita State Univ. (USA); Hang Hu, Harbin Institute of Technology (China) [10643-42]

It's a target-rich environment in the IoT, Michael Anderson, The PTR Group (USA) [10643-43]

Technical trade-offs of IoT platforms, Michael Anderson, The PTR Group (USA) [10643-44]

Networking 20-billion devices, Michael Anderson, The PTR Group (USA) [10643-45]

Cloud versus Fog: Which model is more secure for the IoT?, Michael Anderson, The PTR Group (USA) [10643-46]

Printed self-powered miniature air sampling sensors, Joseph Birmingham, Birmingham Technologies, Inc. (USA) [10643-47]

An IOT honeynet for military deception and indications and warnings, Peter Hanson, Concurrent Technologies Corp. (USA) [10643-48]

Optical communication protocol for high-gamma smartphones with android operating system, using the rolling shutter effect, Jaime Rafael Rafael Ek-Ek, Abraham Sierra-Calderon, Jose Alfredo Alvarez-Chavez, Ctr. de Investigación e Innovación Tecnológica (Mexico); Ponciano Jorge Escamilla-Ambrosio, Ctr. de Investigación en Computación (Mexico) [10643-49]

Data processing for cyber security at the network edge with fog computing, Christopher Schuck, Alion Science and Technology Corp. (USA) [10643-50]

WEDNESDAY 18 APRIL

SESSION 6

LOCATION: BALLROOM LEVEL, MIAMI 1 WED 8:35 AM TO 10:00 AM

Autonomous Operations, Artificial Intelligence, and Navigation II

Session Chairs: Brian Hibbeln, Naval Postgraduate School (USA); Jennifer C. Ricklin, Carnegie Mellon Univ.— Software Engineering Institute (USA)

8:35 am: Hacking mobility (Keynote Presentation), Craig Smith, Rapid7 (USA) [10643-29]

9:20 am: Robust hierarchical reasoning over sensor data with the Soar cognitive architecture, Timothy Saucer, Jacob Crossman, Soar Technology, Inc. (USA) [10643-30]

9:40 am: Optimizing cooperative cognitive search and rescue UAVs, Mark D. Rahmes, David Chester, Jodie Hunt, Basil Chiasson, Harris Corp. (USA) [10643-31]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 7

LOCATION: BALLROOM LEVEL, MIAMI 1 WED 11:00 AM TO 12:20 PM

Autonomous Operations, Artificial Intelligence, and Navigation III

Session Chairs: Brian Hibbeln, Naval Postgraduate School (USA); Jennifer C. Ricklin, Carnegie Mellon Univ.— Software Engineering Institute (USA)

11:00 am: Power line-tree conflict detection and 3D mapping using aerial images taken from UAV, Jun-ichiro Watanabe, Hitachi, Ltd. (Japan); Sanko Ren, Hitachi Solutions, Ltd. (Japan); Yu Zhao, Tomonori Yamamoto, Hitachi, Ltd. (Japan) [10643-32]

11:20 am: The state of solid-state 3D lidar for autonomous systems, Frank Bertini, Velodyne LiDAR, Inc. (USA) [10643-33]

11:40 am: Survivability: a hierarchical fuzzy logic layered model for threat management of unmanned ground vehicles, Shashank Kamthan, Harpreet Singh, Wayne State Univ. (USA); Thomas J. Meitzler, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA) . . . [10643-34]

12:00 pm: Distributed control technology for management of roads with driverless cars, Peter Sapaty, The National Academy of Sciences of Ukraine (Ukraine) [10643-35]

CONFERENCE 10644

LOCATION: BALLROOM LEVEL, OSCEOLA 2

Tuesday–Thursday 17–19 April 2018 • Proceedings of SPIE Vol. 10644

Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XXIV

Conference Chairs: **Miguel Velez-Reyes**, The Univ. of Texas at El Paso (USA); **David W. Messinger**, Rochester Institute of Technology (USA)

Program Committee: **Wojciech Czaja**, Univ. of Maryland, College Park (USA); **Michael T. Eismann**, Air Force Research Lab. (USA); **Jacqueline J. Le Moigne**, NASA Goddard Space Flight Ctr. (USA); **Joseph Meola**, Air Force Research Lab. (USA); **Daniela I. Moody**, Descartes Labs, Inc. (USA); **Dalton S. Rosario**, U.S. Army Research Lab. (USA); **Alan P. Schaum**, U.S. Naval Research Lab. (USA); **Torbjørn Skauli**, Norwegian Defence Research Establishment (Norway); **James Theiler**, Los Alamos National Lab. (USA); **Grady Tuell**, 3D Ideas LLC (USA); **Alina Zare**, Univ. of Florida (USA)

TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, OSCEOLA 2 TUE 8:20 AM TO 10:00 AM

Target and Anomaly Detection

Session Chair: **Miguel Velez-Reyes**,
The Univ. of Texas at El Paso (USA)

8:20 am: **Target detection using artificial neural networks on LWIR hyperspectral imagery**, Jacob A. Martin, Air Force Research Lab. (USA) [10644-1]

8:40 am: **Impact of platform motion on hyperspectral imaging target detection and ground resolution distance**, Nathan P. Wurst, Air Force Research Lab. (USA) [10644-3]

9:00 am: **A machine learning approach to hyperspectral target detection**, Amanda K. Ziemann, James Theiler, Los Alamos National Lab. (USA) [10644-4]

9:20 am: **On-board CubeSat processing for hyperspectral gas detection**, James Theiler, Bernard Foy, Steven P. Love, Claira Safi, Los Alamos National Lab. (USA) [10644-5]

9:40 am: **Closed-form solutions to replacement target models of sub-pixel spectral detection**, Alan P. Schaum, U.S. Naval Research Lab. (USA) [10644-6]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 2

LOCATION: BALLROOM LEVEL, OSCEOLA 2 TUE 11:00 AM TO 12:20 PM

Dimensionality Reduction and Feature Extraction

Session Chair: **Amanda K. Ziemann**, Los Alamos National Lab. (USA)

11:00 am: **Optimal sensor control for fast target detections in hyperspectral imagery**, Cara P. Murphy, Gil Raz, Chelsea Georgan, Mark Chilenski, Systems & Technology Research (USA) [10644-7]

11:20 am: **Data fusion for land-use classification**, Poppy G. Immel, Rochester Institute of Technology (USA); Nathan D. Cahill, Rochester Institute of Technology (USA) [10644-8]

11:40 am: **Dimensionality reduction for spatial-spectral target detection on hyperspectral imagery**, Jason R. Kaufman, Univ. of Dayton Research Institute (USA); Joseph Meola, Air Force Research Lab. (USA) [10644-9]

12:00 pm: **Column subset selection methods for endmember extraction in hyperspectral unmixing**, Maher Aldeghlawi, The Univ. of Texas at El Paso (USA); Miguel Velez-Reyes, Univ of Texas at El Paso (USA) [10644-10]

Lunch/Exhibition Break Tue 12:20 pm to 2:00 pm

SESSION 3

LOCATION: BALLROOM LEVEL, OSCEOLA 2 TUE 2:00 PM TO 3:20 PM

Image Fusion

Session Chair: **Dalton S. Rosario**, U.S. Army Research Lab. (USA)

2:00 pm: **On the generation of high-spatial and high-spectral resolution images using THEMIS and TES for Mars Exploration**, Chiman Kwan, Signal Processing, Inc. (USA); Christopher Haberle, Arizona State Univ. (USA); Bulent Ayhan, Signal Processing, Inc. (USA); Bryan Chou, Applied Research LLC (USA); Scott Dickenshied, Arizona State Univ. (USA) [10644-11]

2:20 pm: **Spectral-elevation data registration using visible-SWIR spatial correspondence**, Dalton S. Rosario, U.S. Army Research Lab. (USA) [10644-12]

2:40 pm: **Landing zone identification for autonomous UAV applications using fused hyperspectral imagery and LIDAR point clouds**, Sarah Lane, Zsolt Kira, Ryan James, Domenic Carr, Georgia Tech Research Institute (USA); Grady Tuell, 3D Ideas, LLC (USA) [10644-13]

3:00 pm: **Photogrammetric point cloud and LIDAR fusion for improved building delineation**, Jeremy P. Metcalf, Richard C. Olsen, Naval Postgraduate School (USA) [10644-14]

Coffee Break Tue 3:20 pm to 4:00 pm

SESSION 4

LOCATION: BALLROOM LEVEL, OSCEOLA 2 TUE 4:00 PM TO 6:00 PM

Machine Learning in Spectral Sensing

Session Chair: **Wojciech Czaja**,
Univ. of Maryland, College Park (USA)

4:00 pm: **A study of the effect of alternative similarity measures on the performance of graph-based anomaly detection algorithms** (*Invited Paper*), Tegan Emerson, Timothy J. Doster, Colin Olson, U.S. Naval Research Lab. (USA) [10644-20]

4:20 pm: **Threat determination for radiation detection from the Remote Sensing Laboratory** (*Invited Paper*), Thomas McCullough, William Ford, National Security Technologies, LLC (USA) [10644-16]

4:40 pm: **Scattering transforms for hyperspectral data analysis** (*Invited Paper*), Wojciech Czaja, Weilin Li, Ilya Kavalerov, Univ. of Maryland, College Park (USA) [10644-17]

5:00 pm: **Diffusion learning for hyperspectral clustering** (*Invited Paper*), James M. Murphy, Johns Hopkins Univ. (USA) [10644-18]

5:20 pm: **Deep learning with convolutional fiber filters for spectral analysis of hyperspectral imagery**, Robert S. Rand, R3-Experts, Inc. (USA) [10644-19]

5:40 pm: **Deep supervised autoencoder network for graph-based dimensionality reduction in hyperspectral imagery**, Xuwen Zhang, Nathan D. Cahill, Rochester Institute of Technology (USA) [10644-15]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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 new bandwidth selection criterion for using SVDD to analyze, Yuwei Liao, Deovrat Kakde, Arin Chaudhuri, Hansi Jiang, Carol Sadek, Seunghyun Kong, SAS Institute Inc. (USA) [10644-60]

Efficient measurement and analysis method of the smile and keystone of the hyperspectral imager, Jinsuk Hong, Samsung Thales Co., Ltd. (Korea, Republic of) [10644-62]

Programmable system on chip implementation of a principal component analysis for preprocessing of multispectral image data acquired with filter wheel cameras, Mathias Schellhorn, Richard Fütterer, Gunther Notni, Technische Univ. Ilmenau (Germany) [10644-63]

Enhanced radiosity processing: target classification in scenes with non-lambertian objects, Ping Fung, Mario Parente, Univ. of Massachusetts Amherst (USA); Steven E. Golowich, MIT Lincoln Lab. (USA) [10644-64]

Noise reduction for improving the performance of gas detection algorithms in the FTIR spectrometer, Hyeong-Geun Yu, Yong-Chan Kim, Jai-Hoon Lee, Dong-Jo Park, KAIST (Korea, Republic of) [10644-65]

Wide dense neural network for material classification based on spectral BTF, Gefei Yang, Michael Gartley, Rochester Institute of Technology (USA) [10644-66]

Advanced imaging system with multiple optical sensing modes, Kyle McCormick, Jaclyn M. Nascimento, Leif Hendricks, Michael Beecroft, Mark Dombrowski, Surface Optics Corp. (USA) [10644-67]

Parametric modeling of NIR and SWIR reflectance spectra for dye mixtures in fabrics using reference spectra, Rachel Viger, Scott Ramsey, Troy Mayo, Samuel G. Lambrakos, U.S. Naval Research Lab. (USA) [10644-68]

Evaluation of MODIS and Sentinel-3 SLSTR thermal emissive bands calibration consistency using Dome C, Ashish Shrestha, Amit Angal, Yonghong Li, Science Systems and Applications, Inc. (USA); Xiaoxiong Xiong, NASA Goddard Space Flight Ctr. (USA) [10644-69]

Comparative study of spectral matched filter, constrained energy minimization, and adaptive coherence estimator for subpixel target detection based on hyperspectral imaging, Kamal Jnawali, Navalgund Rao, Rochester Institute of Technology (USA) [10644-70]

Processes for conducting HSI pan-sharpening with 3D digital flattening, Tyler Peery, David W. Messinger, Rochester Institute of Technology (USA) [10644-71]

Evaluation of the on-orbit response versus scan-angle (RVS) performance for the MODIS reflective solar bands using multiple ground targets, Qiaozhen Mu, Amit Angal, Xu Geng, Aisheng Wu, Science Systems and Applications, Inc. (USA); Xiaoxiong Xiong, NASA Goddard Space Flight Ctr. (USA) [10644-72]

Spectral encoding using the k-space/frequency duality for compression-less imaging, Hichem Guerboukha, Kathirvel Nallappan, Maksim Skorobogatiy, Ecole Polytechnique de Montréal (Canada) . [10644-73]

Underwater target detection with hyperspectral imagery for search and rescue missions, İsa Cem Eken, Yasemin Yardımcı Çetin, Middle East Technical Univ. (Turkey) [10644-74]

Spectral phenomenology of historical parchments and inks to aid cultural heritage imaging system development, Tyler Kuhns, Rochester Institute of Technology (USA) [10644-75]

Seeded Laplacian in sparse subspace for hyperspectral image classification, Chunhua Dong, Xiangyan Zeng, Masoud Naghedolfeizi, Dawit Abera, Hao Qiu, Fort Valley State Univ. (USA) [10644-76]

Low-dimensional superpixel representation with homogeneity testing for unmixing of hyperspectral imagery, Jiarui Yi, Miguel Velez-Reyes, The Univ. of Texas at El Paso (USA) [10644-77]

AR in multiperspective environmental imaging, Luke J. Nichols, Zachary Weingarten, Chris Didier, Joseph Prine, Ryan Integlia, Florida Polytechnic Univ. (USA) [10644-78]

Autonomous systems for nuclear crisis response, consequence management and forensics, Lance K. McLean, National Security Technologies, LLC (USA) [10644-79]

Subpixel target detection in hyperspectral imaging, Edisanter Lo, Susquehanna Univ. (USA) [10644-80]

An efficient hyperspectral feature selection strategy using multiple distance metrics, Yusuf Kalaycı, Yildiz Technical Univ. (Turkey) . . [10644-81]

Improved anomaly detection via spatial-spectral kernel fusion in a skeleton kernel principle component analysis framework, Renee Meinhold, Rochester Institute of Technology (USA); Timothy J. Doster, Colin Olson, U.S. Naval Research Lab. (USA) [10644-83]

Modeling apparent camouflage patterns for visual evaluation, Troy Mayo, Scott Ramsey, Chris Howells, Andrew Shabaev, Samuel G. Lambrakos, U.S. Naval Research Lab. (USA) [10644-84]

Satellite imagery analysis for automated global food security forecasting, Daniela I. Moody, Steven P. Brumby, David Nicholaeff, Rick Chartrand, Mark Mathis, Justin Poehnel, Samuel W. Skillman, Michael S. Warren, Descartes Labs, Inc. (USA) [10644-85]

WEDNESDAY 18 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, OSCEOLA 2 WED 8:00 AM TO 10:00 AM

Performance Evaluation of Sensors and Systems

Session Chair: **Joseph Meola**, Air Force Research Lab. (USA)

8:00 am: **Examining the impact of spectral uncertainty on hyperspectral data exploitation,** Joseph Meola, Air Force Research Lab. (USA) . [10644-21]

8:20 am: **Figures of merit for the optical performance of Fresnel zone light field spectral imagers,** Anthony L. Franz, Jack A. Shepherd, Carlos D. Diaz, Air Force Institute of Technology (USA) [10644-22]

8:40 am: **Evaluating calibration consistency of Terra and Aqua MODIS LWIR PV bands using Dome C,** Ashish Shrestha, Truman Wilson, Aisheng Wu, Science Systems and Applications, Inc. (USA); Xiaoxiong Xiong, NASA Goddard Space Flight Ctr. (USA) [10644-23]

9:00 am: **Evaluating the long-term stability and response versus scan angle effect in the SNPP VIIRS SDR reflectance product using a deep convective cloud technique,** Qiaozhen Mu, Tiejun Chang, Aisheng Wu, Science Systems and Applications, Inc. (USA); Xiaoxiong Xiong, NASA Goddard Space Flight Ctr. (USA) [10644-24]

9:20 am: **Simulation techniques for image utility analysis,** Sanghui Han, John P. Kerekes, Rochester Institute of Technology (USA) [10644-25]

9:40 am: **A computational approach to hyperspectral imaging for long-range target identification,** Robert A. Lamb, Leonardo MW Ltd. (United Kingdom); Simon Vary, Andrew Thompson, Univ. of Oxford (United Kingdom); David Humphreys, Leonardo MW Ltd. (United Kingdom); Jared Tanner, Univ. of Oxford (United Kingdom) [10644-26]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

CONFERENCE 10644

SESSION 6

LOCATION: BALLROOM LEVEL, OSCEOLA 2 WED 11:00 AM TO 12:20 PM

Atmospheric Modeling and Compensation

Session Chair: **John P. Kerekes**,
Rochester Institute of Technology (USA)

11:00 am: **Sensitivity of temperature and emissivity separation to atmospheric errors in LWIR hyperspectral imagery**, Michael L. Pieper, Dimitris Manolakis, Eric Truslow, MIT Lincoln Lab. (USA); Vinay Ingle, Northeastern Univ. (USA) [10644-27]

11:20 am: **Operational and deployable remote sensing calibration**, Lester Foster, EWA Government Systems, Inc. (USA); Carl Guerreri, Electronic Warfare Associates, Inc. (USA) [10644-28]

11:40 am: **Seeing through heavily polluted satellite imagery using QUAC**, Steven M. Adler-Golden, Lawrence Bernstein, Benjamin St. Peter, Bridget E. Tannian, Spectral Sciences, Inc. (USA) [10644-29]

12:00 pm: **Atmospheric correction of commercial thermal infrared hyperspectral imagery using FLAASH-IR**, Steven M. Adler-Golden, Nevzat Guler, Spectral Sciences, Inc. (USA) [10644-30]

Lunch/Exhibition Break Wed 12:20 pm to 2:00 pm

SESSION 7

LOCATION: BALLROOM LEVEL, OSCEOLA 2 WED 2:00 PM TO 3:20 PM

LWIR and MWIR Spectral Sensing

Session Chair: **Michael T. Eismann**, Air Force Research Lab. (USA)

2:00 pm: **Comparison of bad pixel replacement techniques for LWIR hyperspectral imagery**, Jacob A. Martin, Air Force Research Lab. (USA); Genesis Islas, Arizona State Univ. (USA) [10644-31]

2:20 pm: **Infrared signature measurements of a jet turbine using a hyperspectral imager for combustion diagnostics**, Mason Paulec, Naval Air Warfare Ctr. Weapons Div. (USA) and Air Force Institute of Technology (USA); Michael A. Marciniak, Kevin Gross, Air Force Institute of Technology (USA); David Azevedo, Pratt & Whitney (USA); Kevin Young, Naval Air Warfare Ctr. Weapons Div. (USA) [10644-32]

2:40 pm: **Design, calibration and characterization of a low-cost spatial Fourier transform LWIR hyperspectral imaging camera with spatial and temporal scanning modes**, Thomas Svensson, Martin Fridlund, David Bergström, Linnéa Axelsson, FOI-Swedish Defence Research Agency (Sweden) [10644-33]

3:00 pm: **Infrared absorption bands measured with an uncooled interferometric LWIR hyperspectral camera**, Thomas Svensson, Tomas Hallberg, FOI-Swedish Defence Research Agency (Sweden) [10644-34]

Coffee Break Wed 3:20 pm to 4:00 pm

SESSION 8

LOCATION: BALLROOM LEVEL, OSCEOLA 2 WED 4:00 PM TO 6:00 PM

Change Detection and Image Registration

Session Chair: **James P. Theiler**, Los Alamos National Lab. (USA)

4:00 pm: **Multispectral change detection methods: evaluation on simulated and real-world satellite imagery**, Jobin J. Mathew, John P. Kerekes, Rochester Institute of Technology (USA) [10644-37]

4:20 pm: **Robust long-wave infrared hyperspectral change detection**, Nicholas Durkee, Wright State Univ. (USA); Joseph Meola, Air Force Research Lab. (USA); Joshua Ash, Wright State Univ. (USA) [10644-38]

4:40 pm: **Fine tune image registration for orthorectified commercial imagery**, Michael E. Zelinski, Lawrence Livermore National Lab. (USA) [10644-39]

5:00 pm: **Auto-adaptive harris corner detection algorithm based on entropy-improved block processing**, Yihang Sun, Emmett Ientilucci, Rochester Institute of Technology (USA); Sophie Voisin, Oak Ridge National Lab. (USA) [10644-40]

5:20 pm: **High performance change detection in hyperspectral images using multiple references**, Jin Zhou, Chiman Kwan, Signal Processing, Inc. (USA) [10644-35]

5:40 pm: **A new nonlinear change detection approach based on band ratioing**, Bulent Ayhan, Chiman Kwan, Jin Zhou, Signal Processing, Inc. (USA) [10644-36]

THURSDAY 19 APRIL

SESSION 9

LOCATION: BALLROOM LEVEL, OSCEOLA 2 THU 8:00 AM TO 10:00 AM

Applications

Session Chair: **Emmett J. Ientilucci**,
Rochester Institute of Technology (USA)

8:00 am: **Pigment diversity estimation for hyperspectral images of the Selden map of China**, Di Bai, David W. Messinger, Rochester Institute of Technology (USA); David Howell, Univ. of Oxford (United Kingdom) . [10644-41]

8:20 am: **Necessary steps for the systematic calibration of a multispectral imaging system to achieve a targetless workflow in reflectance estimation: a study of Parrot SEQUOIA for precision agriculture**, Luis Mario Domenzain, Clément Fallet, Parrot S.A. (France) [10644-42]

8:40 am: **Virtual true-color imagery for advanced baseline imager**, Irina Gladkova, Michael Grossberg, The City College of New York (USA); Don Hillger, NOAA Ctr. for Satellite Applications and Research (USA) and Cooperative Institute for Research in the Atmosphere, Colorado State Univ. (USA) [10644-43]

9:00 am: **Multispectral imaging for improved liquid classification in security sensor systems**, Andrea Burns, Ctr. for Discrete Mathematics and Theoretical Computer Science (USA); Waheed U. Bajwa, Rutgers, The State Univ. of New Jersey (USA) [10644-44]

9:20 am: **Initial investigation of AVIRIS-NG imaging spectroscopy data to map domestic animals and wildlife in Birds of Prey National Conservation Area, Idaho**, Zan L. Aslett, Solis Applied Science (USA); Leslie G. Garza, George Mason Univ. (USA) [10644-45]

9:40 am: **Application of random forests machine learning technique for classifying AVIRIS-NG imaging spectroscopy data to identify domestic animals and wildlife in Chino, California**, Leslie G. Garza, Independent (USA); Zan L. Aslett, Solis Applied Science (USA) [10644-46]

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

SESSION 10

LOCATION: BALLROOM LEVEL, OSCEOLA 2 THU 10:30 AM TO 12:30 PM

Sensor, Design, Development, and Characterization

Session Chair: **Torbjørn Skauli**,
Norwegian Defence Research Establishment (Norway)

10:30 am: **Efficient assembly and alignment method for optimized spatial resolution of three-mirror off-axis fore optics of hyperspectral imager**, Jinsuk Hong, Samsung Thales Co., Ltd. (Korea, Republic of) [10644-47]

10:50 am: **Modification of Fresnel zone light field spectral imaging system for higher resolution**, Carlos D. Diaz, Anthony L. Franz, Jack A. Shepherd, Air Force Institute of Technology (USA) [10644-48]

11:10 am: **A compressive approach to speckle-based imaging spectroscopy**, Rebecca French, Univ. of Southampton (United Kingdom); Sylvain Gigan, Lab. Kastler Brossel (France); Otto L. Muskens, Univ. of Southampton (United Kingdom) [10644-49]

11:30 am: **Agile optoelectronic fiber sources for hyperspectral sensing from SWIR to LWIR**, Inuk Kang, Andrew Grant, Mihaela Dinu, LGS Innovations Inc. (USA); James Jaques, LGS Innovations, LLC (USA); Luke Pfister, Rohit Bhargava, Univ. of Illinois (USA); Scott Carney, Univ. of Rochester (USA) [10644-50]

11:50 am: **Measurement of point spread function for comparison of the coregistration performance of hyperspectral cameras**, Hans Erling Torkildsen, Torbjørn Skauli, Norwegian Defence Research Establishment (Norway) [10644-51]

12:10 pm: **Compact visible to extended-SWIR hyperspectral sensor for unmanned aircraft systems (UAS)**, Leah Ziph-Schatzberg, Corning NetOptix (USA); Richard Wiggins, Patrick Woodman, Mohammad Saleh, Keith Nakanishi, Corning Incorporated (USA); Neil Goldstein, Marsha E. Fox, Bridget E. Tannian, Spectral Sciences, Inc. (USA) [10644-52]

Lunch Break Thu 12:30 pm to 1:30 pm

SESSION 11

LOCATION: BALLROOM LEVEL, OSCEOLA 2 THU 1:30 PM TO 2:20 PM

Keynote Session

Session Chair: **Daniela I. Moody**, Descartes Labs, Inc. (USA)

1:30 pm: **The confluence of commercial space and the computing revolution** (*Keynote Presentation*), Joseph B. Evans, Defense Advanced Research Projects Agency/STO (USA) [10644-53]

SESSION 12

LOCATION: BALLROOM LEVEL, OSCEOLA 2 THU 2:20 PM TO 3:40 PM

Spectral Modeling and Characterization

Session Chair: **David W. Messinger**,
Rochester Institute of Technology (USA)

2:20 pm: **Grazing angle experimental analysis of modification to microfacet BRDF model for improved accuracy**, Becca E. Ewing, Wright State Univ. (USA); Samuel Butler, Air Force Institute of Technology (USA) [10644-54]

2:40 pm: **Case-study analysis of apparent color for camouflage fabrics**, Scott Ramsey, Troy Mayo, Samuel G. Lambrakos, U.S. Naval Research Lab. (USA) [10644-55]

3:00 pm: **Surface roughness and particle size influences in reflectance infrared spectroscopy**, Emmanuela Diaz, Defence Research and Development Canada, Valcartier (Canada) [10644-56]

3:20 pm: **Measurement campaign for hyperspectral imaging in complex illumination environments**, Steven E. Golowich, Ronald Lockwood, Marius Albota, MIT Lincoln Lab. (USA); John Jacobson, National Air and Space Intelligence Ctr. (USA) [10644-58]

CONFERENCE 10645

LOCATION: BALLROOM LEVEL, OSCEOLA 2

Monday-Tuesday 16-17 April 2018 • Proceedings of SPIE Vol. 10645

Geospatial Informatics, and Motion Imagery Analytics VIII

Conference Chairs: **Kannappan Palaniappan**, Univ. of Missouri-Columbia (USA); **Peter J. Doucette**, U.S. Geological Survey (USA); **Gunasekaran Seetharaman**, U.S. Naval Research Lab. (USA)

Program Committee: **Alex Aved**, Air Force Research Lab. (USA); **John A. Berger**, Toyon Research Corp. (USA); **Subhasis Chaudhuri**, Indian Institute of Technology Bombay (India); **Ananda Shankar Chowdhury**, Jadavpur Univ. (India); **John T. Dolloff**, Integrity Applications, Inc. (USA); **Joshua D. Harguess**, SPAWAR Systems Ctr. Pacific (USA); **Jutta E. Hild**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **John M. Irvine**, Draper Lab. (USA); **Stefan R. Jaeger**, National Library of Medicine (USA); **Simon J. Julier**, Univ. College London (United Kingdom); **Chandra Kambhamettu**, Univ. of Delaware (USA); **Ross Maciejewski**, Arizona State Univ. (USA); **Richard J. Maude**, Univ. of Oxford (United Kingdom); **Upesh Patel**, U.S. Army Communications-Electronics Command (USA); **V. B. Surya Prasath**, Univ. of Missouri-Columbia (USA); **Bruce Quirk**, U.S. Geological Survey (USA); **Sartaj Sahni**, Univ. of Florida (USA); **Carl Salvaggio**, Rochester Institute of Technology (USA); **Stefano Soatto**, Univ. of California, Los Angeles (USA); **Clark N. Taylor**, Air Force Research Lab. (USA); **William R. Thissell**, Chenega Technical Innovations, LLC (USA); **Jonathan D. Tucker**, Lockheed Martin Corp. (USA); **Zhuoting Wu**, U.S. Geological Survey (USA)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, OSCEOLA 2 MON 9:00 AM TO 10:00 AM

Geospatial Analytics I

Session Chair: **Kannappan Palaniappan**, Univ. of Missouri (USA)

9:00 am: **Ground vehicle power line spectral sensing using GIS**, Mark W. Roberson, C. Kenneth Williams, Laura E. Roberson, Goldfinch Sensor Technologies and Analytics LLC (USA) [10645-1]

9:20 am: **Urban 3D challenge: building footprint detection using orthorectified imagery and digital surface models from commercial satellites**, Hirsh Goldberg, Myron Brown, Gordon Christie, Sean Wang, Johns Hopkins Univ. Applied Physics Lab., LLC (USA) [10645-2]

9:40 am: **Quadcopter sensing of magnetic and electric field with geospatial analytics**, Mark W. Roberson, Charles E. Bartee, Laura E. Roberson, Goldfinch Sensor Technologies and Analytics LLC (USA) [10645-3]

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

SESSION 2

LOCATION: BALLROOM LEVEL, OSCEOLA 2 MON 10:30 AM TO 11:30 AM

Geospatial Analytics II

Session Chair: **Kannappan Palaniappan**, Univ. of Missouri (USA)

10:30 am: **Tailoring image compression to mission needs: Predicting NIIRS loss due to image compression**, Hua-Mei Chen, Intelligent Fusion Technology, Inc. (USA); John M. Irvine, Draper Lab. (USA); Zhonghai Wang, Genshe Chen, Intelligent Fusion Technology, Inc. (USA); Erik Blasch, James Nagy, Air Force Research Lab. (USA) [10645-5]

10:50 am: **Feasibility of an interpretability metric for LIDAR data**, Ye Duan, Univ. of Missouri (USA); John M. Irvine, Draper Lab. (USA); Hua-Mei Chen, Genshe Chen, Intelligent Fusion Technology, Inc. (USA); Erik Blasch, James Nagy, Air Force Research Lab. (USA) [10645-6]

11:10 am: **Leveraging synthetic imagery for collision-at-sea avoidance**, Chris M. Ward, Joshua D. Harguess, Alexander G. Corelli, SPAWAR Systems Ctr. Pacific (USA) [10645-7]

Lunch Break Mon 11:30 am to 1:00 pm

SESSION 3

LOCATION: BALLROOM LEVEL, OSCEOLA 2 MON 1:00 PM TO 2:20 PM

Motion Imagery Analytics

Session Chair: **Guna Seetharaman**, U.S. Naval Research Lab. (USA)

1:00 pm: **Learning a dictionary of activities from motion imagery tracking data**, John M. Irvine, Richard J. Wood, Draper Lab. (USA) [10645-8]

1:20 pm: **Motion image data collection simulation for 3D target reconstruction**, Andrew Kalukin, Robert F. Pinkerton, National Geospatial-Intelligence Agency (USA) [10645-9]

1:40 pm: **Aggregating motion cues and image quality metrics for video quality estimation**, Joshua D. Harguess, Michael Reese, SPAWAR Systems Ctr. Pacific (USA) [10645-10]

2:00 pm: **Robust multi-object tracking with semantic color correlation and motion smoothness constraint for wide-area motion imagery**, Noor Al-Shakarji, Filiz Bunyak, Univ. of Missouri (USA); Guna Seetharaman, U.S. Naval Research Lab. (USA); Kannappan Palaniappan, Univ. of Missouri (USA) [10645-11]

SESSION 4

LOCATION: BALLROOM LEVEL, OSCEOLA 2 MON 2:20 PM TO 4:50 PM

Geolocation and Registration

Session Chair: **Peter J. Doucette**, U.S. Geological Survey (USA)

2:20 pm: **Geolocation system estimators: processes for their quality assurance and quality control**, John T. Dolloff, Jacqueline Carr, Integrity Applications, Inc. (USA) [10645-12]

2:40 pm: **Targeted 3D modeling from UAV imagery**, Abe Martin, Brigham Young Univ. (USA); Benjamin Heiner, Air Force Research Lab. (USA); John D. Hedengren, Brigham Young Univ. (USA) [10645-13]

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

3:30 pm: **An improved method for verifying the predicted uncertainty of Bayesian state estimators**, Clark N. Taylor, Shane Lubold, Air Force Research Lab. (USA) [10645-14]

3:50 pm: **An investigation into strategies to improve optical flow on degraded data**, Joshua D. Harguess, Diego Marez, SPAWAR Systems Ctr. Pacific (USA); Nancy Ronquillo, Univ. of California, San Diego (USA) [10645-15]

4:10 pm: **Evaluation of different image processing methods in the context of an image registration framework**, Stefan Brüstle, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10645-16]

4:30 pm: **Real-time georegistration and stabilization on embedded systems**, Evan Teters, Hadi AliAkbarpour, Kannappan Palaniappan, Univ. of Missouri (USA); Guna Seetharaman, U.S. Naval Research Lab. (USA) [10645-17]

SYMPOSIUM-WIDE PLENARY SESSION
LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

- 5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**
 - 5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)
 - 5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin
 - 6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)
- See pages 6–7 for details.*

TUESDAY 17 APRIL

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Automatic mosaicing of the field data from drone aerial imagery, Rumana Aktar, Hadi AliAkbarpour, Toni Kazic, Univ. of Missouri (USA); Guna Seetharaman, U.S. Naval Research Lab. (USA); Kannappan Palaniappan, Univ. of Missouri (USA) [10645-18]

Evaluation of feature matching in aerial imagery for structure-from motion and bundle adjustment, Ke Gao, Hadi AliAkbarpour, Kannappan Palaniappan, Univ. of Missouri (USA); Guna Seetharaman, U.S. Naval Research Lab. (USA) [10645-19]

Grid-based multi-view stereo for high-resolution imagery, Shizeng Yao, Hadi AliAkbarpour, Univ. of Missouri (USA); Guna Seetharaman, U.S. Naval Research Lab. (USA); Kannappan Palaniappan, Univ. of Missouri (USA) [10645-20]

Robust target tracking using adaptive color feature and likelihood fusion, Arnaud Bouix, Institut National des Sciences Appliquées de Ctr. Val de Loire (France); Noor Al-Shakarji, Ke Gao, Filiz Bunyak, Kannappan Palaniappan, Univ. of Missouri (USA) [10645-21]

CONFERENCE 10646

LOCATION: BALLROOM LEVEL, OSCEOLA 1

Monday–Thursday 16–19 April 2018 • Proceedings of SPIE Vol. 10646

Signal Processing, Sensor/Information Fusion, and Target Recognition XXVII

Conference Chair: **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA)

Conference Co-Chairs: **Bhashyam Balaji**, Defence Research and Development Canada (Canada); **Erik P. Blasch**, Air Force Research Lab. (USA); **Lynne L. Grewe**, California State Univ., East Bay (USA); **Thia Kirubarajan**, McMaster Univ. (Canada); **Ronald P. S. Mahler**, Random Sets, LLC (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); **Alex L. Chan**, U.S. Army Research Lab. (USA); **Kuo-Chu Chang**, George Mason Univ. (USA); **Chee-Yee Chong**, Independent Consultant (USA); **Marvin N. Cohen**, Georgia Tech Research Institute (USA); **Frederick E. Daum**, Raytheon Co. (USA); **Jean Dezert**, The French Aerospace Lab. (France); **Mohammad Farooq**, AA Scientific Consultants Inc. (Canada); **Laurie H. Fenstermacher**, Air Force Research Lab. (USA); **Charles W. Glover**, Oak Ridge National Lab. (USA); **I. R. Goodman**, Consultant (USA); **Michael L. Hinman**, Independent Consultant (USA); **Jon S. Jones**, Air Force Research Lab. (USA); **Georgiy M. Levchuk**, Aptima, Inc. (USA); **Martin E. Liggins II**, Independent 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.**, Harris Corp. (USA); **Robert W. Schutz**, Consultant (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); **Shanchieh Jay Yang**, Rochester Institute of Technology (USA)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, OSCEOLA 1 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); **Thia Kirubarajan**, TrackGen Solutions Inc. (Canada); **Bhashyam Balaji**, Defence Research and Development Canada (Canada)

- 8:30 am: **Track stitching and approximate track association on a pairwise-likelihood graph**, Lingji Chen, nuTonomy (USA); Sarah E. Rumbley, BAE Systems (USA) [10646-1]
- 8:50 am: **From labels to tracks: it's complicated**, Lingji Chen, nuTonomy (USA) [10646-2]
- 9:10 am: **An introduction to the generalized labeled multi-Bernoulli filter through Matlab code**, Lingji Chen, nuTonomy (USA) [10646-3]
- 9:30 am: **On-orbit calibration of satellite based imaging sensors**, Djedjiga Belfadel, Fairfield Univ. (USA); Yaakov Bar-Shalom, Peter K. Willett, Univ. of Connecticut (USA) [10646-5]
- 9:50 am: **The data-driven delta-generalized labeled multi-Bernoulli tracker for automatic birth initialization**, Keith LeGrand, Sandia National Labs. (USA); Kyle J. DeMars, Missouri Univ. of Science and Technology (USA) [10646-4]
- Coffee Break. Mon 10:10 am to 10:40 am

SESSION 2

LOCATION: BALLROOM LEVEL, OSCEOLA 1 MON 10:40 AM TO 12:20 PM

Multisensor Fusion, Multitarget Tracking, and Resource Management II

Session Chairs: **Thia Kirubarajan**, TrackGen Solutions Inc. (Canada); **Ronald P. S. Mahler**, Random Sets, LLC (USA); **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA)

- 10:40 am: **Localization of a point target from an optical sensor's focal plane array**, Qin Lu, Yaakov Bar-Shalom, Peter K. Willett, Balakumar Balasingam, Univ. of Connecticut (USA) [10646-6]
- 11:00 am: **Accuracy of target location estimation in a focal plane array**, Andrew Finelli, Yaakov Bar-Shalom, Peter K. Willett, Balakumar Balasingam, Univ. of Connecticut (USA) [10646-7]
- 11:20 am: **Trajectory estimation and impact point prediction of a ballistic object from a single fixed passive sensor**, Kaipei Yang, Yaakov Bar-Shalom, Peter K. Willett, Ronen Ben-Dov, Benny Milgrom, Univ. of Connecticut (USA) [10646-8]
- 11:40 am: **A study of particle filtering approaches for the kidnapped robot problem**, Clark N. Taylor, Air Force Research Lab. (USA); David Mohler, Wright State Univ. (USA) [10646-9]
- 12:00 pm: **Evaluation of optimizations of Murty's M-best assignment method**, Qin Lu, Wenbo Dou, Radu Visina, Krishna Pattipati, Yaakov Bar-Shalom, Univ. of Connecticut (USA) [10646-10]
- Lunch Break Mon 12:20 pm to 1:15 pm

INVITED PANEL DISCUSSION

LOCATION: BALLROOM LEVEL, OSCEOLA 1 MON 1:15 PM TO 4:45 PM

Deep Learning in AI and Information Fusion

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

Panel Moderators: **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA) and **Chee-Yee Chong**, Independent Consultant (USA)

Panelists: **Chee-Yee Chung**, Independent Consultant (USA); **George Cybenko**, Dartmouth College (USA); **Lynn Grewe**, California State Univ. (USA); **Henry Leung**, Univ. Calgary (Canada); **Shashi Phoba**, The Pennsylvania State Univ. (USA); **Majumder Uttam**, AFMC AFRL/RITB (USA)

In the early days of artificial intelligence (AI) starting say in 1970s and 1980s the predominant reasoning methods were logical and symbolic using e.g., Lisp/Prolog languages, and later in the 1980s AI tools i.e., Knowledge Environment Engineering (KEE) and Automated Reasoning Tool (ART) expert systems, and early heuristic reasoning methods. Also the concept and mathematical representation of "context" logic was defined. The concept and apps of both "knowledge based" and "context" are currently used in several apps in information fusion (IF) along with several methods to apply and learn contextual information.

Also in the early 1980's, AI was viewed as the solution to information fusion problems. In fact, many contributors to the first distributed sensor networks program were AI researchers. However, inadequate computing and AI approaches such as expert systems and heuristic uncertainty reasoning could not address the challenges of information fusion. Thus, important advances in information fusion, and in particular, multi-target tracking, were made with little contribution from AI.

During the long AI winter, researchers addressed the deficiencies of early AI, developing rigorous representation and reasoning techniques for uncertainty, and machine learning approaches. Recently, data science was established as a popular area to exploit the large volumes of data (a.k.a. Big Data) collected by physical sensors and online activities using machine learning and other analytic tools.

Artificial intelligence and data science pose both challenges and opportunities to IF. They are challenges because they appear to address the same problems as information fusion, but with more powerful techniques, thus siphoning away both research funding and research talent. However, these challenges can also be opportunities because AI and data science provide new research directions for information fusion. Examples include: IF with big data, hard and soft data fusion, learning about context, graph techniques for tracking and fusion, dynamic network analysis, apps to cyber and imagery processing.

The objective of this panel is to bring to the attention of the fusion community the importance of the application of Deep Learning in AI and IF, highlighting issues, illustrating potential approaches and addressing challenges. A number of invited experts will discuss challenges in processing and research, and address these challenges with IF. The panelists will illustrate parts of the above-mentioned areas over different applications and association with IF. The panel to highlight impending issues and challenges will use conceptual and real-world related examples associated with the applications of above.

SYMPOSIUM-WIDE PLENARY SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

- 5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**
- 5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)
- 5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin
- 6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)
See pages 6-7 for details.

TUESDAY 17 APRIL

SESSION 3

LOCATION: BALLROOM LEVEL, OSCEOLA 1 TUE 8:00 AM TO 9:20 AM

Information Fusion Methodologies and Applications I

Session Chair: **Ronald P. S. Mahler**, Random Sets LLC (USA)

- 8:00 am: **A generalized labeled multi-Bernoulli filter for correlated multitarget systems**, Ronald P. S. Mahler, Random Sets LLC (USA) [10646-11]
- 8:20 am: **A clutter-agnostic generalized labeled multi-Bernoulli filter**, Ronald P. S. Mahler, Random Sets LLC (USA) [10646-12]
- 8:40 am: **A fast labeled multi-Bernoulli filter for superpositional sensors**, Ronald P. S. Mahler, Random Sets LLC (USA) [10646-13]
- 9:00 am: **Mega-constellation tracking using a labeled multi-Bernoulli filter**, Nicholas Ravago, Brandon A. Jones, The Univ. of Texas at Austin (USA) [10646-14]

SESSION 4

LOCATION: BALLROOM LEVEL, OSCEOLA 1 TUE 9:20 AM TO 10:00 AM

Information Fusion Methodologies and Applications II

- Session Chairs: **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA); **Chee-Yee Chong**, Independent Consultant (USA); **Bhashyam Balaji**, Defence Research and Development Canada (Canada)
- 9:20 am: **Detection system fusion based on the precision-recall curve and its variations**, Mark E. Oxley, Christine M. Schubert Kabban, Air Force Institute of Technology (USA) [10646-15]
 - 9:40 am: **Improving ATR system performance through sequences of classification tasks**, Christine M. Schubert Kabban, Mark E. Oxley, Air Force Institute of Technology (USA) [10646-16]
- Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

CONFERENCE 10646

SESSION 5

LOCATION: BALLROOM LEVEL, OSCEOLA 1 TUE 11:00 AM TO 12:20 PM

Information Fusion Methodologies and Applications III

Session Chairs: **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA); **Chee-Yee Chong**, Independent Consultant (USA); **Bhashyam Balaji**, Defence Research and Development Canada (Canada)

11:00 am: **New theory for stochastic Bayesian particle flow using Gromov's method for the exponential family**, Frederick E. Daum, Raytheon Co. (USA) [10646-17]

11:20 am: **Numerical experiments for stochastic Bayesian particle flow filters using Gromov's method for the exponential family**, Frederick E. Daum, Raytheon Co. (USA) [10646-18]

11:40 am: **pystemlib: Toward an open source tracking, state estimation and mapping library in Python**, Bhashyam Balaji, Peter Carniglia, Emilie Altman, Defence Research and Development Canada (Canada) [10646-19]

12:00 pm: **Analysis of noise impact on distributed average consensus**, Boyuan Li, Henry Leung, Chatura Seneviratne, Univ. of Calgary (Canada) [10646-20]

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

SESSION 6

LOCATION: BALLROOM LEVEL, OSCEOLA 1 TUE 1:40 PM TO 3:20 PM

Information Fusion Methodologies and Applications IV

Session Chairs: **Chee-Yee Chong**, Independent Consultant (USA); **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA); **Bhashyam Balaji**, Defence Research and Development Canada (Canada)

1:40 pm: **A framework for adaptive MaxEnt modeling within distributed sensors and decision fusion for robust target detection/recognition**, Ivan Kadar, Interlink Systems Sciences, Inc. (USA) [10646-21]

2:00 pm: **A comparison between robust information-theoretic estimator and asymptotic maximum likelihood estimator for misspecified model**, Xin Zhou, Steven Kay, The Univ. of Rhode Island (USA) [10646-22]

2:20 pm: **Optimizing collaborative computations for scalable distributed fusion and learning in large graphs**, Georgiy M. Levchuk, John Colonna-Romano, Aptima, Inc. (USA); Eric Buras, Aptima Inc. (USA) [10646-23]

2:40 pm: **Enabling self-configuration of fusion networks via scalable opportunistic sensor calibration**, Murat Uney, The Univ. of Edinburgh (United Kingdom); Keith Copsey, Scott Page, Cubica Technology Ltd. (United Kingdom); Bernard Mulgrew, The Univ. of Edinburgh (United Kingdom); Paul Thomas, Defence Science and Technology Lab. (United Kingdom) . [10646-24]

3:00 pm: **Multiscale graph-based framework for efficient multisensor integration and event detection**, Lakshman Prasad, Los Alamos National Lab. (USA) [10646-25]

Coffee Break. Tue 3:20 pm to 3:50 pm

SESSION 7

LOCATION: BALLROOM LEVEL, OSCEOLA 1 TUE 3:50 PM TO 5:30 PM

Information Fusion Methodologies and Applications V

Session Chairs: **Erik Blasch**, Air Force Research Lab. (USA); **Bhashyam Balaji**, Defence Research and Development Canada (Canada); **Ivan Kadar**, Interlink Systems Sciences, Inc. (USA)

3:50 pm: **Impact of emerging quantum information technologies (QIT) on information fusion: panel summary**, Erik Blasch, Air Force Research Lab. (USA); Bhashyam Balaji, Defence Research and Development Canada (Canada); Ivan Kadar, Interlink Systems Sciences, Inc. (USA) [10646-26]

4:10 pm: **An adaptive sensing approach for detection of small UAV: first investigation of static sensor network and moving sensor platform**, Martin Laurentis, Sebastien Hengy, Institut Franco-Allemand de Recherches de Saint-Louis (France); Marcus Hammer, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Alexander Hommes, Winfried Johannes, Fraunhofer-Institut für Hochfrequenzphysik und Radartechnik (Germany); Oussama Rassy, Emmanuel Bacher, Stephane Schertzer, Jean-Michel Poyet, Institut Franco-Allemand de Recherches de Saint-Louis (France) [10646-27]

4:30 pm: **Multi-camera multi-target perceptual activity recognition via meta-data fusion**, Amir Shirkhodaie, Kalyankumar Bogi, Tennessee State Univ. (USA) [10646-28]

4:50 pm: **MARINE-EO bridging innovative downstream earth observation and Copernicus enabled services for integrated maritime environment, surveillance, and security**, Stelios C. A. Thomopoulos, Alkis Astyakopoulos, Constantinos Rizogiannis, Dimitris M. Kyriazanos, National Ctr. for Scientific Research Demokritos (Greece) [10646-29]

5:10 pm: **A novel architecture for behavior/event detection in security and safety management systems**, Stelios C. A. Thomopoulos, Constantinos Rizogiannis, Konstantinos-Georgios Thanos, John M. A. Bothos, Dimitris M. Kyriazanos, National Ctr. for Scientific Research Demokritos (Greece) [10646-30]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C ... TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Attitude control system for a stratospheric balloon based telescope, Jordi Vila Hernández de Lorenzo, The Catholic Univ. of America (USA) and NASA Goddard Space Flight Ctr. (USA); George Nehmetallah, The Catholic Univ. of America (USA); Stephen A. Rinehart, NASA Goddard Space Flight Ctr. (USA) [10646-60]

Fusion of IMU and structure from motion for MAV based photogrammetry, Xichao Teng, Qifeng Yu, Yang Shang, Xiaoliang Sun, National Univ. of Defense Technology (China) [10646-61]

Blind modulation detection via staged GLRT, Colleen Bailey, Univ. of North Texas (USA); Dimitris A. Pados, Florida Atlantic Univ. (USA) [10646-62]

CRLB for estimation of 3D sensor biases in spherical coordinates, Michael Kowalski, Univ. of Connecticut (USA); Djedjiga Belfadel, Fairfield Univ. (USA); Yaakov Bar-Shalom, Peter K. Willett, Univ. of Connecticut (USA) [10646-63]

WEDNESDAY 18 APRIL

SESSION 8

LOCATION: BALLROOM LEVEL, OSCEOLA 1 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); **Alex L. Chan**, U.S. Army Research Lab. (USA)

8:00 am: **A new FSII-CFAR detector based on fuzzy membership degree**, Yingying Kong, Shu Zhang, Nanjing Univ. of Aeronautics and Astronautics (China); Leung Henry, Univ. of Calgary (Canada) [10646-31]

8:20 am: **Feasibility of EEG recordings at ultra-high magnetic fields up to 9.4T**, Saed Khawaldeh, Univ. de Girona (Spain); Afia Asif, Muhammad Salman Khan, Technical Univ. of Denmark (Denmark); Usama Pervaiz, Erasmus Mundus Joint Master Degree in Medical Imaging and Applications (Spain) [10646-32]

8:40 am: **An FPGA implementation of tile based affine transformation for an IR and night vision fusion system**, Mehmet Sinan Eroglu, ASELSAN A.S. (Turkey) [10646-33]

9:00 am: **Low-cost multi-camera module and processor array for the ultra-fast framerate recognition, location, and characterization of explosive events**, Cedric Yoedt, Carlos Maraviglia, Sungjoo Park, U.S. Naval Research Lab. (USA) [10646-34]

9:20 am: **Super-resolution of remote sensing images using edge-directed radial basis functions**, Manohar Mareboyana, Bowie State Univ. (USA) [10646-35]

SESSION 11

LOCATION: BALLROOM LEVEL, OSCEOLA 1 THU 8:00 AM TO 12:30 PM

Signal and Data Processing for Small Targets

Session Chairs: Philip D. West,

Georgia Tech Research Institute (USA); Darren K. Emge,
U.S. Army Edgewood Chemical Biological Ctr. (USA)

8:00 am: Estimation of single-point sea-surface brightness statistics, Kevin Nielson, Georgia Tech Research Institute (USA). [10646-48]

8:20 am: Detection of low-SNR targets using joint probability distributions of moments, Shannon R. Young, Kevin C. Gross, Bryan J. Steward, Air Force Institute of Technology (USA) [10646-49]

8:40 am: Robust spectral classification, Andrew Tucker, Steven Kay, The Univ. of Rhode Island (USA) [10646-50]

9:00 am: Poisson maximum likelihood spectral inference, Darren K. Emge, U.S. Army Edgewood Chemical Biological Ctr. (USA) [10646-51]

9:20 am: Small target anomaly image segmentation in multispectral mixtures based on statistical independence, Darren K. Emge, U.S. Army Edgewood Chemical Biological Ctr. (USA); Rami Mowakeea, Univ. of Maryland, Baltimore County (USA) [10646-52]

9:40 am: Sparse channel estimation and equalization for underwater communication channels, Muhammad Talal Ali Khan, King Fahd Univ. of Petroleum & Minerals (Saudi Arabia) [10646-53]

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

10:30 am: Interacting multiple model (IMM) mixing strategy in tracking slow accelerating target, Yanhua Ruan, William D. Blair, Georgia Tech Research Institute (USA); Peter K. Willett, Univ. of Connecticut (USA) [10646-54]

10:50 am: Error statistics of bias-naive filtering in the presence of bias, Zachary Chance, Stephen Relyea, Evan Anderson, MIT Lincoln Lab. (USA) [10646-55]

11:10 am: An analytic solution for fusing multistatic measurements, Samuel Shapero, Georgia Tech Research Institute (USA) [10646-56]

11:30 am: Multilevel probabilistic target identification methodology utilizing multiple heterogeneous sensors providing various levels of target characteristics, Jeffery Hurley, Jimmy Simmons, Clint Johnson, Georgia Tech Research Institute (USA) [10646-57]

11:50 am: Stochastic Bayesian particle flow filters using Gromov's method without splitting, Frederick E. Daum, Raytheon Co. (USA) [10646-58]

12:10 pm: Numerical experiments for stochastic particle flow filters using Gromov's method without splitting, Frederick E. Daum, Raytheon Co. (USA) [10646-59]

9:40 am: Compressive sensing using log-barrier algorithm given complex-valued data, Felipe da Silva, Ricardo F. von Borries, The Univ. of Texas at El Paso (USA) [10646-36]

Coffee Break and Dedicated Exhibition Time. Wed 10:00 am to 1:00 pm

SESSION 9

LOCATION: BALLROOM LEVEL, OSCEOLA 1 WED 1:00 PM TO 3:00 PM

Signal and Image Processing, and Information Fusion Applications II

Session Chairs: Lynne L. Grewe, California State Univ., East Bay (USA); Alex L. Chan, U.S. Army Research Lab. (USA)

1:00 pm: Stabilization and georegistration of full-motion video data using deep convolutional neural networks, Derek J. Walvoord, Michael A. Bayer, Harris Corp. (USA) [10646-37]

1:20 pm: iSight: computer vision based system to assist low-vision with object detection, Lynne L. Grewe, Archana Kashyap, Krishnan Chandran, Allen Shahshahani, Jake Shahshahani, California State Univ., East Bay (USA) [10646-38]

1:40 pm: A real-time object detection framework for aerial imagery using deep neural networks and synthetic training images, Priya Narayanan, Christoph Borel-Donohue, U.S. Army Research Lab. (USA); Hyungtae Lee, Booz Allen Hamilton Inc. (USA); Heesung Kwon, Raghuvveer Rao, U.S. Army Research Lab. (USA) [10646-39]

2:00 pm: Mobile crowd-sensing for access point localization, Alex Silva, Sylvain Leirens, CEA-LETI (France) [10646-40]

2:20 pm: Going deeper with CNN in malicious crowd event classification, Sungmin Eum, Booz Allen Hamilton Inc. (USA) and U.S. Army Research Lab. (USA); Hyungtae Lee, U.S. Army Research Lab. (USA) and Booz Allen Hamilton Inc. (USA); Heesung Kwon, U.S. Army Research Lab. (USA) [10646-41]

2:40 pm: Deep learning of group activities from partially observable surveillance video streams, Amir Shirkhodaie, Tennessee State Univ. (USA) [10646-42]

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

SESSION 10

LOCATION: BALLROOM LEVEL, OSCEOLA 1 WED 3:30 PM TO 5:10 PM

Signal and Image Processing, and Information Fusion Applications III

Session Chairs: Alex L. Chan, U.S. Army Research Lab. (USA); Lynne L. Grewe, California State Univ., East Bay (USA)

3:30 pm: A mathematical approach on cyberattack incidents' correlation and dependence, Stelios C. A. Thomopoulos, John M. A. Bothos, Konstantinos-Georgios Thanos, Dimitris M. Kyriazanos, Andreas Zalonis, George Vardoulas, Eirini Papadopoulou, Michail Bampatsikos, Ioannis Korovesis, National Ctr. for Scientific Research Demokritos (Greece) [10646-43]

3:50 pm: Object recognition and tracking based on multiscale synthetic SAR and IR in the virtual environment, Amir Shirkhodaie, Cheng Zhang, Leila Borooshak, Yuanyuan Zhou, Tennessee State Univ. (USA) [10646-44]

4:10 pm: Multiscale synthetic SAR and IR imagery features generation in the cluttered virtual environment, Amir Shirkhodaie, Yuanyuan Zhou, Leila Borooshak, Tennessee State Univ. (USA) [10646-45]

4:30 pm: A two-level forest fire detection scheme applying multiple combination rules, Stelios C. A. Thomopoulos, Constantinos Rizogiannis, National Ctr. for Scientific Research Demokritos (Greece) [10646-46]

4:50 pm: Scanning LiDAR for airfield damage assessment, Brian M. Robinson, Torch Technologies (USA) [10646-47]

CONFERENCE 10647

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A

Thursday 19 April 2018 • Proceedings of SPIE Vol. 10647



Algorithms for Synthetic Aperture Radar Imagery XXV

Conference Chairs: **Edmund Zelnio**, Air Force Research Lab. (USA); **Frederick D. Garber**, Wright State Univ. (USA)

Program Committee: **Joshua N. Ash**, Wright State Univ. (USA); **David Blacknell**, Defence Science and Technology Lab. (United Kingdom); **Mujdat Cetin**, Sabanci Univ. (Turkey); **Gil J. Ettinger**, Systems & Technology Research (USA); **David A. Garren**, Naval Postgraduate School (USA); **Eric R. Keydel**, Leidos, Inc. (USA); **Juan Li**, Univ. of Central Florida (USA); **Uttam Kumar Majumder**, Air Force Research Lab. (USA); **Michael J. Minardi**, Air Force Research Lab. (USA); **Randolph L. Moses**, The Ohio State Univ. (USA); **Les Novak**, Scientific Systems Co., Inc. (USA); **Christopher Paulson**, Air Force Research Lab. (USA); **Lee C. Potter**, The Ohio State Univ. (USA); **Brian Rigling**, Wright State Univ. (USA); **Timothy D. Ross**, Jacobs Technology (USA)

THURSDAY 19 APRIL

WELCOME

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A 8:00 AM TO 8:10 AM

Session Chair: **Christopher R. Paulson**, Air Force Research Lab. (USA)

SESSION 1

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A .. THU 8:10 AM TO 10:20 AM

Synthetic Data and Deep Learning

Session Chair: **Christopher R. Paulson**,
Air Force Research Lab. (USA)

8:10 am: **"AFacet": A geometry based format and visualizer to support SAR and multisensor signature generation**, Stephen Rosencrantz, John Nehrbass, Wright State Univ. (USA) [10647-1]

8:20 am: **High-performance computing strategies for SAR image experiments**, Michael A. Saville, Wright State Univ. (USA) [10647-2]

8:30 am: **Antialiasing filter for synthetic SAR imagery**, John Nehrbass, Wright State Univ. (USA) [10647-3]

8:40 am: **Synthetic RF data for advanced machine learning algorithms development**, Uttam Kumar Majumder, Air Force Research Lab. (USA); John Nehrbass, Wright State Univ. (USA); Eric Branch, Edmund Zelnio, Air Force Research Lab. (USA) [10647-4]

8:50 am: **Using synthetic SAR data to analyze ATR performance under various conditions**, Christopher R. Paulson, Air Force Research Lab. (USA); Adam R. Nolan, Etegent Technologies, Ltd. (USA); Edmund G. Zelnio, Air Force Research Lab. (USA) [10647-5]

9:00 am: **A review on image quality and computational costs for various SAR imaging algorithms for machine learning applications**, Uttam Kumar Majumder, Air Force Research Lab. (USA); Mehrdad Soumekh, Consultant (USA) [10647-6]

9:10 am: **Mobile high-performance computing (HPC) for synthetic aperture radar signal processing**, Joshua Misko, Youngsoo Kim, Chenchen Qi, Birsan Sirkeci, San José State Univ. (USA) [10647-7]

9:20 am: **Generative adversarial networks for SAR image realism**, Benjamin Lewis, Air Force Research Lab. (USA); Amy Wong, Cornell Univ. (USA) [10647-8]

9:30 am: **Blending synthetic and measured data using transfer learning for synthetic aperture radar (SAR) target classification**, Julia M. Arnold, Air Force Research Lab. (USA) and Massachusetts Institute of Technology (USA); Linda Moore, Edmund Zelnio, Air Force Research Lab. (USA) . [10647-9]

9:40 am: **Deep learning model-based algorithm for SAR ATR**, Michael Levy, Air Force Research Lab. (USA); Robert D. Friedlander, Georgia Institute of Technology (USA); Edmund G. Zelnio, Elizabeth Sudkamp, Air Force Research Lab. (USA); Robert D. Friedlander, Georgia Institute of Technology (USA) [10647-10]

9:50 am: **Development of CNNs for feature extraction**, Nicole Eikmeier, Purdue Univ. (USA); Rachel Westerkamp, Illinois Wesleyan Univ. (USA); Edmund Zelnio, Air Force Research Lab. (USA) [10647-11]

10:00 am: **Image optimization for SAR images using deep learning**, Peter John-Baptiste, The Ohio State Univ. (USA); Edmund Zelnio, Air Force Research Lab. (USA); Graeme E. Smith, The Ohio State Univ. (USA) [10647-12]

10:10 am: **Deep learning for waveform estimation in passive synthetic aperture radar imaging**, Bariscan Yonel, Eric Mason, Birsan Yazici, Rensselaer Polytechnic Institute (USA) [10647-13]

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

WELCOME

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A 10:50 AM TO 11:00 AM

Session Chair: **Uttam Kumar Majumder**,
Air Force Research Lab. (USA)

SESSION 2

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A .. THU 11:00 AM TO 1:00 PM

Advanced Image Formation, 3D Reconstruction, and Moving Target Exploitation

Session Chair: **Uttam Kumar Majumder**,
Air Force Research Lab. (USA)

11:00 am: **SAR processing of UWB VHF data without a motion measurement system**, Jan Torgrimsson, Chalmers Univ. of Technology (Sweden); Patrik Dammert, Hans Hellsten, Saab Electronic Defence Systems (Sweden); Lars Ulander, Chalmers Univ. of Technology (Sweden); Anders Åhlander, Saab Electronic Defence Systems (Sweden) [10647-14]

11:10 am: **Sparsity-driven coupled imaging and autofocusing for interferometric SAR**, Oguzcan Zengin, Ahmed Shaharyar Khwaja, Sabanci Univ. (Turkey); Müjdat Çetin, Univ. of Rochester (USA) [10647-15]

11:20 am: **Leveraging 3D models for SAR-based navigation in GPS-denied environments**, Zachary Reid, Josh Ash, Wright State Univ. (USA) [10647-16]

11:30 am: **Three-dimensional total least square Prony method for 3D synthetic aperture scatterer localization**, Matthew P. Pepin, Sandia Staffing Alliance, LLC (USA) [10647-17]

11:40 am: **Sparse 4D TomoSAR imaging in the presence of non-linear deformation**, Ahmed Shaharyar Khwaja, Sabanci Univ. (Turkey); Müjdat Çetin, Univ. of Rochester (USA) [10647-18]

11:50 am: **Moving-target SAR imaging using low-rank and sparse decomposition**, Mubashar Yasin, Ahmed Shaharyar Khwaja, Sabanci Univ. (Turkey); Müjdat Çetin, Univ. of Rochester (USA) [10647-19]

12:00 pm: **Insights into the complicated SAR signature shapes induced by braking targets**, David A. Garren, Naval Postgraduate School (USA) [10647-20]

12:10 pm: **Multi-function radio frequency ISR in contested environments**, Steven Jaroszewski, Allan Corbeil, Technology Service Corp. (USA); Jeffrey Corbeil, KEYW Corp. (USA) [10647-21]

12:20 pm: **SAR geolocation of moving targets using knowledge of network of roads**, Uttam Kumar Majumder, Air Force Research Lab. (USA); Mehrdad Soumekh, Consultant (USA); Alexander Boytim, Michael Minardi, Air Force Research Lab. (USA) [10647-22]

12:30 pm: **Global measures of robustness: A non-Euclidean approach to the understanding of algorithm performance**, Michael Bakich, Air Force Research Lab. (USA) [10647-23]

12:40 pm: **Synthetic aperture radar quantized grayscale reference automatic target recognition algorithm**, Christopher R. Paulson, Air Force Research Lab. (USA); Jervon Wilson, Univ. of Cincinnati (USA); Travius Lewis, Rose Hulman Institute of Technology (USA) [10647-24]

12:50 pm: **Scalability of GPU accelerated SAR algorithms**, Edward H. Hill, BAE Systems (USA); Thomas J. Kragh, BAE Systems, Inc. (USA); Steven Koberger, Howard E. Nichols, Gregory J. Owirka, BAE Systems (USA); Uttam Kumar Majumder, Steven M. Scarborough, Air Force Research Lab. (USA); Edward D. Hill, General Dynamics Land Systems (USA) [10647-26]

Lunch Break Thu 1:00 pm to 2:10 pm

POSTERS
LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A 2:10 TO 4:20 PM
Coffee Break 3:00 pm to 3:30 pm

PANEL DISCUSSION
LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A . THU 4:20 TO 5:20 PM

CONFERENCE 10648

LOCATION: BALLROOM LEVEL, TAMPA 2

Monday–Tuesday 16–17 April 2018 • Proceedings of SPIE Vol. 10648

Automatic Target Recognition XXVIII

Conference Chairs: **Firooz A. Sadjadi**, Lockheed Martin Advanced Technology Labs. (USA); **Abhijit Mahalanobis**, Lockheed Martin Missiles and Fire Control (USA)

Program Committee: **Leon Cohen**, Hunter College (USA); **Frederick D. Garber**, Wright State Univ. (USA); **Izidor Gertner**, The City College of New York (USA); **Riad I. Hammoud**, BAE Systems (USA); **Behzad Kamgar-Parsi**, U.S. Naval Research Lab. (USA); **Randolph L. Moses**, The Ohio State Univ. (USA); **Robert R. Muise**, Lockheed Martin Missiles and Fire Control (USA); **Nasser M. Nasrabadi**, West Virginia Univ. (USA); **Timothy L. Overman**, Lockheed Martin (USA); **Alan J. Van Nevel**, Naval Air Warfare Ctr. Aircraft Div. (USA); **Edmund Zelnio**, Air Force Research Lab. (USA)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, TAMPA 2 MON 8:40 AM TO 10:00 AM

Advances in Machine Learning in ATR I

Session Chair: **Firooz A. Sadjadi**, Lockheed Martin Advanced Technology Labs. (USA)

- 8:40 am: **Performance optimization of deep learning via transfer learning with limited datasets for scene understanding**, Jonathan D. Tucker, S. Robert Stanfill, Lockheed Martin Corp. (USA) [10648-2]
- 9:00 am: **Systematic evaluation of deep learning based detection frameworks for aerial imagery**, Lars W. Sommer, Arne Schumann, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10648-4]
- 9:20 am: **Comparison of SVM and CNN classification methods for infrared target recognition**, Ozan Yardimci, Barış Çağlar Ayyıldız, Roketsan Roket Sanayii ve Ticaret A.S. (Turkey) [10648-5]
- 9:40 am: **The semantic web and computer vision: old AI meets new AI**, Joseph L. Mundy, Yi Dong, Vision Systems, Inc. (USA) [10648-25]
- Coffee Break. Mon 10:00 am to 10:30 am

PANEL DISCUSSION

LOCATION: BALLROOM LEVEL, TAMPA 2 10:30 AM TO 12:30 PM

Machine Learning for Automatic Target Recognition (ML4ATR)

Panel Moderators: **Riad I. Hammoud**, BAE Systems (USA); **Timothy L. Overman**, Lockheed Martin (USA)

Panelists: **Vincent J. Velten**, Air Force Research Lab. (USA); **Martin O. Hofmann**, Lockheed Martin Corp. (USA); **William C. Snyder**, BAE Systems (USA); **Daniela I. Moody**, Descartes Labs, Inc. (USA); **Anthony J. Hoogs**, Kitware, Inc. (USA); **Joseph L. Mundy**, Vision Systems, Inc.; **May V. Casterline**, NVIDIA (USA); **Denis Garagic**, BAE Systems (USA);

Hakjae Kim, Intelligence Advanced Research Projects Activity (USA); **Jason Stack**, Office of Naval Research (USA)

The Machine Learning for Automatic Target Recognition (ML4ATR) session at SPIE Defense + Security 2018 (ATR conference) highlights the accomplishments to date and challenges ahead in designing and deploying deep learning and big data analytics algorithms, systems, and hardware for ATR. It provides a forum for researchers, practitioners, solution architects and program managers across all the widely varying disciplines of ATR involved in connecting, engaging, designing solutions, setting up requirements, testing and evaluating to shape the future of this exciting field.

ML4ATR topics of interest include training deep learning based ATR with limited measured/real data, multi-modal satellite/hyperspectral/Sonar/FMV Imagery analytics, graph analytic multi-sensory fusion, change detection, pattern-of-life analysis, adversarial learning, trust and ethics.

This year ML4ATR hosts 10 panelists from government labs, research institutions and defense R&D companies. Each panelist gives a short keynote talk about their projects on machine learning for ATR. The chairs of this session encourage attendees from the SPIE Defense + Commercial Sensing 2018 community to engage in the discussions with the panel members.

Lunch Break Mon 12:30 pm to 1:40 pm

SESSION 2

LOCATION: BALLROOM LEVEL, TAMPA 2 MON 1:40 PM TO 3:20 PM

Advanced Algorithms in ATR I

Session Chair: **Abhijit Mahalanobis**, Lockheed Martin Missiles and Fire Control (USA)

- 1:40 pm: **Fast and robust image processing algorithms based on approximations to order statistics**, Hans C. Palm, Forsvarets forskningsinstitutt (Norway) [10648-6]
- 2:00 pm: **Optical flow assisted IRCCM algorithm for sea skimming anti-ship missile systems**, Kemal Arda Özertem, Roketsan AS (Turkey) [10648-7]
- 2:20 pm: **Segmentation of concealed objects in active terahertz images**, Zhan Ou, Xiao Ping Zheng, Tsinghua Univ. (China); Yang Yu, Microsystem & Terahertz Research Ctr. (China) [10648-8]
- 2:40 pm: **Object recognition using low light level 3D point clouds**, Kaitlyn Jones, Edward A. Watson, Univ. of Dayton (USA) [10648-9]
- 3:00 pm: **Performance evaluation of a real-time seismic detection system for moving targets based on CFAR detectors**, Ripul Ghosh, Anirudh Vajpeyi, Aparna Akula, Vikash Shaw, Satish Kumar, Harish Kumar Sardana, Central Scientific Instruments Organisation (India) [10648-10]
- Coffee Break. Mon 3:20 pm to 3:50 pm

SESSION 3

LOCATION: BALLROOM LEVEL, TAMPA 2 MON 3:50 PM TO 4:50 PM

Advanced Algorithm in ATR II

Session Chair: **Leon Cohen**, Hunter College (USA)

- 3:50 pm: **Correcting probability densities and noise statistics**, Leon Cohen, Hunter College (USA) [10648-11]
- 4:10 pm: **Recognizing objects in 3D data with distinctive self-similarity features**, Suya You, U.S. Army Research Lab. (USA); Jing Huang, Univ. of Southern California (USA) [10648-12]
- 4:30 pm: **Automatic intrusion detection on oil/gas pipeline right-of-ways**, Ming Gong, Almbrok Essa, Vijayan K. Asari, Univ. of Dayton (USA) [10648-13]

SYMPOSIUM-WIDE PLENARY SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

- 5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**
- 5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)
- 5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin
- 6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6–7 for details.

TUESDAY 17 APRIL

SESSION 4

LOCATION: BALLROOM LEVEL, TAMPA 2 TUE 8:00 AM TO 9:00 AM

Advanced Algorithms in ATR III

Session Chair: Timothy L. Overman, Lockheed Martin Corp. (USA)

- 8:00 am: Mask size independent and orientation invariant object finding, Bingcheng Li, Lockheed Martin Systems Integration-Owego (USA) . [10648-14]
8:20 am: An approach to image clustering and retrieval, Izidor Gertner, Bharat Rosanlall, The City College of New York (USA) [10648-15]
8:40 am: Effective direction of arrival estimation of gunshot signals from an in-flight unmanned aerial vehicle, Juliano G. C. Ribeiro, Felipe G. Serrenho, José A. Apolinário Jr., Instituto Militar de Engenharia (Brazil); Antonio L. L. Ramos, Univ. College of Southeast Norway (Norway) . [10648-16]

SESSION 5

LOCATION: BALLROOM LEVEL, TAMPA 2 TUE 9:00 AM TO 10:00 AM

Advances in Machine Learning in ATR II

Session Chair: Vahid R. Riasati, Raytheon Space and Airborne Systems (USA)

- 9:00 am: Automatic target recognition using deep convolutional neural networks, Hadi Kazemi, Mehdi Iranmanesh, Nasser M. Nasrabadi, West Virginia Univ. (USA) [10648-17]
9:20 am: Evaluating bag of features approach for vehicle classification in infrared imagery, Naga Vara Aparna Akula, Ripul Ghosh, Satish Kumar, Harish Kumar K. Sardana, Central Scientific Instruments Organisation (India) [10648-18]
9:40 am: Collaborative sparse priors for multi-view ATR, Xuelu Li, Vishal Monga, The Pennsylvania State Univ. (USA) [10648-19]
Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, TAMPA 2 TUE 11:00 AM TO 12:50 PM

Advances in Machine Learning in ATR III

Session Chair: Vahid R. Riasati, Raytheon Space and Airborne Systems (USA)

- 11:00 am: On adaptive compressive sensing and radar target recognition, Ismail I. Jouny, Lafayette College (USA) [10648-20]
11:20 am: Random forest estimator for enhanced target detection, Vahid R. Riasati, Raytheon Space and Airborne Systems (USA) [10648-21]
11:40 am: Fusion of ATR and Contextual Information for Convoy Detection in Satellite Imagery, Riad I. Hammoud, Michael K Schneider, BAE Systems (USA); Erik Blasch, AFRL/AFOSR/RTA; Data Science, Program Officer (USA) [10648-22]
12:00 pm: Performance Analysis of Deep Learning-based Automatic Target Recognition, Riad I. Hammoud, Daniel S. Pineo, William Snyder, BAE Systems (USA) [10648-23]
12:20 pm: Advanced IR sensors for detection, tracking, and threat warning (Invited Paper), Miriam Rauch, Nu-Trek Inc (USA); Steve Black, James Asbrock, James Elliott, Kyle Lyson, Nu-Trek, Inc. (USA) [10648-24]

DEFENSE + SECURITY

CONFERENCE 10649

LOCATION: BALLROOM LEVEL, SARASOTA 1

Wednesday–Thursday 18–19 April 2018 • Proceedings of SPIE Vol. 10649

Pattern Recognition and Tracking XXIX

Conference Chair: **Mohammad S. Alam**, Texas A&M Univ.-Kingsville (USA)

Program Committee: **Ayman Alfalou**, ISEN Brest (France); **Vijayan K. Asari**, Univ. of Dayton (USA); **Khan M. Iftekaruddin**, Old Dominion Univ. (USA); **Jed Khoury**, Lartec, Inc. (USA); **Thomas T. Lu**, Jet Propulsion Lab. (USA); **Asif Mehmood**, Air Force Research Lab. (USA); **Vahid R. Riasati**, Northrop Grumman Corp. (USA); **Ashit Talukder**, The Univ. of North Carolina at Charlotte (USA); **Rupert C. D. Young**, Univ. of Sussex (United Kingdom)

TUESDAY 17 APRIL

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Bayesian belief network modeling of direct numerically simulated riverine flow imagery variables for sub-surface structure diagnostics, Nicholas V. Scott, Riverside Research (USA); Tian-Jian Hsu, Univ. of Delaware (USA) [10649-12]

Automatic assessment of road damage in SAR imagery via image processing and keypoint detection, Steven R. Price, Mississippi College (USA); Carey D. Price, Clay B. Blount, U.S. Army Corps of Engineers (USA); Stanton R. Price, Mississippi State Univ. (USA) [10649-30]

Benchmarking Deep Learning Trackers on Aerial Videos, Breton Minnehan, Anthony Salmin, Rochester Institute of Technology (USA); Karl Salva, Wright-Patterson Air Force Base / AFRL (USA); Andreas Savakis, Rochester Institute of Technology (USA) [10649-44]

WEDNESDAY 18 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SARASOTA 1 WED 8:00 AM TO 9:30 AM

Novel Pattern Recognition and Tracking Systems

Session Chair: **Mohammad S. Alam**, Texas A&M Univ.-Kingsville (USA)

8:00 am: **A systematic evaluation of recent deep learning architectures for fine-grained vehicle classification** (*Invited Paper*), Krassimir Valev, Karlsruher Institut für Technologie (Germany); Arne Schumann, Lars Sommer, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10649-1]

8:30 am: **A simplification of the Shor quantum factorization algorithm employing a quantum Hadamard transform** (*Invited Paper*), Rupert Young, Philip Birch, Chris Chatwin, Univ. of Sussex (United Kingdom) [10649-2]

9:00 am: **Deep neural network for precision multi-band IR image segmentation** (*Invited Paper*), Thomas T. Lu, Alexander Huyen, Kevin Payumo, Luis Figueroa, Edward Chow, Jet Propulsion Lab. (USA); Gilbert Torres, U.S. Navy (USA) [10649-3]

SESSION 2

LOCATION: BALLROOM LEVEL, SARASOTA 1 WED 9:30 AM TO 12:10 PM

Novel Detection Algorithms

Session Chair: **Asif Mehmood**, Air Force Research Lab. (USA)

9:30 am: **Image-based flight data recording for United States Air Force aircraft**, Abby L. Bassie, U.S. Air Force Mishap Analysis & Animation Facility (USA) and Geosystems Research Institute (USA); Dale Carter, Jeff Barnette, U.S. Air Force Mishap Analysis & Animation Facility (USA); Robert Moorhead, Geosystems Research Institute (USA) [10649-4]

9:50 am: **Efficient anomaly detection algorithms for summarizing low quality videos**, Chiman Kwan, Jin Zhou, Signal Processing, Inc. (USA); Zheshen Wang, Amazon.com, Inc. (USA); Baoxin Li, Arizona State Univ. (USA) [10649-5]

Coffee Break and Dedicated Exhibition Time Wed 10:10 am to 11:10 am

11:10 am: **The development of a video browsing and video summary review tool**, Chiman Kwan, Signal Processing, Inc. (USA); Jenson Yin, Signal Processing, Inc. (USA); Jin Zhou, Signal Processing, Inc. (USA) [10649-6]

11:30 am: **Comparative study of local binary pattern and its shifted variant for osteoporosis identification**, Hina Ajmal, Saad Rehman, Farhan Hussain, Muhammad Abbas, Aimal Khan, National Univ. of Sciences and Technology (Pakistan); Rupert Young, Univ. of Sussex (United Kingdom); Mohammad S. Alam, Texas A&M Univ.-Kingsville (USA) [10649-8]

11:50 am: **A composite framework for segregating x-rays of osteoporosis cases from healthy controls**, Rehan Nemati, Ahmed B. Awan, Saad Rehman, National Univ. of Sciences and Technology (Pakistan) [10649-9]

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

SESSION 3

LOCATION: BALLROOM LEVEL, SARASOTA 1 WED 1:30 PM TO 2:30 PM

Neural Network Based Detection and Tracking

Session Chair: **Rupert Young**, Univ. of Sussex (United Kingdom)

1:30 pm: **Investigating the performance of deep neural networks for image compression based on different activation functions**, Farhan Hussain, Aimal Khan, National Univ. of Sciences and Technology (Pakistan); Mohammad S. Alam, Texas A&M Univ.-Kingsville (USA) [10649-10]

1:50 pm: **Wildland fires detection and segmentation using deep learning**, Moussa Ba, Moulay A. Akhouloufi, Univ. de Moncton (Canada) [10649-11]

2:10 pm: **ASIFT based recognition of fixed shape moving objects and tracking via modified particle filters**, Haris Masood, Saad Rehman, Farhan Riaz, Ali Hassan, Muhammad Abbas, National Univ. of Sciences and Technology (Pakistan); Mohammad S. Alam, Texas A&M Univ.-Kingsville (USA); Rupert Young, Univ. of Sussex (United Kingdom) [10649-14]

SESSION 4

LOCATION: BALLROOM LEVEL, SARASOTA 1 WED 2:30 PM TO 5:40 PM

Motion Sensing and Estimation Algorithms

Session Chair: **Thomas T. Lu**, Jet Propulsion Lab. (USA)

- 2:30 pm: **Nanosensor network for 3D+T motion analysis**, Jean-Pierre Leduc, Reliance Core Consulting (USA) [10649-15]
- 2:50 pm: **ATR performance improvement using images with corrupted or missing pixels**, Jin Zhou, Bulent Ayhan, Chiman Kwan, Signal Processing, Inc. (USA); Trac Tran, Johns Hopkins Univ. (USA) [10649-16]
- 3:10 pm: **Anomaly detection in low quality traffic monitoring videos using optical flow**, Jin Zhou, Chiman Kwan, Signal Processing, Inc. (USA) [10649-17]
- Coffee Break Wed 3:30 pm to 4:00 pm
- 4:00 pm: **A fast method for detecting and estimating motion in radar images using normalized cross-correlation**, Sacha Nandall, Defence Research and Development Canada (Canada) [10649-18]
- 4:20 pm: **Automated WAMI system calibration procedure based on multi-scale fusion and adaptive data association for geo-coding error correction**, Anastasiia Volkova, Peter W. Gibbens, The Univ. of Sydney (Australia) [10649-19]
- 4:40 pm: **Vehicle tracking in full motion video using the progressively expanded neural network (PENNet) tracker**, Evan Krieger, Theus Aspiras, Vijayan K. Asari, Univ. of Dayton (USA); Kevin Krucki, Yakov Diskin, MZA Associates Corp. (USA); Karl Salva, Air Force Research Lab. (USA) [10649-20]
- 5:00 pm: **Parallax rectification and stabilization technique for multiple object tracking in wide area surveillance system**, Issacniwas Swamidoss, Slim Sayadi, Maya Al Hemeiri, Emirates Technology and Innovation Ctr. (United Arab Emirates) [10649-43]
- 5:20 pm: **Road sign identification and geolocation using JTC and VIAPIX module**, Ayman Alfalou, Yousri Ouerhani, Marwa Elbouz, ISEN Brest (France) [10649-21]

THURSDAY 19 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, SARASOTA 1 THU 8:40 AM TO 10:00 AM

Biometric Recognition

Session Chair: **Vahid R. Riasati**, Northrop Grumman Corp. (USA)

- 8:40 am: **PCA and LDA based classifiers for osteoporosis identification**, Hina Ajmal, Saad Rehman, Farhan Riaz, Ali Hassan, Aqib Perwaiz, National Univ. of Sciences and Technology (Pakistan); Qurrat U. Ain, COMSATS Institute of Information Technology (Pakistan) [10649-23]
- 9:00 am: **Biometric based human recognition using gait energy images**, Memoona Iftikhar, Seemi Karim, Saad Rehman, Arslan Shaukat, National Univ. of Sciences and Technology (Pakistan) [10649-24]
- 9:20 am: **A Comparative Study of CFs, LBP, HOG, SIFT, SURF, and BRIEF techniques for face recognition**, Ayman Alfalou, Maher Jridi, Yassin Kourtli, ISEN Brest (France); Mohamed Atri, Univ. de Monastir (Tunisia) . . . [10649-25]
- 9:40 am: **Convolutional neural network based image segmentation: A review**, Hina Ajmal, Saad Rehman, Umar Farooq, National Univ. of Sciences and Technology (Pakistan); Qurrat U. Ain, COMSATS Institute of Information Technology (Pakistan); Farhan Riaz, Ali Hassan, National Univ. of Sciences and Technology (Pakistan) [10649-26]
- Coffee Break Thu 10:00 am to 10:30 am

SESSION 6

LOCATION: BALLROOM LEVEL, SARASOTA 1 THU 10:30 AM TO 11:30 AM

Image Analysis and Registration

Session Chair: **Ayman Alfalou**, ISEN Brest (France)

- 10:30 am: **Comparison of modified-RANSAC algorithms used in SIFT for image registration**, Fei Liu, Shaokun Han, Beijing Institute of Technology (China) [10649-27]
- 10:50 am: **Interest point based correlation filtering strategy for clutter defiance in object recognition**, Ahmed B. Awan, Rehan Nemati, Saad Rehman, National Univ. of Sciences and Technology (Pakistan) [10649-28]
- 11:10 am: **Detection and Decoding of the Invisible Data Matrix with Smartphone by Using Hough Lines and Online Learning**, Mahir C Uysalturk, Melikah University (Turkey); Hait SUN, Melikah University (Turkey); Mahmut Karakaya, Univ. of Central Arkansas (USA) [10649-29]
- Lunch Break Thu 11:30 am to 1:10 pm

SESSION 7

LOCATION: BALLROOM LEVEL, SARASOTA 1 THU 1:10 PM TO 2:30 PM

Deep Learning Based Pattern Recognition

Session Chair: **Vijayan K. Asari**, Univ. of Dayton (USA)

- 1:10 pm: **Stochastic gradient descent implementation of the modified forward-backward linear prediction**, Vahid R. Riasati, Raytheon Space and Airborne Systems (USA); Christopher O'hara, California State Univ., Northridge (USA) [10649-32]
- 1:30 pm: **Approximate regularized least squares algorithm for classification**, Jing Peng, Montclair State Univ. (USA); Alex J. Aved, Air Force Research Lab. (USA) [10649-33]
- 1:50 pm: **Occluded object reconstruction for first responders with augmented reality (AR) glasses using deep learning generative adversarial networks (GAN)**, Kyongsik Yun, Thomas T. Lu, Jet Propulsion Lab. (USA) [10649-34]
- 2:10 pm: **Augmented reality data generation for training deep learning neural network**, Kevin Payumo, Univ. of California, Irvine (USA); Landan Seguin, Georgia Institute of Technology (USA); Thomas T. Lu, Jet Propulsion Lab. (USA) [10649-35]

SESSION 8

LOCATION: BALLROOM LEVEL, SARASOTA 1 THU 2:30 PM TO 5:20 PM

Novel Filtering Strategies

Session Chair: **Jed Khoury**, Lartec, Inc. (USA)

- 2:30 pm: **Real-time holographic heterodyne spatial filtering**, Jed Khoury, Lartec, Inc. (USA) [10649-36]
- 2:50 pm: **Real-time holographic deconvolution for image differentiation**, Jed Khoury, Lartec, Inc. (USA) [10649-37]
- Coffee Break Thu 3:10 pm to 3:40 pm
- 3:40 pm: **Rotation invariant crowd detection using correlation filters**, Naeem Akbar, Saad Rehman, Ahmed B. Awan, National Univ. of Sciences and Technology (Pakistan) [10649-38]
- 4:00 pm: **Low-complexity algorithm using DCT approximation for POST-HEVC standard**, Ayman Alfalou, Maher Jridi, ISEN Brest (France); Sonda Ben Jdidia, Fatma Belghith, Nouri Masmoudi, Univ. de Stax (Tunisia) . . . [10649-39]
- 4:20 pm: **Comparison of SIFT and ASIFT based filters for better recognition and tracking in a remote scene environment**, Haris Masood, Qaiser Chaudry, Saad Rehman, Muhammad Abbas, Farhan Riaz, Ali Hassan, Umar Farooq, National Univ. of Sciences and Technology (Pakistan) [10649-40]
- 4:40 pm: **A multi-component based volumetric directional pattern for texture feature extraction from hyperspectral imagery**, Paheding Sidike, Abduwasit Ghulam, Saint Louis Univ. (USA); Vijayan Asari, Univ. of Dayton (USA) [10649-41]
- 5:00 pm: **A new correlation criterion based on energy distribution: face recognition application**, Ayman Alfalou, Abdelkader Kouas, Marwa Elbouz, ISEN Brest (France) [10649-42]

CONFERENCE 10650

LOCATION: BALLROOM LEVEL, SARASOTA 1

Tuesday 17 April 2018 • Proceedings of SPIE Vol. 10650

Long-Range Imaging III

Conference Chair: **Eric J. Kelmelis**, EM Photonics, Inc. (USA)

Program Committee: **Jeremy P. Bos**, Michigan Technological Univ. (USA); **Chris J. Cormier**, Raytheon Co. (USA); **Vincent Hamel**, L-3 Wescam (Canada); **Jony Jiang Liu**, U.S. Army Research Lab. (USA); **Craig Olson**, L-3 Sonoma EO (USA); **Kevin Rice**, UTC Aerospace Systems (USA); **Michael A. Rucci**, Air Force Research Lab. (USA)

TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SARASOTA 1 TUE 8:00 AM TO 10:00 AM

Systems and Applications

Session Chair: **Eric J. Kelmelis**, EM Photonics, Inc. (USA)

- 8:00 am: **High-accuracy orientation estimation for augmented reality using vision coupled with IMU**, Benjamin Raskob, Applied Research Associates, Inc. (USA); Eric Gans, Applied Research Associates (USA) [10650-1]
- 8:20 am: **Electro-optical tracking considerations III**, Brian A. Karr, Rockledge Design Group, Inc. (USA) [10650-2]
- 8:40 am: **Efficiency measurements for a digital-holography system**, Douglas E. Thornton, Air Force Institute of Technology (USA); Mark F. Spencer, Air Force Research Lab. (USA); Glen P. Perram, Air Force Institute of Technology (USA) [10650-3]
- 9:00 am: **Exploring mitigation of image blur due to atmospheric turbulence by utilizing multiple sensors to achieve optical path diversity**, Tom Underwood, Joe Stufflebeam, David Soules, TRAX International, LLC (USA); Jason Shankle, U.S. Army White Sands Missile Range (USA); Mark Kircher, Mark Roberts, Joachim Lohn-Jaramillo, Geoff Knox, TRAX International, LLC (USA) [10650-4]
- 9:20 am: **Long-range video analytics**, Stephen T. Kozacik, Ariel Sherman, Aaron Paolini, Eric J. Kelmelis, Edwin Francois, EM Photonics, Inc. (USA) [10650-5]
- 9:40 am: **Analysis of three-dimensional scenes using photon-starved data in cluttered target scenarios**, Julian Tachella, Yoann Altmann, Aurora Maccarone, Heriot-Watt Univ. (United Kingdom); Agata Pawlikowska, Leonardo MW Ltd. (United Kingdom); Aongus McCarthy, Heriot-Watt Univ. (United Kingdom); Robert A. Lamb, Leonardo MW Ltd. (United Kingdom); Jean-Yves Tourneret, INP-ENSEEIH (France); Stephen McLaughlin, Gerald S. Buller, Heriot-Watt Univ. (United Kingdom) [10650-6]
- Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 2

LOCATION: BALLROOM LEVEL, SARASOTA 1 TUE 11:00 AM TO 12:00 PM

Atmospheric Effects

Session Chair: **Eric J. Kelmelis**, EM Photonics, Inc. (USA)

- 11:00 am: **Signal-to-noise models for digital-holographic detection (Rising Researcher Presentation)**, Mark F. Spencer, Air Force Research Lab. (USA) [10650-7]
- 11:20 am: **Accounting for optical refractivity and turbulence effects in optical wave propagation over long distances**, Mikhail Vorontsov, Victor A. Kulikov, Zhijun Yang, Univ. of Dayton (USA) [10650-8]
- 11:40 am: **Characterizing atmospheric turbulence over long paths using time-lapse imagery**, Santasri R. Bose-Pillai, Jack E. McCrae Jr., Steven T. Fiorino, Air Force Institute of Technology (USA) [10650-9]
- Lunch/Exhibition Break Tue 12:00 pm to 1:00 pm

SESSION 3

LOCATION: BALLROOM LEVEL, SARASOTA 1 TUE 1:00 PM TO 3:00 PM

Turbulence Mitigation

Session Chair: **Eric J. Kelmelis**, EM Photonics, Inc. (USA)

- 1:00 pm: **Optically coherent image reconstruction in the presence of phase errors using advanced-prior models**, Casey J. Pellizzari, Air Command and Staff College (USA); Mark F. Spencer, Air Force Research Lab. (USA); Charles A. Bouman, Purdue Univ. (USA) [10650-10]
- 1:20 pm: **Real-time high performance atmospheric distortion correction using a Xilinx UltraScale Plus**, Steve Parker, RFEL Ltd. (United Kingdom); Aaron Paolini, James L. Bonnett, EM Photonics, Inc. (USA) [10650-11]
- 1:40 pm: **Variable aperture lucky look approach to imaging through deep turbulence**, Jonathan M. Mooney, James E. Murguia, Solid State Scientific Corp. (USA) [10650-12]
- 2:00 pm: **Mitigation of image intensity distortion using chaotic image propagation through gamma-gamma atmospheric turbulence**, Monish R. Chatterjee, Ali A. Mohamed, Univ. of Dayton (USA) [10650-13]
- 2:20 pm: **Augmenting atmospheric turbulence mitigation with additional image enhancement algorithms**, Stephen T. Kozacik, Aaron Paolini, Jonathan D. Olson, Eric J. Kelmelis, EM Photonics, Inc. (USA) [10650-14]
- 2:40 pm: **Development of super-resolution based video stream enhancement system on FPGA**, Can Uğur Oflamaz, ASELSAN A.S. (Turkey); Umut Sezen, Hacettepe Univ. (Turkey) [10650-15]
- Coffee Break Tue 3:00 pm to 3:30 pm

SESSION 4

LOCATION: BALLROOM LEVEL, SUN BALLROOM B TUE 3:30 PM TO 5:50 PM

NOTE ROOM CHANGE

Modeling, Metrics, and Tools

Joint Session with conferences 10625 and 10650

- Session Chairs: **Richard L. Espinola**, U.S. Naval Research Lab. (USA); **Katrin Braesicke**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Andre Repasi**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Nicolas Rivière**, ONERA (France)
- 3:30 pm: **Imaging simulation of active EO-camera**, José Pérez, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10625-17]
- 3:50 pm: **Super-resolution in the presence of atmospheric optical turbulence**, Russell Hardie, Univ. of Dayton (USA); Michael Rucci, Barry Karch, Air Force Research Lab. (USA); Alex Dapore, Doug Droege, L-3 Cincinnati Electronics (USA) [10650-16]
- 4:10 pm: **Development of a man-portable turbulence mitigation system**, James L. Bonnett, Aaron Paolini, Stephen T. Kozacik, Ariel Sherman, Eric J. Kelmelis, EM Photonics, Inc. (USA) [10650-17]
- 4:30 pm: **Estimating uncertainty in limiting resolution of full motion video**, Richard Gueler, Craig Olson, Andrew Sparks, L-3 Sonoma EO (USA) [10650-18]

- 4:50 pm: **Validating pyBSM: A Python package for modeling imaging systems**, Daniel A. LeMaster, Air Force Research Lab. (USA) [10650-19]
- 5:10 pm: **Statistical evaluation of motion-based MTF for full-motion video using the Python-based PyBSM image quality analysis toolbox**, Craig Olson, David Gaudio, Andrew Beard, Richard Gueler, L-3 Sonoma EO (USA) [10650-20]
- 5:30 pm: **Precision motion enables unique optical zoom and staring capabilities of a miniature payload**, Gal Peled, Nir Karasikov, Roman Yasinov, Vadim Derechinsky, Rita Yetkariov, Israel Shayer, Alan Feinstein, Nanomotion Inc. (USA) [10650-21]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

- The approach for authenticity verification of user generated video files on a mobile device**, Evgeny A. Semenishchev, Don State Technical Univ. (Russian Federation) [10650-22]

CONFERENCE 10651

LOCATION: BALLROOM LEVEL, SANIBEL 3

Tuesday–Thursday 17–19 April 2018 • Proceedings of SPIE Vol. 10651

Open Architecture/Open Business Model Net-Centric Systems and Defense Transformation 2018

Conference Chair: **Raja Suresh**, General Dynamics Mission Systems (USA)

Program Committee: **Robert Bond**, MIT Lincoln Lab. (USA); **Vasu D. Chakravarthy**, Air Force Research Lab. (USA); **Megan Cramer**, U.S. Navy PEO LCS (USA); **Christiane Duarte**, Naval Undersea Warfare Ctr. (USA); **Jacob Glassman**, Naval Sea Systems Command (USA); **Darlene Hart**, General Dynamics Mission Systems (USA); **Patrick Jungwirth**, U.S. Army Research, Development and Engineering Command (USA); **Jonathan D. Shaver**, Air Force Research Lab. (USA); **Jason R. Stack**, Office of Naval Research (USA)

TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SANIBEL 3 TUE 9:00 AM TO 12:30 PM

Open Architecture Systems I

Session Chairs: **Darlene Hart**, General Dynamics Mission Systems (USA); **Patrick W. Jungwirth**, U.S. Army Research, Development and Engineering Command (USA)

9:00 am: **Choosing the best open architecture approach for software defined radio** (*Invited Paper*), Michael Gudaitis, John Matyjas, Air Force Research Lab. (USA) [10651-2]

9:30 am: **Time critical systems and open architecture** (*Invited Paper*), Patrick Bagby, Engility Corp. (USA); Jonathan Shaver, Air Force Research Lab. (USA) [10651-3]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

11:00 am: **Layered approach to open architecture development** (*Invited Paper*), Neil R. Young, Shawn S. Reese, Luke K. Nakatsukasa, Taylor N. Alfiler, Andrew B. Schmidt, Mark Y. Kunimoto, Sean P. Head, General Dynamics Mission Systems (USA) [10651-4]

11:30 am: **Experiences in open architecture research and experimentation** (*Invited Paper*), Charles Satterthwaite, Air Force Research Lab. (USA); Vahid Rajabian-Schwartz, Alexander Paxton, Kenneth Littlejohn, Nicholas Kovach, U.S. Air Force (USA) [10651-5]

12:00 pm: **Open architecture of a counter UAV system** (*Invited Paper*), Wilmoth Müller, Frank Reinert, Dirk Pallmer, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10651-6]

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

SESSION 2

LOCATION: BALLROOM LEVEL, SANIBEL 3 TUE 2:00 PM TO 4:50 PM

Open Architecture Systems II

Session Chairs: **Raja Suresh**, General Dynamics Mission Systems (USA); **Jason R. Stack**, Office of Naval Research (USA)

2:00 pm: **An introduction to model based engineering** (*Invited Paper*), Patrick W. Jungwirth, U.S. Army Research Lab. (USA) [10651-7]

2:30 pm: **Blue Guardian open adaptable architecture for C4ISR (Rising Researcher Presentation)** (*Invited Paper*), Russell Shirey, Benjamin Natarian, Joann Luu, Juliana Nine, U.S. Air Force (USA) ... [10651-8]

Coffee Break Tue 3:00 pm to 3:30 pm

3:30 pm: **Systems of systems integration without requiring a common interface standard** (*Invited Paper*), Evan Fortunato, Apogee Research, LLC (USA) [10651-9]

4:00 pm: **Modular communications and software-defined networks for aerospace applications** (*Invited Paper*), James C. Lyke, Khanh Pham, Air Force Research Lab. (USA) [10651-10]

4:30 pm: **An open architecture approach to voting**, Ahmad Abusalsamid, Charles E. Hughes, Univ. of Central Florida (USA) [10651-11]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C ... TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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Secure communication using ergodic chaotic parameter modulation, Boyuan Li, Henry Leung, Chatura Seneviratne, Univ. of Calgary (Canada) [10651-22]

WEDNESDAY 18 APRIL

SESSION 3

LOCATION: BALLROOM LEVEL, SANIBEL 3 WED 8:30 AM TO 12:20 PM

C4ISR Networks

Session Chairs: **Jonathan D. Shaver**, Air Force Research Lab. (USA); **Raja Suresh**, General Dynamics Mission Systems (USA)

8:30 am: **Named data networking protocols for tactical command and control** (*Invited Paper*), Joseph Evans, Defense Advanced Research Projects Agency (USA); Benjamin J. Ewy, Steven G. Pennington, Tactical Blue Labs., LLC (USA) [10651-12]

9:00 am: **Multi-agent relative pose estimation: approaches and applications** (*Invited Paper*), Kevin Brink, Air Force Research Lab. (USA) [10651-13]

9:30 am: **Decentralized decision-making for self-organizing collaborative robotic teams** (*Invited Paper*), John Budenske, Lori Murray, General Dynamics Mission Systems (USA) [10651-14]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

11:00 am: **Cyber security and integrity self-awareness of mobile autonomous systems** (*Invited Paper*), John Budenske, Lori Murray, Shubhagat Gangopadhyay, Robert K. Finstad, General Dynamics Mission Systems (USA) [10651-15]

11:30 am: **High-level data fusion component for drone classification and decision support in counter UAV** (*Invited Paper*), Wilmoth Müller, Jennifer Sander, Achim Kuwertz, Dirk Mühlenberg, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10651-16]

12:00 pm: **28 Gbaud PAM4 real time optical Datacom link up to 10 km**, John Pertessis, Dan Mohr, Shubhashish Datta, Abhay Joshi, Discovery Semiconductors, Inc. (USA) [10651-17]

Lunch/Exhibition Break Wed 12:20 pm to 3:40 pm

SESSION 4

LOCATION: BALLROOM LEVEL, SANIBEL 3 WED 3:40 PM TO 5:50 PM

**Autonomous C4ISR Systems of the Future:
Autonomous Decision-Making Approaches**

Joint Session with conferences 10639 and 10651

Session Chairs: **Wolfgang Fink**, The Univ. of Arizona (USA); **Raja Suresh**, General Dynamics Mission Systems (USA)

3:40 pm: **The Stratollite: a navigable and persistent flight vehicle for research, commercial, and defense applications** (*Keynote Presentation*), Tom Pirrone, World View Enterprises, Inc. (USA) . [10639-68]

4:10 pm: **Integrated air and missile defence under spatial grasp technology** (*Invited Paper*), Peter Sapaty, The National Academy of Sciences of Ukraine (Ukraine) [10651-18]

4:30 pm: **A hierarchical approach to lidar-based autonomous robotic navigation** (*Invited Paper*), Alexander J. W. Brooks, Wolfgang Fink, Mark A. Tarbell, The Univ. of Arizona (USA) [10639-69]

4:50 pm: **An artificial intelligence platform for prediction and decision making in natural disasters** (*Invited Paper*), Shankar Sankararaman, One Concern, Inc. (USA) [10639-70]

5:10 pm: **Anomaly detection and target prioritization in planetary imagery performed by the automated global feature analyzer (AGFA): a driver for autonomous C4ISR missions** (*Invited Paper*), Wolfgang Fink, Alexander J. W. Brooks, Mark A. Tarbell, The Univ. of Arizona (USA) [10639-71]

5:30 pm: **Mobile node networks model for the generation of knowledge** (*Invited Paper*), Manuel Alejandro Diaz-Casco, Blanca Esther Carvajal-Gómez, Instituto Politécnico Nacional (Mexico) [10651-19]

THURSDAY 19 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, SANIBEL 3 THU 8:00 AM TO 10:20 AM

Collaborative Robotic Teams

Joint Session with conferences 10640 and 10651

Session Chairs: **Robert E. Karlisen**, U.S. Army Tank Automotive Research, Development and Engineering Ctr. (USA); **Raja Suresh**, General Dynamics Mission Systems (USA)

8:00 am: **Advances in autonomous underwater vehicles and the move to network centric persistent subsea capabilities** (*Invited Paper*), Thomas Altshuler, Clayton Jones, Robert G. Melvin II, Daniel Shropshire, Joseph Borden, Teledyne Marine (USA) [10651-20]

8:30 am: **Swarm of autonomous unmanned aerial vehicles with 3-D deconfliction** (*Invited Paper*), Zbigniew Bogdanowicz, U.S. Army Armament Research, Development and Engineering Ctr. (USA) [10651-21]

9:00 am: **Removing the bottleneck: Utilizing autonomy to manage multiple UAS sensors from inside a cockpit**, Thomas Alicia, Grant S. Taylor, U.S. Army (USA); Terry Turpin, Turpin Technologies (USA); Amit Surana, United Technologies Research Ctr. (USA) [10640-22]

9:20 am: **Real-time Inspection of 3D features using sUAS with low-cost sensor suites**, Benjamin Purman, Chris Kawatsu, Mike Jeffers, Paul Sheridan, Aaron Zhao, Soar Technology, Inc. (USA) [10640-23]

9:40 am: **Benchmarking a LIDAR obstacle perception system for aircraft autonomy**, Adam Stambler, Hugh Cover, Kyle Strabala, Near Earth Autonomy, Inc. (USA) [10640-24]

10:00 am: **Cooperative cognitive electronic warfare UAV game modeling for frequency hopping radar**, Mark D. Rahmes, Dave Chester, Rich Clouse, Jodie Hunt, Tom Ottoson, Harris Corp. (USA) [10640-25]

CONFERENCE 10652

LOCATION: BALLROOM LEVEL, SANIBEL 2

Tuesday–Wednesday 17–18 April 2018 • Proceedings of SPIE Vol. 10652

Disruptive Technologies in Information Sciences

Conference Chairs: **Misty Blowers**, Peraton (USA); **Russell D. Hall**, Northrop Grumman Corp. (USA); **Venkateswara R. Dasari**, U.S. Army Research Lab. (USA)

Program Committee: **Gustave W. Anderson**, Lockheed Martin Corp. (USA); **Josep Miquel Jornet**, Univ. at Buffalo (USA); **Georgiy M. Levchuk**, Aptima, Inc. (USA); **Chen Liu**, Clarkson Univ. (USA); **Raju Namburu**, U.S. Army Research Lab. (USA); **Val A. Red**, Air Force Research Lab. (USA); **James Sidoran**, Air Force Research Lab. (USA); **Jon R. Williams**, U.S. Air Force (USA)

TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SANIBEL 2 TUE 8:00 AM TO 11:40 AM

IoT, Big Data Analytics and Storage

Session Chair: **James Sidoran**, Air Force Research Lab. (USA)

8:00 am: **Improved speech recognition for NASA mission control center communications using recurrent neural networks with data augmentation and custom language models**, Kyongsik Yun, Jet Propulsion Lab. (USA) and California Institute of Technology (USA); Joseph Osborne, Madison Lee, Jet Propulsion Lab. (USA); Thomas T. Lu, Jet Propulsion Lab. (USA) and California Institute of Technology (USA) [10652-1]

8:20 am: **Factor analysis in automated face detection: gender, occlusion, eyewear, brightness, contrast, and focus measure**, Benjamin Jafek, Brigham Young Univ. (USA); John Hendershott, The Univ. of Tennessee (USA); Matthew Eicholtz, Hector J. Santos-Villalobos, Oak Ridge National Lab. (USA) [10652-2]

8:40 am: **Power management in IoT**, Brian Jalaian, U.S. Army Research Lab. (USA) [10652-3]

9:00 am: **A scalable communication abstraction framework for Internet of Things applications using Raspberry Pi**, Behshad Mohebbali, Amirhessam Tahmassebi, Florida State Univ. (USA); Amir H. Gandomi, Stevens Institute of Technology (USA) [10652-4]

9:20 am: **Capacity-aware fairness measures for distributed analytics**, Brent Kraczek, U.S. Army Research Lab. (USA) [10652-5]

9:40 am: **OpenTap: Software defined data acquisition**, Christian A. Macias, The Univ. of Texas at El Paso (USA); Venkateswara R. Dasari, U.S. Army Research Lab. (USA); Michael McGarry, The Univ. of Texas at El Paso (USA) [10652-6]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

11:00 am: **Topic modeling for analysis of big data tensor decompositions**, Thomas S. Henretty, M. Harper Langston, Muthu Baskaran, James Ezick, Richard Lethin, Reservoir Labs, Inc. (USA) [10652-7]

11:20 am: **Resilient sensor data storage in contested environments**, Jason Wampler, INCA Engineering (USA); Chien Hsieh, ICF International (USA); Andrew Toth, U.S. Army Research Lab. (USA) [10652-8]

PANEL DISCUSSION

LOCATION: BALLROOM LEVEL, SANIBEL 2 11:40 AM TO 12:00 PM

IoT, Big Data Analytics and Storage Panel Q&A

Session Chair: **James Sidoran**, Air Force Research Lab. (USA)

Lunch/Exhibition Break Tue 12:00 pm to 2:10 pm

SESSION 2

LOCATION: BALLROOM LEVEL, SANIBEL 2 TUE 2:10 PM TO 5:40 PM

Advanced Networking

Session Chair: **Michael Lee**, U.S. Army Research Lab. (USA)

2:10 pm: **Demonstration of provably secure quantum key distribution (QKD)**, Venkateswara R. Dasari, Billy E. Geerhart III, U.S. Army Research Lab. (USA); Ronald Sadlier, Travis S. Humble, Oak Ridge National Lab. (USA) [10652-9]

2:30 pm: **Software-defined quantum network switching**, Travis S. Humble, Ronald J. Sadlier, Brian P. Williams, Ryan C. Prout, Oak Ridge National Lab. (USA) [10652-10]

2:50 pm: **Automating intra-links and node analysis**, Anthony Smith, Kaleb Smith, Florida Institute of Technology (USA); Alex J. Aved, Air Force Research Lab. (USA) [10652-11]

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

3:40 pm: **Resilient detection of multiple targets using a distributed algorithm with limited information sharing**, Jing Wang, Bradley Univ. (USA); Tianyu Yang, Embry-Riddle Aeronautical Univ. (USA); Gennady Staskevich, Air Force Research Lab. (USA) [10652-12]

4:00 pm: **Integrating ground surveillance with aerial surveillance for enhanced amateur drone detection**, Jian Wang, Embry-Riddle Aeronautical Univ. (USA); Xuejun Yue, South China Agricultural University (China); Yongxin Liu, Houbing Song, Embry-Riddle Aeronautical Univ. (USA) [10652-13]

4:20 pm: **Collaborative Unmanned Aerial Systems for Effective and Efficient Airborne Surveillance**, Xiaoping Wang, Zefang Ouyang, Air Force Engineering University (China); Houbing Song, Embry-Riddle Aeronautical Univ. (USA); Qinying Lin, Air Force Engineering University (China) . . [10652-14]

4:40 pm: **Large-scale parallel simulations of distributed detection algorithms for collaborative autonomous sensor networks**, Anton Y. Yen, Peter D. Barnes, Bhavya Kaikhura, Priyadip Ray, Deepak Rajan, Kathleen L. Schmidt, Ryan A. Goldhahn, Lawrence Livermore National Lab. (USA) [10652-15]

5:00 pm: **Development of software architecture for naval system integration**, Vladimir Diaz Charris, COTECMAR (Colombia); Lalo Omar Garces Morcillo, Escuela Naval de Cadetes "Almirante Padilla" (Colombia) and COTECMAR (Colombia); Wilbhart Alejandro Castro Celis, COTECMAR (Colombia) [10652-16]

5:20 pm: **Development and evaluation of a security system for wireless sensor networks with mobile data collectors**, Karanam Dayananda, Jeremy Straub, North Dakota State Univ. (USA) [10652-17]

PANEL DISCUSSION

LOCATION: BALLROOM LEVEL, SANIBEL 2 5:40 PM TO 6:00 PM

Advanced Networking Panel Q&A

Session Chair: **Michael Lee**, U.S. Army Research Lab. (USA)

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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Deep ear biometrics, Moulay A. Akhlooui, Axel-Christian Guei, Univ. de Moncton (Canada) [10652-35]

Effect of Segmentation Errors on Off-angle Iris Recognition, Sema Keles Cetin, Mahmut Karakaya, Univ. of Central Arkansas (USA) [10652-36]

WEDNESDAY 18 APRIL

SESSION 3

LOCATION: BALLROOM LEVEL, SANIBEL 2 WED 8:00 AM TO 9:40 AM

Advanced Hardware Architectures

Session Chair: **Travis S. Humble**, Oak Ridge National Lab. (USA)

8:00 am: **Memristors: Where fantasy meets fact**, Alexander Nugent, M. Alexander Nugent Consulting (USA) [10652-18]

8:20 am: **Reconfigurable visual computing architecture for extreme-scale visual analytics**, Simon Su, Rajgopal Kannan, Luis Bravo, Michael An, Vincent Perry, U.S. Army Research Lab. (USA) [10652-19]

8:40 am: **Increasing optical time delay reservoir throughput via input temporal multiplexing**, Nathan McDonald, Bryant Wysocki, Air Force Research Lab. (USA) [10652-20]

9:00 am: **Path forward for softwarization to tackle evolving hardware**, Sunita Chandrasekaran, Univ. of Delaware (USA) [10652-21]

9:20 am: **Cyber defense through hardware security**, Patrick W. Jungwirth, Philip Chan, U.S. Army Research Lab. (USA); Thomas Barnett Jr., U.S. Army Aviation and Missile Command (USA); Abdel-Hameed Badawy, New Mexico State Univ. (USA) [10652-22]

PANEL DISCUSSION

LOCATION: BALLROOM LEVEL, SANIBEL 2 9:40 AM TO 10:00 AM

Advanced Hardware Architectures Panel Q&A

Session Chair: **Travis S. Humble**, Oak Ridge National Lab. (USA)

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 4

LOCATION: BALLROOM LEVEL, SANIBEL 2 WED 11:00 AM TO 12:00 PM

Artificial Neural Networks and Deep Learning

Session Chair: **Gustave W. Anderson**, Lockheed Martin Corp. (USA)

11:00 am: **Recurrent neural networks for distinguishing between beneficial and malicious activities**, Michael Lee, U.S. Army Research Lab. (USA) [10652-23]

11:20 am: **iDeepLe: deep learning in a flash**, Amirhessam Tahmassebi, Florida State Univ. (USA) [10652-24]

11:40 am: **Deep learning for face recognition at a distance**, Moulay A. Akhlooui, Axel-Christian Guei, Univ. de Moncton (Canada) [10652-25]

Lunch/Exhibition Break Wed 12:00 pm to 2:10 pm

SESSION 5

LOCATION: BALLROOM LEVEL, SANIBEL 2 WED 2:10 PM TO 3:10 PM

Blockchain Inspired Architectures

Session Chair: **James Sidoran**, Air Force Research Lab. (USA)

2:10 pm: **Blockchain of trust on a M2AP IoT architecture**, Irak Mayer, ICF International (USA) [10652-26]

2:30 pm: **Low-latency partition tolerant distributed ledger**, Andrew Gorczyca, Audrey Decker, U.S. Air Force Lab. (USA) [10652-27]

2:50 pm: **Securing high performance computing systems with a tamper evident blockchain**, Jason Wampler, INCA Engineering (USA); Garrett S. Payer, ICF International (USA) [10652-28]

Coffee Break Wed 3:10 pm to 3:30 pm

SESSION 6

LOCATION: BALLROOM LEVEL, SANIBEL 2 WED 3:30 PM TO 5:40 PM

Computational Intelligence for Mission Assurance and Resilience

Session Chair: **Venkateswara R. Dasari**, U.S. Army Research Lab. (USA)

3:30 pm: **Cyber autonomy: Considering the right level of human intervention and developing metrics to assess the risk of different autonomous capabilities before using them to gain a strategic military advantage (Keynote Presentation)**, Misty Blowers, ICF International (USA) [10652-29]

4:00 pm: **Mission optimization**, Gustave W. Anderson, Lockheed Martin Corp. (USA) [10652-30]

4:20 pm: **Algebra for distributed collaborative semi-supervised classification of cyber activities**, Georgiy M. Levchuk, John Colonna-Romano, Aptima, Inc. (USA); Mohammed Eslami, Netrias, LLC (USA); Eric Buras, Aptima, Inc. (USA) [10652-31]

4:40 pm: **Cyber compass: Using simulation and intelligent models to apply cyber resources for maximum effect**, Garrett S. Payer, ICF International (USA); Vassili G. Popov, Yan Yufik, Machine Understanding, LLC (USA); Joey Cusimano, ICF International (USA) [10652-32]

5:00 pm: **An integrated swarm intelligence algorithm for resilient autonomous systems**, Jayson Clifford, Keith Garfield, Massood Towhidnejad, Jake Neighbors, Embry-Riddle Aeronautical Univ. (USA) [10652-33]

5:20 pm: **A machine learning framework to understand multiphase flow using acoustic signals**, Maruti K. Mudunuru, Vamshi Krishna Chillara, Satish Karra, Dipen Sinha, Los Alamos National Lab. (USA) [10652-34]

PANEL DISCUSSION

LOCATION: BALLROOM LEVEL, SANIBEL 2 5:40 PM TO 6:00 PM

Computational Intelligence for Mission Assurance and Resilience Panel Q&A

Session Chair: **Venkateswara R. Dasari**, U.S. Army Research Lab. (USA)

CONFERENCE 10653

LOCATION: BALLROOM LEVEL, MIAMI 3 AND

THURSDAY AFTERNOON: BALLROOM LEVEL, OSCEOLA 4

Monday-Tuesday 16-17 April 2018 • Proceedings of SPIE Vol. 10653

Next-Generation Analyst VI

Conference Chairs: **Timothy P. Hanratty**, U.S. Army Research Lab. (USA); **James Llinas**, Univ. at Buffalo (USA)

Program Committee: **Kevin Barry**, Lockheed Martin Corp. (USA); **Erik Blasch**, Air Force Research Lab. (USA); **James Fink**, U.S. Army Intelligence Ctr. of Excellence (USA); **Bruce Forrester**, Defence Research and Development Canada, Valcartier (Canada); **Sue E. Kase**, U.S. Army Research Lab. (USA); **Bob Madahar**, Defence Science and Technology Lab. (United Kingdom); **Sonya A. H. McMullen**, Embry-Riddle Aeronautical Univ. (USA); **Ranjeev Mittu**, U.S. Naval Research Lab. (USA); **Edward L. Waltz**, BAE Systems (USA)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, MIAMI 3 MON 8:20 AM TO 10:00 AM

Human and Information Integration

Session Chair: **Timothy P. Hanratty**, U.S. Army Research Lab. (USA)

8:20 am: **Understanding theoretical human information interaction, the development of a standard model using an agent based modeling framework**, Adrienne Raglin, U.S. Army Research Lab. (USA) [10653-1]

8:40 am: **Intelligence analyst and adaptive agent interaction through modeling and simulation**, Derrik Asher, Alexis R. Neigel, U.S. Army Research Lab. (USA) [10653-2]

9:00 am: **Methodology for using the operations order to filter intelligence reports**, John Richardson, Timothy P. Hanratty, Mark R. Mittrick, Eric G. Heilman, U.S. Army Research Lab. (USA) [10653-3]

9:20 am: **Active learning and structure adaptation in teams of heterogeneous agents: Designing organizations of the future**, Georgiy M. Levchuk, Adam Fouse, Aptima, Inc. (USA); Krishna Pattipati, Univ. of Connecticut (USA); Daniel Serfaty, Robert McCormack, Aptima, Inc. (USA) [10653-4]

9:40 am: **The role-relevance model for enhanced semantic targeting in unstructured text**, Christopher A. George, Kendra E. Moore, Onur Ozdemir, Connie Fournelle, Boston Fusion Corp. (USA) [10653-5]

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

SESSION 2

LOCATION: BALLROOM LEVEL, MIAMI 3 MON 10:30 AM TO 12:10 PM

Sensemaking

Session Chair: **John Richardson**, U.S. Army Research Lab. (USA)

10:30 am: **Hypothesis management for open source intelligence (OSINT) with the Sensemaking for OSINT eXploitation (SOX) tool**, Phil DiBona, Lockheed Martin Corp. (USA); Hillary Holloway, Systems & Technology Research (USA); Jorge Tierno, Barnstorm Research Corp. (USA) [10653-6]

10:50 am: **Abductive reasoning under uncertainty for soldier centric human-agent decision making**, Adrienne Raglin, U.S. Army Research Lab. (USA) [10653-7]

11:10 am: **Argumentation-based sense-making exploiting open sources**, Timothy J. Norman, Univ. of Southampton (United Kingdom); Federico Cerutti, Cardiff Univ. (United Kingdom); Stuart Middleton, Univ. of Southampton (United Kingdom); Alice Toniolo, Univ. of St. Andrews (United Kingdom) [10653-8]

11:30 am: **Analysis of a computational framework to capture commanders' decision-making processes**, Eugene Santos Jr., Thayer School of Engineering at Dartmouth (USA); Hien Nguyen, Univ. of Wisconsin-Whitewater (USA); Keum J. Kim, Jacob Russell, Thayer School of Engineering at Dartmouth (USA); Luke Veenhuis, Ramnjit Boparai, Gregory Hyde, Luke De Guelle, Hung Vu, Univ. of Wisconsin-Whitewater (USA) [10653-9]

11:50 am: **Analyst as Data Scientist: Surfing vs Drowning in the Information Environment**, Laurie H. Fenstermacher, Air Force Research Lab (USA); Kelly Kaleda, Air Force Research Lab. (USA); Steve Shellman, Strategic Analytic Enterprises (USA) [10653-33]

Lunch Break Mon 12:10 pm to 1:20 pm

SESSION 3

LOCATION: BALLROOM LEVEL, MIAMI 3 MON 1:20 PM TO 3:00 PM

Social Computing

Session Chair: **James Llinas**, Univ. at Buffalo (USA)

1:20 pm: **Social computing approaches and applications for defense and intelligence operations**, Sue E. Kase, Judith Klavans, U.S. Army Research Lab. (USA) [10653-10]

1:40 pm: **Big open-source social science: Capabilities and methodology for automating social science analytics**, Anthony Palladino, Boston Fusion Corp. (USA); Elisa J. Bienenstock, Arizona State Univ. (USA); Christopher A. George, Kendra E. Moore, Boston Fusion Corp. (USA) [10653-11]

2:00 pm: **Data fusion for sociocultural place understanding using deep learning**, Bryce Inouye, Micheal Forkin, Jake Popham, Nicholas Hamblet, Commonwealth Computer Research, Inc. (USA) [10653-12]

2:20 pm: **Integrated analytic simulation tools to support emergency management**, Jeffrey Burkhalter, Charles Ehlschlaeger, Natalie Myers, U.S. Army Engineer Research and Development Ctr. (USA); Yanfeng Ouyang, Liqun Lu, Univ. of Illinois (USA); Antoine Petit, Univ. of Illinois (USA); Olaf David, Colorado State Univ. (USA); David Patterson, Colorado State Univ. (USA) [10653-13]

2:40 pm: **A computational framework for modelling inter-group behaviour using psychological theory**, Gualtiero Colombo, Cardiff Univ. (United Kingdom); Geeth De Mel, IBM United Kingdom Ltd. (United Kingdom); Cheryl Giammanco, U.S. Army Research Lab. (USA); Rhodri Morris, Cardiff Univ. (United Kingdom); David G. Rand, Yale Univ. (USA); Liam Turner, Roger Whitaker, Cardiff Univ. (United Kingdom); Grace-Rose Williams, Defence Science and Technology Lab. (United Kingdom) [10653-14]

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

SESSION 4

LOCATION: BALLROOM LEVEL, MIAMI 3 MON 3:30 PM TO 4:50 PM

Emerging Technology

Session Chair: **Sonya A. H. McMullen**, Embry-Riddle Aeronautical Univ. (USA)

3:30 pm: **Content-based multimedia analytics: Leveraging US and NATO research**, Elizabeth K. Bowman, U.S. Army Research Lab. (USA) [10653-15]

3:50 pm: **Forecasting aggressive state behavior and assessing courses of action to successfully deter hostile adversaries**, Brian Levey, Steve Shellman, Strategic Analysis Enterprises, Inc. (USA) [10653-16]

4:10 pm: **Text motifs: Classifying influential individuals and follower networks with language agnostic methods**, Tod Hagan, Securboratorion (USA) [10653-17]

4:30 pm: **A framework for relation extraction from unstructured text via link grammar parsing**, Ken Samuel, Onur Savas, Vikram Manikonda, Intelligent Automation, Inc. (USA) [10653-18]

SYMPOSIUM-WIDE PLENARY SESSION
LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

- 5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**
- 5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)
- 5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin
- 6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)
- See pages 6-7 for details.*

TUESDAY 17 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, MIAMI 3 TUE 8:40 AM TO 12:00 PM

Advanced Applications

Session Chair: **Sue E. Kase**, U.S. Army Research Lab. (USA)

- 8:40 am: **A visualization technique to improve situational awareness**, Mark R. Mittrick, John Richardson, Derrick Asher, U.S. Army Research Lab. (USA); Alex James, CUBRC, Inc. (USA); Timothy P. Hanratty, U.S. Army Research Lab. (USA) [10653-19]
- 9:00 am: **Human-machine collaboration to disambiguate entities in unstructured text datasets**, Jack H. Davenport, Decisive Analytics Corp. (USA) [10653-20]
- 9:20 am: **Collaborative mixed reality (MxR) and networked decision making**, Theron Trout, Stormfish Scientific Corp. (USA); Stephen M. Russell, Andre V. Harrison, U.S. Army Research Lab. (USA); Ryan Spicer, USC Institute for Creative Technologies (USA) [10653-21]
- 9:40 am: **Value of Information driven content management in mixed reality infrastructures**, James R. Michaelis, U.S. Army Research Lab. (USA) [10653-22]
- Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am
- 11:00 am: **NewsAnalyticalToolkit: an online natural language processing platform to analyze news**, Ian McCann, Amirhessam Tahmassebi, Anke Meyer-Baese, Gordon Erlebacher, Florida State Univ. (USA) . . [10653-23]
- 11:20 am: **Cloud-based microservice, development, deployment, and composition for agile intelligence processing**, Bruce R. McQueary, Anton DeFrancesco, Securboratorion (USA) [10653-24]
- 11:40 am: **ISR activities with limited communication network availability in support of disaster response missions**, Michael Hirsch, ISEA TEK, LLC (USA); Azar Sadeghnejad, Univ. at Buffalo (USA); Tim Schuler, Hector Ortiz-Pena, CUBRC, Inc. (USA) [10653-25]
- Lunch/Exhibition Break Tue 12:00 pm to 1:30 pm

SESSION 6

LOCATION: BALLROOM LEVEL, OSCEOLA 4 TUE 1:30 PM TO 3:10 PM

NOTE ROOM CHANGE

Advanced Concepts

Joint Session with conferences 10653 and 10635

- Session Chairs: **Timothy P. Hanratty**, U.S. Army Research Lab. (USA); **Michael A. Kolodny**, U.S. Army Research Lab. (USA)
- 1:30 pm: **The machine, data analytics and situational understanding: a perspective your mother was afraid to tell you** (*Invited Paper*), Michael A. Kolodny, U.S. Army Research Lab. (USA) [10653-44]
- 1:55 pm: **From sensors to knowledge: The challenge of training the next generation of data analysts**, Sonya A. H. McMullen, David Ison, Erin Bowen, Troy Henderson, Johnny Young, Embry-Riddle Aeronautical Univ. (USA) [10653-27]
- 2:20 pm: **Reexamining computational support for intelligence analysis: A functional design for a future capability**, James Llinas, Galina Rogova, Univ. at Buffalo (USA); Kevin Barry, Lockheed Martin Corp. (USA); James W. Scrofani, Naval Postgraduate School (USA) [10653-28]
- 2:45 pm: **When data lie: fairness and robustness in contested environments**, Ramya Raghavendra, IBM Thomas J. Watson Research Ctr. (USA); Alun Preece, Federico Cerutti, Cardiff Univ. (United Kingdom) [10653-29]
- Coffee Break Tue 3:10 pm to 3:40 pm

SESSION 7

LOCATION: BALLROOM LEVEL, MIAMI 3 TUE 3:40 PM TO 5:00 PM

NOTE ROOM CHANGE

Advanced Analytics

Joint Session with conferences 10635 and 10653

- Session Chairs: **Timothy P. Hanratty**, U.S. Army Research Lab. (USA); **Michael A. Kolodny**, U.S. Army Research Lab. (USA)
- 3:40 pm: **The event tracking dashboard: from multilingual social media feeds to event patterns and anomalies**, Tarek Abdelzaher, Prasanna Giridhar, Univ. of Illinois (USA); Lance Kaplan, U.S. Army Research Lab. (USA) [10653-30]
- 4:00 pm: **The role of motifs in understanding behavior in social and engineered networks**, Diane Felmler, The Pennsylvania State Univ. (USA); Don Towsley, Univ. of Massachusetts Amherst (USA); Roger Whitaker, Cardiff Univ. (United Kingdom); Dave Braines, IBM United Kingdom Ltd. (United Kingdom); Liam Turner, Cardiff Univ. (United Kingdom) [10653-31]
- 4:20 pm: **Customizable fusion of violent event mentions in heterogeneous data**, Justin M. Del Vecchio, CUBRC, Inc. (USA); Timothy K. Perkins, U.S. Army Corps of Engineers (United Kingdom) [10653-32]
- 4:40 pm: **Towards a methodology for lossless data exchange between NoSQL data structures**, Ronald Rudnicki, Brian Donohue, Alexander P. Cox, Mark Jensen, CUBRC, Inc. (USA) [10653-25]

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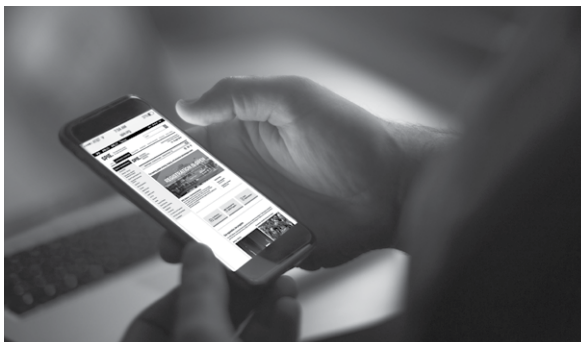
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CONFERENCE 10654

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A

Tuesday–Wednesday 17–18 April 2018 • Proceedings of SPIE Vol. 10654

Fiber Optic Sensors and Applications XV

Conference Chairs: Alexis Mendez, MCH Engineering LLC (USA); Christopher S. Baldwin, Weatherford International Ltd. (USA); Henry H. Du, Stevens Institute of Technology (USA)

Conference Co-Chairs: Eric Udd, Columbia Gorge Research (USA); Gary Pickrell, Virginia Tech (USA); Anbo Wang, Virginia Polytechnic Institute and State Univ. (USA)

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TUESDAY 17 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A . . TUE 8:00 AM TO 10:00 AM

Fiber Optic Sensing for Electric Power Systems

Session Chairs: Alexis Mendez, MCH Engineering LLC (USA); Eric Udd, Columbia Gorge Research LLC (USA)

8:00 am: **Fiber optic current and voltage sensors for electric power transmission systems** (*Invited Paper*), Klaus M. Bohnert, Andreas Frank, Georg M. Mueller, Lin Yang, Miklos Lenner, Philippe Gabus, Xun Gu, ABB Corporate Research (Switzerland); Sergio V. Marchese, ABB Ltd. (Switzerland) [10654-1]

8:30 am: **Fiber optic sensors and applications in the power generation industry** (*Invited Paper*), Evangelos V. Diatzikis, Siemens Power Generation, Inc. (USA) [10654-2]

9:00 am: **Optical sensors technologies evolution applied for power quality monitoring in the medium-voltage**, Joao Batista Rosolem, Claudio Florida, Fabio Renato Bassan, Eduardo Ferreira da Costa, Celio Fonseca Barbosa, Danilo Cesar Dini, Rivael Strobel Penze, Felipe Lima dos Reis Marques, Renan Augusto Viana Teixeira, CPqD (Brazil) [10654-3]

9:20 am: **Low-cost fiber optic sensor array for simultaneous hydrogen and temperature sensing from National Energy Technology Laboratory**, Chenhu Sun, Ping Lu, Ruishu Feng, Paul R. Ohodnicki, National Energy Technology Lab. (USA) [10654-4]

9:40 am: **Merits of a hybrid fluorescent fiber sensor and power over fiber partial discharge detection solution**, Mico Perales, Mei-huan Yang, Cheng-Liang Wu, Kun-Hsien Chen, MH GoPower Company Limited (Taiwan) [10654-5]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 2

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A . TUE 11:00 AM TO 12:30 PM

Fiber Bragg Grating Sensors I

Session Chairs: Christopher S Baldwin, Weatherford International Ltd. (USA); Evangelos V. Diatzikis, Siemens Power Generation, Inc. (USA)

11:00 am: **Multipoint high temperature sensing with regenerated fiber Bragg gratings** (*Invited Paper*), Franz Dutz, Markus Lindner, Hochschule für Angewandte Wissenschaften München (Germany); Andreas Heinrich, Carl G. Seydel, MAN Diesel & Turbo SE (Germany); Thomas Bosselmann, Siemens AG (Germany); Johannes Roths, Hochschule für Angewandte Wissenschaften München (Germany) [10654-6]

11:30 am: **High temperature measurement of a low emission, high pressure combustor using femtosecond laser written fiber Bragg gratings**, Robert B. Walker, Sangsig Yun, Manny De Silva, Nicholas Charest, Doug Robertson, Stephen Mihailov, National Research Council Canada (Canada) [10654-7]

11:50 am: **Packaged FBG based optical fiber sensor for simultaneously pressure and temperature monitoring**, Ji-Ying Huang, Univ. de Mons (Belgium); Jan Van Roosbroeck, Johan Vlecken, Eric Daerden, FBGS International NV (Belgium); Antonio Bueno Martinez, Univ. de Mons (Belgium); Thomas Geernaert, Francis Berghmans, Vrije Univ. Brussel (Belgium); Bram Van Hoe, Eric Lindner, FBGS International NV (Belgium); Christophe Caucheteur, Univ. de Mons (Belgium) [10654-8]

12:10 pm: **Secondary Bragg grating based fiber sensors for the application in high temperature environment**, Yang Ran, Jinan Univ. (China) and Duke Univ. (USA); Fu-Rong Feng, Long Jin, Bai-Ou Guan, Jinan Univ. (China) [10654-9]

Lunch/Exhibition Break Tue 12:30 pm to 1:40 pm

SESSION 3

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A . . . TUE 1:40 PM TO 3:00 PM

Distributed Fiber Optic Sensing I

Session Chairs: Hamid Alemohammad, Univ. of Waterloo (Canada); Ingrid Scheel, Columbia Gorge Research LLC (USA)

1:40 pm: **Stable dynamic phase demodulation in a DAS based on double-pulse Φ -OTDR using homodyne demodulation and direct detection**, Yonas Muanenda, Stefano Faralli, Claudio J. Oton, Fabrizio Di Pasquale, Scuola Superiore Sant'Anna (Italy) [10654-10]

2:00 pm: **Field tests of a distributed acoustic sensing system based on temporal adaptive matched filtering of phase-sensitive OTDR signals**, Ibrahim Olcer, TÜBITAK BILGEM (Turkey) [10654-11]

2:20 pm: **Field test and fading measurement of a distributed acoustic sensor system over a 50 km-long fiber**, Faruk Uyar, Tolga Kartaloglu, Bilkent Univ. (Turkey); Ibrahim T. Ozdur, Abdullah Gül Univ. (Turkey) and Bilkent Univ. (Turkey); Ekmel Ozbay, Bilkent Univ. (Turkey) [10654-12]

2:40 pm: **Optical fibers for distributed sensing in harsh environments**, Jie Li, Xiaoguang Sun, OFS (USA) [10654-13]

Coffee Break Tue 3:00 pm to 3:30 pm

SESSION 4

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A . . . TUE 3:30 PM TO 5:50 PM

New Avenues in Fiber Optic Sensing

Session Chairs: **Fei Tian**, Stevens Institute of Technology (USA);
Gary Pickrell, Virginia Tech (USA)

3:30 pm: **Multiplexed fiber-coupled accelerometers for security monitoring applications** (*Invited Paper*), Dustin W. Carr, John M. Baxley, Micron Optics, Inc. (USA); Bobby Nakanelua, Steve Sohn, Scott C. Rye, CyberSecure IPS (USA); Steve K. Ferguson, David Robinson, Micron Optics, Inc. (USA) [10654-14]

4:00 pm: **Fiber optic sensors: Technical trends from the mid 1970s to the present** (*Invited Paper*), Eric Udd, Columbia Gorge Research LLC (USA) [10654-15]

4:30 pm: **Compact and robust optical Fabry-Perot interferometers for structural health monitoring**, Jie Huang, Missouri Univ. of Science and Technology (USA) [10654-16]

4:50 pm: **A novel multi-mode fiber optic accelerometer: an intelligent sensor**, Soroush Razmyar, Taghi Mostafavi, The Univ. of North Carolina at Charlotte (USA) [10654-17]

5:10 pm: **Concave-core photonic crystal fiber based Fabry-Perot interferometer fiber sensor for measurements of strain and microfluidic refractive index**, Jiajun Tian, Shaobo Ji, Yong Yao, Harbin Institute of Technology Shenzhen Graduate School (China) [10654-18]

5:30 pm: **Nanoparticles functionalized long-period fiber grating for sensing applications**, Di Wu, Fan Yang, Fei Tian, Stevens Institute of Technology (USA) [10654-19]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Second generation fs-laser-written fiber Bragg gratings for high accuracy temperature measurement in harsh environments, Margarethe Kampling, FemtoFiberTec GmbH (Germany) [10654-39]

Intracavity absorption gas sensor in the near-infrared region by using a tunable erbium-doped fiber laser based on a Hi-Bi FOLM, Ricardo I. Álvarez-Tamayo, Consejo Nacional de Ciencia y Tecnología (Mexico) and Univ. Autónoma de Nuevo León (Mexico); Manuel Durán-Sánchez, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico); Antonio Barcelata-Pinzón, Univ. Tecnológica de Puebla (Mexico); Antonio Felix Rodríguez-Berlanga, Patricia Prieto-Cortés, Arturo A. Castillo-Guzmán, Guillermo Salceda-Delgado, Romeo Selvas-Aguilar, Univ. Autónoma de Nuevo León (Mexico) [10654-40]

A power over fiber voltage and current sensor using multiplexed PWM signals, Fabio R. Bassan, Joao Batista Rosolem, Celio Fonseca Barbosa, Renan Augusto Viana Teixeira, CpqD (Brazil) [10654-41]

Standard optical fibers for load measuring of concrete structures using BOTDR, Marcel Fajkus, Jan Nedoma, Martin Novák, Radek Martinek, Jan Vanus, Jan Jargus, Jan Skapa, Vladimír Vašínek, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-42]

FBG strain sensor mounted on plastic carrier, Marcel Fajkus, Marcel Fajkus, Jan Nedoma, Martin Novák, Radek Martinek, Jan Skapa, Jan Jargus, Lucie Svobodova, Petr Siska, Vladimír Vašínek, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-43]

Temperature sensor with using of optical fibers, Jan Jargus, Martin Novák, Jan Nedoma, Marcel Fajkus, Vladimír Vašínek, Radek Martinek, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-44]

Alternative fiber detector of vibrations, Jan Jargus, Jan Nedoma, Marcel Fajkus, Martin Novák, Radek Martinek, Vladimír Vašínek, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-45]

Detection of magnetic field with use of optical sensors, Jan Jargus, Marcel Fajkus, Jan Nedoma, Martin Novák, Vladimír Vašínek, Radek Martinek, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-46]

Measuring of the petroleum product leaks by distributed temperature systems, Jakub Jaros, Vladimír Vašínek, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-47]

Nanostructured sapphire optical fiber for enhanced stability and Raman spectroscopy of MAPbI₃ perovskite solar cell materials, Kai Liu, Xiaoqing Kong, Stephanie S. Lee, Henry Du, Stevens Institute of Technology (USA) [10654-48]

Fiber-optic Bragg grating sensors signal processing for vital signs monitoring, Radek Martinek, Radana Kahankova, Marcel Fajkus, Jan Nedoma, Martin Novák, Jan Jargus, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-49]

Advanced methods for fiber-optic sensor signal processing, Radek Martinek, Radana Kahankova, Jan Nedoma, Marcel Fajkus, Martin Novák, Jan Jargus, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-50]

Pre-processing and extraction techniques for vital signs analysis from phonocardiographic-based interferometric fiber-optic sensor, Radek Martinek, Radana Kahankova, Jakub Cubik, Stanislav Kepak, Marcel Fajkus, Jan Nedoma, Martin Novák, Jan Jargus, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-51]

Analysis of encapsulation the fiber Bragg sensors for biomedical applications, Jan Nedoma, Marcel Fajkus, Martin Novák, Jan Jargus, Radek Martinek, Radana Kahankova, Vladimír Vašínek, Stanislav Žabka, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-52]

Sensor system based on the Mach-Zehnder interferometer for the rail transport, Jan Nedoma, Marcel Fajkus, Radek Martinek, Martin Novák, Jan Jargus, Vladimír Vašínek, Stanislav Žabka, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-53]

Analysis of the attenuation characteristics of cylindrical waveguides made from the polydimethylsiloxane (PDMS) polymer, Martin Novák, Jan Jargus, Marcel Fajkus, Jan Nedoma, Vladimír Vašínek, Radek Martinek, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-54]

Analysis of transmission properties of optical couplers made from the polydimethylsiloxane (PDMS), Martin Novák, Jan Jargus, Marcel Fajkus, Jan Nedoma, Vladimír Vašínek, Radek Martinek, VŠB-Technical Univ. of Ostrava (Czech Republic) [10654-55]

Dynamic variations in optical properties of graphene oxide in response to gas exposure as determined from thin-film interference, Shawana Tabassum, Ratnesh Kumar, Liang Dong, Iowa State Univ. of Science and Technology (USA) [10654-56]

The detection and characterization of weak seismic waves using optical fiber Bragg grating sensor, Allen Ervin, Gregory Tait, Bridgewater College (USA) [10654-57]

Brillouin scattering spectrum character extraction based on genetic algorithm and seeker optimization algorithm, Yanjun Zhang, Peijun Jin, Peng Zhang, Xinghu Fu, Jinrui Xu, Yanshan Univ. (China) [10654-58]

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10654

WEDNESDAY 18 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A . WED 8:20 AM TO 10:00 AM

Applications of Fiber Optic Sensors for Harsh Environments

Session Chairs: **Christopher S Baldwin**, Weatherford International Ltd. (USA); **Alexis Mendez**, MCH Engineering LLC (USA)

8:20 am: **Fiber optic sensing networks for predictive maintenance of railway systems** (*Invited Paper*), Hwa-Yaw Tam, The Hong Kong Polytechnic Univ. (Hong Kong, China) [10654-20]

8:50 am: **Fiber optic sensors for harsh environment sensing: case studies on environmental sensing** (*Invited Paper*), Hamid Alemohammad, Amir Azhari, Richard Liang, Advanced Opto-Mechanical Systems and Technologies Inc. (Canada) [10654-21]

9:20 am: **Single-crystal fiber structures for harsh environment applications** (*Rising Researcher Presentation*), Michael P. Buric, Bo Liu, Paul R. Ohodnicki, Ben Chorpening, National Energy Technology Lab. (USA) [10654-22]

9:40 am: **Nanosecond resolution pressure, temperature, position and velocity measurements in energetic materials**, Ingrid Udd Scheel, Eric Udd, Columbia Gorge Research LLC (USA) [10654-24]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A . WED 11:00 AM TO 12:20 PM

Fiber Bragg Grating Sensors II

Session Chairs: **Eric Udd**, Columbia Gorge Research LLC (USA); **Hwa-Yaw Tam**, The Hong Kong Polytechnic Univ. (Hong Kong, China)

11:00 am: **Development of fiber Bragg grating pH sensors for harsh environments**, Dilara Yilman, Amir Azhari, Advanced Opto-Mechanical Systems and Technologies Inc. (Canada); Brian Chan, Univ. of Waterloo (Canada); Hamid Alemohammad, Richard Liang, Advanced Opto-Mechanical Systems and Technologies Inc. (Canada); Michael Pope, Univ. of Waterloo (Canada) [10654-25]

11:20 am: **Fast ocean salinity sensing based on long-period fiber gratings integrated with ionic strength-responsive hydrogel**, Fan Yang, Stevens Institute of Technology (USA); Raman Hlushko, Texas A&M Univ. (USA); Di Wu, Stevens Institute of Technology (USA); Svetlana Sukhishvili, Texas A&M Univ. (USA); Henry Du, Fei Tian, Stevens Institute of Technology (USA) [10654-26]

11:40 am: **Enhanced sensing and accessing capabilities of an FBG sensor using fiber loop mirror**, Ahmad Atieh, Optiwave Systems Inc. (Canada) [10654-27]

12:00 pm: **Ultrafast pressure measurement in shock wave research using fiber Bragg grating sensors**, Garry Berkovic, Ehud Shafir, Shlomi Zilberman, Yair Saadi, Ofek Gillon, Alexander Fedotov Gefen, Avi Ravid, Yonatan Schweitzer, Soreq Nuclear Research Ctr. (Israel) [10654-28]

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

SESSION 7

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A . . WED 1:40 PM TO 3:00 PM

Specialty Fibers for Sensing Applications

Session Chairs: **Henry Du**, Stevens Institute of Technology (USA); **Jie Li**, OFS (USA)

1:40 pm: **Chemical sensing in harsh environments with nanostructured sapphire optical fiber**, Kai Liu, Stevens Institute of Technology (USA); Hui Chen, Paul R. Ohodnicki, National Energy Technology Lab. (USA); Henry Du, Stevens Institute of Technology (USA) [10654-29]

2:00 pm: **Characterization of ultrasonic generation from a fiber-optic sidewall**, Jingcheng Zhou, Xu Guo, Cong Du, Nan Wu, Xingwei Wang, Univ. of Massachusetts Lowell (USA) [10654-30]

2:20 pm: **Multistage single clad 2 micron TDFA with a shared L-band pump source**, Robert E. Tench, Cybel LLC (USA); Clément Romano, Cybel LLC (USA) and Télécom ParisTech (France); Jean-Marc Delavaux, Cybel LLC (USA) [10654-31]

2:40 pm: **Precise calibration of optical fiber sensor for ammonia sensing using multivariate analysis**, Ahmed H. Jalal, Fahmida Alam, Ashfaq Ahmed, Florida International Univ. (USA); Mohammad A. Ahad, Georgia Southern Univ. (USA) [10654-32]

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

SESSION 8

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A . . WED 3:30 PM TO 5:40 PM

Distributed Fiber Optic Sensing II

Session Chairs: **Stephen T. Kreger**, Luna Innovations Inc. (USA); **Michael Willsch**, Siemens AG (Germany)

3:30 pm: **Fiber optical sensors: Data source for digitalization in electrical power generation** (*Invited Paper*), Michael Willsch, Siemens AG (Germany) [10654-33]

4:00 pm: **Simultaneous distributed temperature and disturbance sensing in single-mode fibre for power cable monitoring**, Simon T. Sorensen, Henry Bookey, Fraunhofer Ctr. for Applied Photonics (United Kingdom) [10654-34]

4:20 pm: **Distributed polarization state sensing with optical frequency domain reflectometry**, Stephen T. Kreger, Anastasia Yakusheva, Nur Aida Abdul Rahim, Luna Innovations Inc. (USA) [10654-35]

4:40 pm: **Sensitivity analysis of OFDR-based distributed sensing for flaws detection in representative coupon from filament wound motor vessel**, Monica Ciminello, Antonio Concilio, Bernardino Galasso, Camillo Richiello, Ctr. Italiano Ricerche Aerospaziali (Italy); Gabriele Fabbri, Andrea Mataloni, Avio S.p.A. (Italy); Pierluigi Perugini, Avio Aero, a GE Aviation Business (Italy) [10654-36]

5:00 pm: **Vector Brillouin optical time-domain analysis for long-range distributed sensing based on Raman amplification and optical pulse coding**, Ping Lu, AECOM (USA) and National Energy Technology Lab. (USA); Michael P. Buric, Bo Liu, Paul R. Ohodnicki, National Energy Technology Lab. (USA) [10654-37]

5:20 pm: **Long distance, high spatial resolution distributed temperature measurement using wideband graded index optical fiber at 1550 nm**, Xiaoguang Sun, Kyle Bedard, Dave Braganza, OFS (USA) [10654-38]

CONFERENCE 10655

LOCATION: BALLROOM LEVEL, NAPLES 1

Monday–Tuesday 16–17 April 2018 • Proceedings of SPIE Vol. 10655

Polarization: Measurement, Analysis, and Remote Sensing XIII

Conference Chairs: **David B. Chenault**, Polaris Sensor Technologies, Inc. (USA); **Dennis H. Goldstein**, Polaris Sensor Technologies, Inc. (USA)
Program Committee: **Julia Craven**, Sandia National Labs. (USA); **Michael G. Gartley**, Rochester Institute of Technology (USA); **Viktor Gruev**, Univ. of Illinois at Urbana-Champaign (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**, North Carolina State Univ. (USA), College of Optical Sciences, The Univ. of Arizona (USA); **Joao M. Romano**, U.S. Army Armament Research, Development and Engineering Ctr. (USA); **Joseph A. Shaw**, Montana State Univ. (USA); **J. Scott Tyo**, UNSW Canberra (Australia)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, NAPLES 1 MON 8:10 AM TO 10:00 AM

Measurements and Applications

Session Chair: **David B. Chenault**,
Polaris Sensor Technologies, Inc. (USA)

- 8:10 am: **An overview of polarimetric thermal imaging for biometrics (Rising Researcher Presentation)** (*Invited Paper*), Shuowen Hu, U.S. Army Research Lab. (USA); Nathaniel J. Short, Booz Allen Hamilton Inc. (USA); Benjamin S. Riggan, Kristan P. Gurton, U.S. Army Research Lab. (USA) [10655-1]
- 8:40 am: **Polarization scattering from skin**, Lisa Li, Russell A. Chipman, College of Optical Sciences, The Univ. of Arizona (USA) [10655-2]
- 9:00 am: **On-demand Mueller matrix bidirectional reflectance distribution function of a common reflectance standard**, Thomas A. Germer, National Institute of Standards and Technology (USA) [10655-3]
- 9:20 am: **Extinction ratio measurements on high purity linear polarizers**, Michael Kraemer, Tom G. Baur, Meadowlark Optics, Inc. (USA) [10655-4]
- 9:40 am: **Achromatic ferroelectric liquid crystal polarization rotator**, Neil Rebolledo, Dmitri Kyle, Meadowlark Optics, Inc. (USA) [10655-5]
- Coffee Break Mon 10:00 am to 10:25 am

SESSION 2

LOCATION: BALLROOM LEVEL, NAPLES 1 MON 10:25 AM TO 12:05 PM

Polarization System Design and Instruments I

Session Chair: **Viktor Gruev**,
Univ. of Illinois at Urbana-Champaign (USA)

- 10:25 am: **Polarization considerations in the multi-angle imager for aerosols (MAIA)**, Julie M. Gillis, Russell A. Chipman, College of Optical Sciences, The Univ. of Arizona (USA); David J. Diner, Jet Propulsion Lab. (USA); Matthew B. Dubin, College of Optical Sciences, The Univ. of Arizona (USA) [10655-7]
- 10:45 am: **Channeled polarimetry using spectrally resolved longitudinal spatial coherence interferometry**, Ethan R. Woodard, Michael W. Kudenov, North Carolina State Univ. (USA) [10655-8]
- 11:05 am: **Full Stokes polarization spectral imaging**, Neelam Gupta, U.S. Army Research Lab. (USA) [10655-9]
- 11:25 am: **Acousto-optic tunable filter based spectropolarimeter for extraction of Stokes and Mueller matrices**, Narasimha S. Prasad, NASA Langley Research Ctr. (USA); Feng Jin, Brimrose Corp. of America (USA); Emir Y. Haskovic, Brimrose Technology Corp. (USA); Sudhir B. Trivedi, Jolanta Soos, Brimrose Corp. of America (USA) [10655-10]
- 11:45 am: **Underwater geolocalization via polarization information**, Viktor Gruev, Univ. of Illinois (USA); Samuel Powell, The Univ. of Queensland (Australia); Roman Garnett, Washington Univ. in St. Louis (USA); Justin Marshall, The Univ. of Queensland (Australia); Charbel Rizk, Johns Hopkins Univ. (USA) [10655-35]
- Lunch Break Mon 12:05 pm to 1:05 pm

SESSION 3

LOCATION: BALLROOM LEVEL, NAPLES 1 MON 1:05 PM TO 2:25 PM

Polarization System Design and Instruments II

Session Chair: **Neelam Gupta**, U.S. Army Research Lab. (USA)

- 1:05 pm: **Biologically inspired imaging sensors for multi-spectral and polarization imagery**, Missael Garcia, Tyler Davis, Univ. of Illinois (USA); Radoslav Marinov, Washington Univ. in St. Louis (USA); Viktor Gruev, Univ. of Illinois (USA) [10655-11]
- 1:25 pm: **Performance of a microgrid polarizer array employing a micro-optic registration element**, Greg A. Finney, Christopher M. Persons, Dane J. Phillips, IERUS Technologies, Inc. (USA) [10655-12]
- 1:45 pm: **Residual interpolation for 3-micropolarizer design of division of focal plane polarization image sensors**, Ashfaq Ahmed, Hong Kong Univ. of Science and Technology (Hong Kong, China); Xiaojin Zhao, Shenzhen Univ. (China); Viktor Gruev, Univ. of Illinois (USA); Amine Bermak, Hamad Bin Khalifa Univ. (Qatar) [10655-13]
- 2:05 pm: **Long wave infrared spectropolarimetric directional reflectometer**, Charles F. LaCasse IV, Kyle H. Fuerschbach, Julia M. Craven, Jacob W. Segal, John D. van der Laan, Jeremy B. Wright, Steven M. Grover, Jessica M. Pehr, Thomas A. Reichardt, Thomas J. Kulp, Sandia National Labs. (USA) [10655-14]

SESSION 4

LOCATION: BALLROOM LEVEL, NAPLES 1 MON 2:25 PM TO 3:05 PM

Active Sensing

Session Chair: **Charles Kim**,
Northrop Grumman Electronic Systems (USA)

- 2:25 pm: **Single-pulse Mueller matrix polarimeter for rapid scene characterization LADAR**, Christian K. Keyser, Air Force Research Lab. (USA); Khanh Nguyen, Torch Technologies (USA); Richard K. Martin, Air Force Institute of Technology (USA); Arielle Adams, Engility Corp. (USA) [10655-15]
- 2:45 pm: **Development and qualification of the beam dithering units for the GEDI Altimeter Mission**, Paul R. Stysley, NASA Goddard Space Flight Ctr. (USA); Demetrios Poullos, Greg B. Clarke, American Univ. (USA); Robert C. Switzer, ASRC Federal Space and Defense (USA); Michael J. Hersh, Joe Thomes, Barry B. Coyle, NASA Goddard Space Flight Ctr. (USA) [10655-16]
- Coffee Break Mon 3:05 pm to 3:30 pm

CONFERENCE 10655

SESSION 5

LOCATION: BALLROOM LEVEL, NAPLES 1 MON 3:30 PM TO 4:30 PM

Analysis and Simulation I

Session Chair: **Michael G. Gartley**,
Rochester Institute of Technology (USA)

3:30 pm: **Channel-first design of modulated polarimeters**, Andrey S. Alenin, Jiawei Song, UNSW Canberra (Australia); Michael E. Gehm, Duke Univ. (USA); Israel J. Vaughn, J. Scott Tyo, UNSW Canberra (Australia) [10655-17]

3:50 pm: **What are the fundamental limits of passive polarization imaging?**, Matthieu Boffety, François Goudail, Lab. Charles Fabry (France) [10655-18]

4:10 pm: **A new analytical relationship linking polarization and reflectivity**, Bradley G. Henderson, Los Alamos National Lab. (USA) [10655-20]

SYMPOSIUM-WIDE PLENARY SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6-7 for details.

TUESDAY 17 APRIL

SESSION 6

LOCATION: BALLROOM LEVEL, NAPLES 1 TUE 8:00 AM TO 10:10 AM

Atmospheric Effects

Session Chair: **Joseph A. Shaw**, Montana State Univ. (USA)

8:00 am: **All-sky polarization measurements of the total solar eclipse on 21 August 2017** (*Invited Paper*), Laura M. Eshelman, Martin Jan Tauc, Montana State Univ. (USA); Taiga Hashimoto, Hokkaido Univ. (Japan); Preston Hooser, Montana State Univ. (USA); Kendra Gillis, William Weiss, Brigham Young Univ.-Idaho (USA); Bryan Stanley, Colorado State Univ. (USA); Glenn E. Shaw, Univ. of Alaska Fairbanks (USA); Joseph A. Shaw, Montana State Univ. (USA) [10655-21]

8:30 am: **Study of natural down-welling sky light with imaging spectro-polarimeter**, David B. Chenault, Joseph L. Pezzaniti, Adam Smith, Polaris Sensor Technologies, Inc. (USA) [10655-22]

8:50 am: **Imaging through haze using multispectral polarization imaging method**, Mohamed El Ketara, Sebastien Breugnot, Bossa Nova Technologies (USA) [10655-23]

9:10 am: **Cloud thermodynamic phase detection with a 3-channel shortwave infrared polarimeter**, Martin Jan Tauc, Carol L. Baumbauer, Benjamin Moon, Andrew M. Abel, Laura M. Eshelman, David W. Riesland, Wataru Nakagawa, Joseph A. Shaw, Montana State Univ. (USA) ... [10655-24]

9:30 am: **Acquisition sensor technologies for improved performance in adverse weather conditions**, Greg A. Finney, Christopher M. Persons, IERUS Technologies, Inc. (USA); Brett H. Hokr, U.S. Army Space and Missile Defense Command (USA) [10655-25]

9:50 am: **Design and testing of an active polarization imager at SWIR wavelengths for imaging in highly scattering environments**, John D. van der Laan, Jeremy B. Wright, Karl R. Westlake, Sandia National Labs. (USA) [10655-26]

Coffee Break and Dedicated Exhibition Time Tue 10:10 am to 11:00 am

SESSION 7

LOCATION: BALLROOM LEVEL, NAPLES 1 TUE 11:00 AM TO 11:40 AM

Analysis and Simulation II

Session Chair: **Michael W. Kudenov**, North Carolina State Univ. (USA)

11:00 am: **Estimating the relative water content of leaves in a cotton canopy II**, Vern C. Vanderbilt, NASA Ames Research Ctr. (USA); Craig S. T. Daughtry, U.S. Dept. of Agriculture (USA); Meredith K. Kupinski, College of Optical Sciences, The Univ. of Arizona (USA); Christine L. Bradley, Jet Propulsion Lab. (USA); Andrew N. French, Kevin Bronson, U.S. Arid-Land Agriculture Research Ctr. (USA); Russell A. Chipman, College of Optical Sciences, The Univ. of Arizona (USA); Robert P. Dahlgren, NASA Ames Research Ctr. (USA) [10655-28]

11:20 am: **Overview of visualization strategies for polarimetric imaging data**, Andrew Kruse, The Univ. of New South Wales (Australia); Andrey S. Alenin, J. Scott Tyo, UNSW Canberra (Australia) [10655-29]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C ... TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Anomaly detection of passive polarimetric LWIR augmented LADAR, Jarrod P. Brown, Air Force Research Lab. (USA); Rodney G. Roberts, Florida State Univ. (USA); Chad M. Welsh, Darrell B. Card, Christian K. Keyser, Air Force Research Lab. (USA) [10655-30]

Compact LWIR polarimeter for cirrus ice properties, Kira Hart, Russell A. Chipman, College of Optical Sciences, The Univ. of Arizona (USA); Dong L. Wu, NASA Goddard Space Flight Ctr. (USA) [10655-31]

Extending the generalized channeled polarimeter formalism to multiple-harmonic carriers, Andrey S. Alenin, UNSW Canberra (Australia); Michael E. Gehm, Duke Univ. (USA); J. Scott Tyo, UNSW Canberra (Australia) [10655-32]

A dual wave infrared imaging polarimeter, David B. Chenault, Joseph L. Pezzaniti, Rich P. Edmondson, Michael E. Roche, Polaris Sensor Technologies, Inc. (USA) [10655-33]

Visible spectrum polarization characterization of Equus zebra hartmannia hide, Bridget Lyons, Torch Technologies (USA); Dennis Goldstein, Air Force Research Lab. (USA) [10655-34]

CONFERENCE 10656

LOCATION: BALLROOM LEVEL, NAPLES 2

Monday–Thursday 16–19 April 2018 • Proceedings of SPIE Vol. 10656

Image Sensing Technologies: Materials, Devices, Systems, and Applications V

Conference Chairs: **Nibir K. Dhar**, U.S. Army Night Vision & Electronic Sensors Directorate (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); **Michael D. Gerhold**, U.S. Army Research Office (USA); **Randy Jacobs**, U.S. Army RDECOM CERDEC NVESD (USA); **Marvin Jaime-Vasquez**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Margaret Kim**, The Univ. of Alabama (USA); **Nobuhiko P. Kobayashi**, Univ. of California, Santa Cruz (USA); **Sanjay Krishna**, The Univ. of New Mexico (USA); **Rihito Kuroda**, Tohoku Univ. (Japan); **Hidenori Mimura**, Shizuoka Univ. (Japan); **Willie Padilla**, Duke Univ. (USA); **Vijay Parameshwaran**, U.S. Army Research Lab. (USA); **Adam Piotrowski**, VIGO Systems S.A. (Poland); **Mukti M. Rana**, Delaware State Univ. (USA); **Siva Sivananthan**, EPIR Technologies, Inc. (USA); **Ashok K. Sood**, Magnolia Optical Technologies, Inc. (USA); **Priyalal S. Wijewarnasuriya**, U.S. Army Research Lab. (USA)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, NAPLES 2 MON 8:05 AM TO 10:00 AM

Advanced Hyperspectral Imaging I

Session Chairs: **Nibir K. Dhar**,
U.S. Army Night Vision & Electronic Sensors Directorate (USA);
Achyut K. Dutta, Banpil Photonics, Inc. (USA)

8:05 am: **National Science Foundation (NSF)'s SBIR/STTR program for small technology companies (Keynote Presentation)**, Murali S. Nair, The National Science Foundation (USA) [10656-1]

8:45 am: **Non-destructive rapid quality control method for tobacco grading using VNIR hyperspectral imaging (Invited Paper)**, Amrita Sahu, Henry Dante, Altria Group, Inc. (USA) [10656-2]

9:10 am: **LED spectral imaging with food and agricultural applications (Invited Paper)**, Jens Michael Carstensen, DTU Compute, Technical Univ. of Denmark (Denmark) [10656-3]

9:35 am: **Using unmanned aerial systems to collect hyperspectral imagery and digital elevation models at a legacy underground nuclear explosion test site (Invited Paper)**, Dylan Anderson, Julia M. Craven, Sandia National Labs. (USA); Robert Dzur, Bohannon Huston, Inc. (USA); Trevor Briggs, Silent Falcon UAS Technologies (USA); Dennis Lee, Sandia National Labs. (USA); Elizabeth Miller, Emily Schultz-Fellenz, Los Alamos National Lab. (USA) [10656-4]

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

SESSION 2

LOCATION: BALLROOM LEVEL, NAPLES 2 MON 10:30 AM TO 11:45 AM

Advanced Hyperspectral Imaging II

Session Chairs: **Amrita Sahu**, Altria Group, Inc. (USA);
Achyut K. Dutta, Banpil Photonics, Inc. (USA)

10:30 am: **Computational imaging spectrometry: the state of our field and what we can do (Invited Paper)**, Nathan Hagen, Utsunomiya Univ. (Japan) [10656-5]

10:55 am: **Synthetic neural network calibration of a hyperspectral imaging camera (Invited Paper)**, Michael W. Kudenov, Edward J. Youngs, Clifton G. Scarboro, North Carolina State Univ. (USA) [10656-6]

11:20 am: **Itchy skin region detection using hyperspectral imaging (Invited Paper)**, Firdous Saleheen, Vira Oleksyuk, Chang-Hee Won, Temple Univ. (USA) [10656-7]

Lunch Break Mon 11:45 am to 12:45 pm

SESSION 3

LOCATION: BALLROOM LEVEL, NAPLES 2 MON 12:45 PM TO 2:20 PM

Advanced Imaging Devices: Photodetectors, X-ray Detectors, Bolometers

Session Chairs: **Nibir K. Dhar**,
U.S. Army Night Vision & Electronic Sensors Directorate (USA);
Mukti M. Rana, Delaware State Univ. (USA)

12:45 pm: **Future directions for microbolometers and thermopile infrared detectors (Invited Paper)**, Joseph J. Talghader, Univ. of Minnesota, Twin Cities (USA) [10656-8]

1:10 pm: **Tuning of TCR in poly-crystalline VO₂ for enhanced IR detection**, Jiwei Lu, Salinporn Kittiwatanakul, Noah Sauber, Mike Cyberey, Art Lichtenberger, Robert Weikle, Univ. of Virginia (USA) [10656-9]

1:30 pm: **Long-wave and mid-wave infrared bolometers with patterned wavelength-selective absorbers (Invited Paper)**, Robert E. Peale, Univ. of Central Florida (USA) [10656-10]

1:55 pm: **Radiation tolerant image sensors using a field emitter array (Invited Paper)**, Hidenori Mimura, Tomoaki Masuzawa, Yoichiro Neo, Shizuoka Univ. (Japan); Masayoshi Nagao, National Institute of Advanced Industrial Science and Technology (Japan); Tamotsu Okamoto, National Institute of Technology, Kisarazu College (Japan); Masafumi Akiyoshi, Osaka Prefecture University (Japan); Nobuhiro Sato, Ikuji Takagi, Yasuhiro Gotoh, Kyoto University (Japan) [10656-67]

SESSION 4

LOCATION: BALLROOM LEVEL, NAPLES 2 MON 2:20 PM TO 4:50 PM

Advanced Photodetectors and Bolometer

Session Chairs: **Mukti M. Rana**, Delaware State Univ. (USA);
Nibir K. Dhar, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

2:20 pm: **Thin film uncooled micro-bolometers on PECVD Si-Ge thermo-sensing materials (Invited Paper)**, Andrey Kosarev, Alfonso Torres Jacome, Mario Moreno, Ismael Cosme, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico) [10656-11]

2:45 pm: **Material considerations for current and next generation microbolometer technology (Invited Paper)**, Athanasios J. Syllaios, Michael S. Harcrow, Brianna J. Western, Vincent C. Lopes, Christopher L. Littler, Univ. of North Texas (USA); Ray Gunawidjaja, Zhi-Gang Yu, Washington State Univ. (USA) [10656-12]

Coffee Break Mon 3:10 pm to 3:35 pm

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10656

3:35 pm: **Uncooled resistive metal foil bolometers for imaging with radiofrequency magnetic fields** (*Invited Paper*), Jeffrey Jennings, Raj Vaidyanathan, Univ. of Central Florida (USA); Aravinda Kar, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) . . . [10656-13]

4:00 pm: **Microwave bolometers based on carbon nanotube thin films and CVD-grown graphene** (*Invited Paper*), Ryan Toonen, Michael R. Gasper, Nitin Parsa, Venkata Sai Praneeth Karempudi, Blake C. Amacher, The Univ. of Akron (USA); Colleen E. Treacy, Ramesh Sivarajan, Nano-C, Inc. (USA); Nicholas C. Varajay, Robert R. Romanofsky, Félix A. Miranda, NASA Glenn Research Ctr. (USA) . . . [10656-14]

4:25 pm: **Customized packaged bolometers in niche applications at INO** (*Invited Paper*), Bruno Fissette, Francis G n reux, David B land, Patrice Topart, Mathieu Tremblay, Yan Desroches, Marc Terroux, Linda Marchese, Christian Proulx, Francois Picard, Denis Dufour, Alain Bergeron, Fran ois Ch teauneau, Christine Alain, INO (Canada) . . . [10656-15]

SYMPOSIUM-WIDE PLENARY SESSION LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6–7 for details.

TUESDAY 17 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, NAPLES 2 TUE 8:00 AM TO 10:10 AM

Advanced Photodetectors and Focal Plane Array (FPA)

Session Chairs: **Arvind I. D'Souza**, DRS Sensors & Targeting Systems, Inc. (USA); **Achyut K. Dutta**, Banpil Photonics, Inc. (USA)

8:00 am: **Low-noise, infrared digital-alloy avalanche photodiodes** (*Invited Paper*), Joe C. Campbell, Univ. of Virginia (USA); Seth R. Bank, The Univ. of Texas at Austin (USA) [10656-16]

8:25 am: **A 400 KHz line rate 2048-pixel stitched SWIR linear array**, Patrick J. Merken, Xenics NV (Belgium) [10656-17]

8:45 am: **Development of a hermetic packaged 13µm pixel pitch 1x6000 element InGaAs linear array**, Kai Song, Jihfen Lei, Henry Yuan, Joe Kimchi, Teledyne Judson Technologies (USA); Anders Petersen, Vincent Douence, Brian Starr, Sundar Sundareswarnan, James W. Beletic, Teledyne Imaging Sensors (USA) [10656-18]

9:05 am: **An extremely compact and high-speed line-scan hyperspectral imager covering the SWIR range (1.1-1.65 µm)** (*Invited Paper*), Pilar Gonzalez, Julien Pichette, Bart Vereecke, Bart Masschelein, Andy Lambrechts, IMEC (Belgium) [10656-19]

9:30 am: **Growth of HgCdTe films on 7x7.5 cm² CdZnTe substrates for science grade H4RG-15 image sensor applications**, F. Erdem Arkun, Dennis Edwall, Aristo Yulius, Majid Zandian, Mark Farris, William McLevige, Eric Holland, Michael Carmody, James Beletic, Teledyne Imaging Sensors (USA) [10656-20]

9:50 am: **Design-optimization and performances of multispectral (VIS-SWIR) photodetector and its array**, Jaydeep Dutta, Banpil Photonics, Inc. (USA); Patrick Oduor, Achyut K. Dutta, Banpil Photonics, Inc. (USA) [10656-21]

Coffee Break and Dedicated Exhibition Time Tue 10:10 am to 11:10 am

SESSION 6

LOCATION: BALLROOM LEVEL, NAPLES 2 TUE 11:10 AM TO 12:00 PM

Computational Imaging I

Session Chairs: **Antoine Wojdyla**, Lawrence Berkeley National Lab. (USA); **Aamod Shanker**, Univ. of California, Berkeley (USA)

11:10 am: **Ultra-miniature computational sensors and imagers: Incorporating algorithms to yield final digital images** (*Invited Paper*), David G. Stork, Rambus Inc. (USA) [10656-22]

11:35 am: **Computed axial lithography: volumetric 3D printing of arbitrary geometries** (*Invited Paper*), Indrasen Bhattacharya, Brett Kelly, Univ. of California, Berkeley (USA); Maxim Shusteff, Christopher Spadaccini, Lawrence Livermore National Lab. (USA); Hayden Taylor, Univ. of California, Berkeley (USA) [10656-36]

Lunch/Exhibition Break Tue 12:00 pm to 1:50 pm

SESSION 7

LOCATION: BALLROOM LEVEL, NAPLES 2 TUE 1:50 PM TO 3:30 PM

Computational Imaging II

Session Chairs: **Antoine Wojdyla**, Lawrence Berkeley National Lab. (USA); **Aamod Shanker**, Univ. of California, Berkeley (USA)

1:50 pm: **Terahertz radar for imaging and science applications** (*Invited Paper*), Goutam Chattopadhyay, Jet Propulsion Lab. (USA) [10656-24]

2:15 pm: **Computational imaging in complex media** (*Invited Paper*), Lei Tian, Boston Univ. (USA) [10656-23]

2:40 pm: **Achieving fast high-resolution 3D imaging by combining synchrotron x-ray microCT, advanced algorithms, and high performance data management** (*Invited Paper*), Dilworth Y. Parkinson, Daniela Ushizima, Harinarayan Krishnan, Talita Perciano, James Sethian, Lawrence Berkeley National Lab. (USA) [10656-26]

3:05 pm: **Linear scattering theory in phase space** (*Invited Paper*), Aamod Shanker, Laura Waller, Univ. of California, Berkeley (USA) . . [10656-27]

Coffee Break Tue 3:30 pm to 4:00 pm

PANEL DISCUSSION

LOCATION: BALLROOM LEVEL, NAPLES 2 4:00 PM TO 6:00 PM

Computational Imaging: Present and Future

Moderator: **Antoine Wojdyla**, Lawrence Berkeley National Lab. (USA)

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Industrial inspection of the optical thin film using dual spectral domain optical coherence tomography systems, Muhammad F. Shirazi, Naresh Kumar Ravichandran, Ruchire Eranga Wijesinghe, Mansik Jeon, Jeehyun Kim, Kyungpook National Univ. (Korea, Republic of) [10656-56]

Grating for improving detection efficiency of Nb5N6 microbolometer THz detector, Peng Xiao, Xuecou Tu, Lin Kang, Chengtao Jiang, Xiaoqing Jia, Peiheng Wu, Nanjing Univ. (China) [10656-58]

Surface plasmon polariton mode validation using commercially available finite element method ANSYS HFSS, Olanrewaju Olaogun, Michael F. Finch, Brian A. Lail, Florida Institute of Technology (USA) [10656-59]

Pulse characteristics of X-ray sensors on high-resistance GaAs:Cr, Irina Kolesnikova, Oleg Tolbanov, Anton Tyazhev, Anastasiya Lozinskaya, Anastasiya Shemeryankina, Andrei Zarubin, Maxim Skakunov, Vladimir Novikov, Tomsk State Univ. (Russian Federation) [10656-60]

Hemispherical image sensors for wide FOV imaging, Kyle Renshaw, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) and Univ. of Central Florida (USA); Zhao Ma, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10656-61]

Adaptive test bench for characterizing image processing sensors, Gunther Notni, Maik Rosenberger, Lisa Radtke, Ilja Graf-Batuchtin, Technische Univ. Ilmenau (Germany) [10656-62]

Day vision unit DC focal motor controller design, co-simulation and implementation on FPGA, Can Uğur Oflamaz, Murat Kalkan, ASELSAN A.S. (Turkey) [10656-63]

Wide range UV irradiation system for imaging reflection spectroscopy, Raik Illmann, Maik Rosenberger, Technische Univ. Ilmenau (Germany) [10656-64]

Finite size narrow-band transmission filters for real-time short wave IR spectroscopy and imaging, Ryan Green, Vitaliy Avrutin, Ümit Özgür, Virginia Commonwealth Univ. (USA); Nibir K. Dhar, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [10656-65]

First demonstration of gate voltage-less chemical vapor deposition graphene (CVD-G) for non-vacuum thermoelectric study, Li Lynn Shiau, Nanyang Technological Univ. (Singapore) and Excelitas Technologies (Singapore); Xingli Wang, Nanyang Technological Univ. (Singapore); Simon Chun Kiat Goh, Nanyang Technological Univ. (Singapore) and Excelitas Technologies (Singapore); Kailiang Chuan, Excelitas Technologies Corp. (Singapore); Henrik Ernst, Excelitas Technologies GmbH & Co. KG (Germany); Beng Kang Tay, Nanyang Technological Univ. (Singapore) [10656-66]

Readout QDC for CdTe x-ray imager using direct charge treatment, Katsuyuki Takagi, Shizuoka Univ (Japan) and ANSeeN Inc. (Japan); Toshiyuki Takagi, ANSeeN Inc. (Japan); Tsuyoshi Terao, Akifumi Koike, Shizuoka Univ (Japan) and ANSeeN Inc. (Japan); Toru Aoki, Shizuoka Univ (Japan) [10656-69]

WEDNESDAY 18 APRIL

SESSION 8

LOCATION: BALLROOM LEVEL, NAPLES 2 WED 8:00 AM TO 10:05 AM

Computational Imaging III

Session Chairs: **Antoine Wojdyla**, Lawrence Berkeley National Lab. (USA); **Aamod Shanker**, Univ. of California, Berkeley (USA)

8:00 am: **High resolution 3D imaging of integrated circuits by x-ray ptychography** (*Invited Paper*), Michal Odstrcil, Mirko Holler, Jörg Raabe, Manuel Guizar-Sicairos, Paul Scherrer Institut (Switzerland) [10656-28]

8:25 am: **A gigapixel camera array for high throughput microscopy** (*Invited Paper*), Roarke Horstmeyer, Charité Universitätsmedizin Berlin (Germany) and Humboldt-Univ. zu Berlin (Germany) [10656-29]

8:50 am: **EUV photolithography mask inspection using Fourier ptychography** (*Invited Paper*), Antoine Wojdyla, Lawrence Berkeley National Lab. (USA) [10656-30]

9:15 am: **New systems for computational x-ray phase imaging with conventional sources** (*Invited Paper*), Jonathan C. Petrucci, Porcelain He, Weiyuan Sun, Danielle Hayden, Sean Starr-Baier, Carolyn A. MacDonald, Univ. at Albany (USA) [10656-31]

9:40 am: **Low dose x-ray imaging by photon counting detector** (*Invited Paper*), Toru Aoki, Shizuoka Univ (Japan) and ANSeeN Inc. (Japan); Kosuke Kimura, Shizuoka Univ. (Japan); Hisashi Morii, Shizuoka Univ (Japan) and ANSeeN Inc. (Japan); Toshiyuki Takagi, ANSeeN Inc. (Japan); Katsuyuki Takagi, Shizuoka Univ. (Japan) and ANSeeN Inc. (Japan); Tsuyoshi Terao, Shizuoka Univ (Japan) and ANSeeN Inc. (Japan); Takaharu Okunoyama, ANSeeN Inc. (Japan); Akifumi Koike, Shizuoka Univ (Japan) and ANSeeN Inc. (Japan) [10656-68]

Coffee Break and Dedicated Exhibition Time Wed 10:05 am to 11:05 am

SESSION 9

LOCATION: BALLROOM LEVEL, NAPLES 2 WED 11:05 AM TO 12:30 PM

Advanced Imaging Technologies I

Session Chairs: **Nibir K. Dhar**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Achyut K. Dutta**, Banpil Photonics, Inc. (USA)

11:05 am: **Hardware based spatio-temporal neural processing backend for imaging sensors: Towards a smart camera** (*Invited Paper*), Samiran Ganguly, Mircea R. Stan, Avik W. Ghosh, Univ. of Virginia (USA) [10656-32]

11:30 am: **Considerations in the development of a foveated imaging system for unmanned aerial vehicles (UAVs)**, Andrew D. O'Neill, The Pennsylvania State Univ. (USA); Joshua C. Davidson, Timothy J. Kane, Pennsylvania State Univ. (USA); Ram M. Narayanan, The Pennsylvania State Univ. (USA); Nibir K. Dhar, U.S. Army Night Vision & Electronic Sensors Directorate (USA) [10656-33]

11:50 am: **Novel high energy short-pulse laser diode source for 3D Flash LIDAR**, Andreas Kohl, Celine Canal, Arnaud Laugustin, Olivier Rabot, Quantel Laser (France) [10656-34]

12:10 pm: **Realization of Si based detector array for hyperspectral optical imaging application**, Parul Singh, Arup Banerjee, Vishal Sakarvadiya, Space Applications Ctr. (India) [10656-35]

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

SESSION 10

LOCATION: BALLROOM LEVEL, NAPLES 2 WED 1:30 PM TO 2:10 PM

Advanced Imaging Technologies II

Session Chairs: **Nibir K. Dhar**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Achyut K. Dutta**, Banpil Photonics, Inc. (USA)

1:30 pm: **PbS CQD Device Performance and Modeling**, Ethan Klem, RTI International (USA) [10656-54]

1:50 pm: **ROIC for 3 um Pixel Pitch Colloidal Quantum Dot Detectors**, Arvind I. DSouza, Alex Bakulin, Leonardo DRS (USA); Ethan Klem, Dorota Temple, RTI International (USA) [10656-55]

SESSION 11

LOCATION: BALLROOM LEVEL, NAPLES 2 WED 2:10 PM TO 6:00 PM

Advanced THz Imaging Technologies I

Session Chairs: **Hou-Tong Chen**, The Ctr. for Integrated Nanotechnologies (USA); **Seongsin Margaret Kim**, The Univ. of Alabama (USA)

2:10 pm: **Near-field microscopy of spontaneous evanescent waves** (*Invited Paper*), Yusuke Kajihara, Institute of Industrial Science, The Univ. of Tokyo (Japan) [10656-37]

2:35 pm: **Narrowband terahertz bandpass filters based on metasurfaces** (*Invited Paper*), Hou-Tong Chen, Chun-Chieh Chang, Los Alamos National Lab. (USA); Li Huang, Harbin Institute of Technology (China); John Nogan, Sandia National Labs. (USA) [10656-38]

3:00 pm: **Terahertz imagers based on metamaterial structures monolithically integrated in standard CMOS technologies** (*Invited Paper*), Ivonne Escorcía, James P. Grant, Univ. of Glasgow (United Kingdom); Luis Gouveia, Instituto de Microelectrónica de Sevilla (Spain); David R. S. Cumming, Univ. of Glasgow (United Kingdom) [10656-39]

Coffee Break Wed 3:25 pm to 3:55 pm

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10656

3:55 pm: **Real-time multispectral T-ray imaging using metamaterials** (*Invited Paper*), Tiger Tao, The Univ. of Texas at Austin (USA) [10656-40]

4:20 pm: **Manipulating terahertz waves using all-dielectric metasurfaces** (*Invited Paper*), Zhen Tian, Mingguai Wei, Huifang Zhang, Quan Xu, Qing Yu, Tianjin Univ. (China); Xueqian Zhang, Tianjin Univ (China); Chunmei Ouyang, Jianqiang Gu, Yanfeng Li, Jiaguang Han, Weili Zhang, Qiu Wang, Tianjin Univ. (China) [10656-41]

4:45 pm: **Microfluidic sensing and dielectric constant measurement of microorganisms based on THz metamaterials** (*Invited Paper*), SaeJune Park, Sae A Na Yoon, Yeong Hwan Ahn, Ajou Univ. (Korea, Republic of) [10656-42]

5:10 pm: **Information metamaterials and metasurfaces** (*Invited Paper*), Xiaojian Fu, Tie Jun Cui, Southeast Univ. (China) [10656-43]

5:35 pm: **THz super-focusing based on Archimedes spiral plasmonic lens** (*Invited Paper*), Yiming Zhu, XiaoFei Zang, Univ. of Shanghai for Science and Technology (China) [10656-44]

THURSDAY 19 APRIL

SESSION 12

LOCATION: BALLROOM LEVEL, NAPLES 2 THU 8:00 AM TO 12:15 PM

Advanced THz Imaging Technologies II

Session Chairs: **Hou-Tong Chen**,

The Ctr. for Integrated Nanotechnologies (USA);

Seongsin Margaret Kim, The Univ. of Alabama (USA)

8:00 am: **Using liquid water as broadband terahertz wave emitter** (*Invited Paper*), Jianming Dai, Tianjin Univ. (China); Qi Jin, Yiwen E., Kaia Williams, Xi-Cheng Zhang, Univ. of Rochester (USA) [10656-45]

8:25 am: **Optimizing the information content of metasurface apertures for computational millimeter-wave imaging** (*Invited Paper*), David R. Smith, Duke Univ. (USA) [10656-46]

8:50 am: **Terahertz nanoscopy: Terahertz time-domain spectroscopy with less than 20nm spatial resolution** (*Invited Paper*), Max Eisele, neaspec GmbH (Germany) [10656-47]

9:15 am: **THz metamaterials for sensing and communication application** (*Invited Paper*), Seongsin M. Kim, The Univ. of Alabama (USA) [10656-48]

9:40 am: **Magnetically tunable terahertz metamaterial by polymeric microactuators** (*Invited Paper*), Jiangfeng Zhou, Univ. of South Florida (USA) [10656-49]

Coffee Break. Thu 10:05 am to 10:35 am

10:35 am: **Terahertz imaging for nondestructive testing of materials for aerospace, automotive, and energy** (*Invited Paper*), David S. Citrin, Alexandre Locquet, Junliang Dong, Georgia Institute of Technology (USA) and Georgia Tech-Lorraine (France) [10656-50]

11:00 am: **Explosive hazard defeat challenges and needs in future conflict and environment** (*Invited Paper*), Joong H. Kim, Office of Naval Research (USA) [10656-51]

11:25 am: **Design and simulation of a handheld telecentric terahertz time-domain spectral scanner** (*Invited Paper*), Zachary Harris, Stony Brook Univ. (USA); Stefan Katletz, Kepler Universitätsklinikum (Austria); M. Hassan Arbab, Stony Brook Univ. (USA) [10656-52]

11:50 am: **Terahertz spectroscopy and imaging** (*Invited Paper*), Cunlin Zhang, Chenyu Li, Capital Normal Univ. (China) [10656-53]

CONFERENCE 10657

LOCATION: BALLROOM LEVEL, SARASOTA 2

Monday–Wednesday 16–18 April 2018 • Proceedings of SPIE Vol. 10657

Next-Generation Spectroscopic Technologies XI

Conference Chairs: **Mark A. Druy**, Galvanic Applied Sciences USA Inc. (USA); **Richard A. Crocombe**, Crocombe Spectroscopic Consulting, LLC (USA); **Steven M. Barnett**, Barnett Technical Services, LLC (USA); **Luisa T.M. Profeta**, Field Forensics, Inc. (USA); **Abul K. Azad**, Los Alamos National Lab. (USA)

Program Committee: **Leigh J. Bromley**, DRS Daylight Solutions (USA); **John M. Dell**, The Univ. of Western Australia (Australia); **Jason M. Eichenholz**, Open Photonics, Inc. (USA); **Fredrick G. Haibach**, Confluent Sciences Consulting, Inc. (USA); **Willem Hoving**, Anterony BV (Netherlands); **Vassili Karanassios**, Univ. of Waterloo (Canada); **Martin Kraft**, Carinthian Tech Research AG (Austria); **Jouko O. Malinen**, VTT Technical Research Ctr. of Finland (Finland); **Ellen V. Miseso**, Hamamatsu Corp. (USA); **Jeffrey J. Santman**, Corning Advanced Optics (USA); **David W. Schiering**, CziTek, LLC (USA); **John Seelenbinder**, Agilent Technologies (USA); **Ulrike Willer**, Technische Univ. Clausthal (Germany)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SARASOTA 2 MON 8:30 AM TO 10:30 AM

Smartphone Spectroscopy

Session Chair: **Richard A. Crocombe**,
Crocombe Spectroscopic Consulting, LLC (USA)

8:30 am: **Smartphone spectroscopy for mobile health diagnostics with laboratory-equivalent capabilities** (*Invited Paper*), Brian T. Cunningham, Kenneth D. Long, Elizabeth Woodburn, Univ. of Illinois (USA); Yuhang Wan, Beihang Univ. (China); John A. Carlson, Patrick Su, Sam Al-Mulla, Benjamin Kesler, John M. Dallesasse, Univ. of Illinois (USA) [10657-1]

9:00 am: **Signal processing of transient signals generated from a microplasma: migrating from a desktop computer to a smartphone**, Ryan Fitzgerald, Amy Chan, Vassili Karanassios, Univ. of Waterloo (Canada) [10657-2]

9:20 am: **From portable Raman to mobile Raman: The progression of Raman spectroscopy**, Bryan Ray, Kieth T. Carron, Metrohm Raman (USA) [10657-3]

9:40 am: **Connecting a smartphone-enabled portable spectrometer to the internet of things**, Ryan Fitzgerald, Amy Chan, Vassili Karanassios, Univ. of Waterloo (Canada) [10657-4]

10:00 am: **Progress towards low resolution visible spectrometry with COTS components** (*Invited Paper*), Alexander Scheeline, SpectroClick, Inc. (USA) [10657-5]

Coffee Break Mon 10:30 am to 10:50 am

SESSION 2

LOCATION: BALLROOM LEVEL, SARASOTA 2 MON 10:50 AM TO 12:10 PM

Laser Sources and Spectroscopy

Session Chair: **Mark A. Druy**,
Galvanic Applied Sciences USA Inc. (USA)

10:50 am: **Tunability improvement of a doubly resonant OPO for fast and high resolution gas spectroscopy**, Benjamin Szymanski, Johann Georges des Aulnois, Blue Industry and Science (France) [10657-6]

11:10 am: **A new way of controlling NesCOPOs (nested Cavity doubly resonant OPO) for faster and more efficient high resolution spectrum measurement**, Johann Georges des Aulnois, Benjamin Szymanski, Axel Grimieau, Léo Sillard, Blue Industry and Science (France) [10657-7]

11:30 am: **Interband cascade lasers integrated on silicon**, Jerry R. Meyer, U.S. Naval Research Lab. (USA) [10657-8]

11:50 am: **Multi-wavelength Mid-IR light source for spectroscopy**, Pentti Karioja, Teemu Alajoki, Matteo Cherchi, Mikko Harjanne, Noora Heinilehto, VTT Technical Research Ctr. of Finland Ltd. (Finland); Soile Suomalainen, Jukka Viheriälä, Heidi Tuorila, Tampere Univ. of Technology (Finland); Ryszard Buczyński, Rafal Kasztelaniec, Institute of Electronic Materials Technology (Poland); Tomi Salo, Sami Virtanen, Vaisala Oy (Finland); Pawel Kluczyński, Airopic Sp z.o.o. (Poland); Lars Borgen, GasSecure AS (Norway); Marcin Ratajczyk, Przemyslaw Kalinowski, VIGO System S.A. (Poland); Jyrki Ollila, VTT Technical Research Ctr. of Finland Ltd. (Finland) [10657-9]

Lunch Break Mon 12:10 pm to 1:25 pm

SESSION 3

LOCATION: BALLROOM LEVEL, SARASOTA 2 MON 1:25 PM TO 3:25 PM

New Technologies

Session Chair: **Steven M. Barnett**,
Barnett Technical Services, LLC (USA)

1:25 pm: **Advances in miniaturized spectral sensors**, Steve Saxe, Viavi Solutions Inc. (USA) [10657-10]

1:45 pm: **Miniaturized electrically tunable Fabry-Pérot interferometer with two movable reflectors for the visible spectral range**, Marco Meinig, Steffen Kurth, Fraunhofer-Institut für Elektronische Nanosysteme (Germany); Mario Seifert, Karla Hiller, Technische Univ. Chemnitz (Germany); Thomas Otto, Fraunhofer-Institut für Elektronische Nanosysteme (Germany) and Technische Univ. Chemnitz (Germany) [10657-11]

2:05 pm: **New organic spectroscopic photodetectors for NIR detection**, Matthias Jahnel, Robert Brückner, David Wynands, Rico Meerheim, Ronny Timmreck, Robert Langer, Karl Leo, TU Dresden (Germany) . [10657-12]

2:25 pm: **Low cost rapid fabrication of in-plane LVOF microspectrometer for MIR sensing**, Simon Chun Kiat Goh, Li Lynn Shiao, Nanyang Technological Univ. (Singapore) and Excelitas Technologies Singapore, Pte. Ltd. (Singapore); Nan Chen, National Univ. of Singapore (Singapore); Kailiang Chuan, Excelitas Technologies Singapore, Pte. Ltd. (Singapore); Ernst Henrik, Excelitas Technologies GmbH & Co. KG (Germany); Chengkuo Lee, National Univ. of Singapore (Singapore); Beng Kang Tay, Chuan Seng Tan, Nanyang Technological Univ. (Singapore) [10657-13]

2:45 pm: **An analytic method for spectrum recovery from wedge or staircase spectrometers**, Michael K. Yetzbacher, U.S. Naval Research Lab. (USA); Christopher W. Miller, The MITRE Corp. (USA); Michael J. DePrenger, Tekla Research Inc. (USA) [10657-14]

3:05 pm: **Compact snapshot image mapping spectrometer (SNAP-IMS) for hyperspectral data cube acquisition using unmanned aerial vehicle environmental imaging**, Jason Dwight, Tomasz S. Tkaczyk, David Alexander, Michal E. Pawlowski, Rice Univ. (USA); Jeffrey C. Luvall, Paul F. Tatum, Gary J. Jedlovec, NASA Marshall Space Flight Ctr. (USA) [10657-28]

Coffee Break Mon 3:25 pm to 3:45 pm

CONFERENCE 10657

SESSION 4

LOCATION: BALLROOM LEVEL, SARASOTA 2 MON 3:45 PM TO 4:45 PM

LIBS and Optical Emission

Session Chair: **Steven M. Barnett**,
Barnett Technical Services, LLC (USA)

3:45 pm: **A vaporization chamber for micro- and nano-sample introduction into a battery-operated microplasma: from 3D printing to computational fluid dynamics (CFDs) simulations**, Ryan Fitzgerald, Mallanie Saddler, Vassili Karanassios, Univ. of Waterloo (Canada) . . [10657-15]

4:05 pm: **Effects of pressure in ultrashort pulse laser induced breakdown spectroscopy (LIBS)**, Dongkeun Lee, Sanghoon Ahn, Jihyun Kim, Jiyeon Choi, Jiwhan Noh, Korea Institute of Machinery & Materials (Korea, Republic of) [10657-16]

4:25 pm: **Laser-induced breakdown spectroscopy for process monitoring of rare-earth elements during extraction from coal or coal byproducts**, Richard T. Wainner, Dorin Preda, Prakash Joshi, Physical Sciences Inc. (USA) [10657-17]

SYMPOSIUM-WIDE PLENARY SESSION LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6–7 for details.

TUESDAY 17 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, SARASOTA 2 TUE 8:20 AM TO 10:00 AM

Raman Spectroscopy and Imaging

Session Chair: **Luisa TM Profeta**, Field Forensics, Inc. (USA)

8:20 am: **Raman-based point and proximal detection and imaging** (*Invited Paper*), Ilana Bar, Ben-Gurion Univ. of the Negev (Israel) . . . [10657-18]

8:50 am: **Fast and safe chemical identification through packaging material**, Jun Zhao, Jack Zhou, Sean Wang, B&W Tek (USA) [10657-19]

9:10 am: **Chemical, biological, and trace gas detection and measurement with a newly developed integrating cavity enhanced Raman (iCERS) technique**, Thomas Z. Moore, Southwest Research Institute (USA). [10657-20]

9:30 am: **High resolution handheld Raman and reflectance hyperspectral imaging for remote sensing and threat detection** (*Invited Paper*), Edward A. Gooding, Hindsight Imaging, Inc. (USA) [10657-21]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, SARASOTA 2 TUE 11:00 AM TO 12:00 PM

Nanoscale Imaging

Session Chair: **Mark A. Druy**,
Galvanic Applied Sciences USA Inc. (USA)

11:00 am: **Infrared spectroscopy below the diffraction limit using an optical probe** (*Invited Paper*), Tyler Huffman, Robert Furstenberg, Christopher Kendziora, Andrew McGill, U.S. Naval Research Lab. (USA) [10657-22]

11:30 am: **Nanoscale imaging and sensing using hyperbolic metamaterials (Rising Researcher Presentation)** (*Invited Paper*), Amit Agrawal, National Institute of Standards and Technology (USA) [10657-23]

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

SESSION 7

LOCATION: BALLROOM LEVEL, SARASOTA 2 TUE 1:30 PM TO 3:30 PM

Novel Imaging Instruments

Session Chair: **Luisa TM Profeta**, Field Forensics, Inc. (USA)

1:30 pm: **Hyper spectral imaging camera in the near-infrared using a novel tunable MEMS Fabry-Pérot interferometer**, Grégory Bouquet, Jo Gjessing, Zeljko Skokic, SINTEF (Norway); Thor Bakke, Tunable Infrared Technologies AS (Norway); Jostein Thorstensen, Jon Tschudi, SINTEF (Norway) [10657-24]

1:50 pm: **A speckle-based approach to compressive hyperspectral imaging**, Rebecca French, Univ. of Southampton (United Kingdom); Sylvain Gigan, Lab. Kastler Brossel (France); Otto L. Muskens, Univ. of Southampton (United Kingdom) [10657-25]

2:10 pm: **A truly mobile push-broom hyperspectral camera**, Jouni Jussila, Kari Kataja, Jarkko Puusaari, Harri Salo, Specim Spectral Imaging Ltd. (Finland) [10657-26]

2:30 pm: **Novel use of shortwave infrared hyperspectral imaging for standoff detection of explosives and narcotics in room clearing applications**, Denise Moon, Nathaniel R. Gomer, Matthew P. Nelson, Shawna K. Tazik, Jason G. Wierszewski, ChemImage Corp. (USA) [10657-27]

2:50 pm: **Real-time, wide-area, standoff detection of hazardous material using a conformal filter based shortwave infrared hyperspectral imaging sensor**, Matthew P. Nelson, Shawna K. Tazik, Patrick J. Treado, ChemImage Corp. (USA); Srinivasa Narasimhan, Bernardo Pires, Martial Hebert, Carnegie Mellon Univ. (USA) [10657-29]

3:10 pm: **Quantum cascade laser characterization of a guided mode resonance filter in LWIR**, Neelam Gupta, U.S. Army Research Lab. (USA); Mark S. Mirotznik, Univ. of Delaware (USA) [10657-30]

Coffee Break Tue 3:30 pm to 4:00 pm

SESSION 8

LOCATION: BALLROOM LEVEL, SARASOTA 2 TUE 4:00 PM TO 6:00 PM

Terahertz I

Session Chair: **Abul K. Azad**, Los Alamos National Lab. (USA)

4:00 pm: **Terahertz atmospheric propagation studies in support of wireless remote sensing** (*Invited Paper*), John O'Hara, Oklahoma State Univ. (USA) [10657-31]

4:30 pm: **Thin film sensing based on symmetric and asymmetric terahertz metamaterials** (*Invited Paper*), Dibakar Roy Chowdhury, Mahindra École Centrale (India); S. Jagan Mohan Rao, Maidul Islam, Indian Institute of Technology Guwahati (India); Chhillamcherla Sai Amith, Sabyasachi Banerjee, Mahindra École Centrale (India); Gagan Kumar, Indian Institute of Technology Guwahati (India) [10657-32]

5:00 pm: **A new THz technology: artificial dielectrics** (*Invited Paper*), Rajind Mendis, Brown Univ. (USA) [10657-33]

5:30 pm: **Quadrupolar interactions to achieve high Q plasmon induced transparency** (*Invited Paper*), Goutam Rana, Indian Institute of Technology Bombay (India); Prathmesh Deshmukh, Tata Institute of Fundamental Research (India); Siddhartha P. Duttagupta, Indian Institute of Technology Bombay (India); Shriramesh S. Prabhu, Venu Gopal Achanta, Tata Institute of Fundamental Research (India); Girish S. Agarwal, Texas A&M Univ. (USA) [10657-34]

WEDNESDAY 18 APRIL

SESSION 9

LOCATION: BALLROOM LEVEL, SARASOTA 2 WED 8:00 AM TO 10:00 AM

Terahertz II

Session Chair: **Abul K. Azad**, Los Alamos National Lab. (USA)

8:00 am: **High-sensitivity terahertz spectroscopy systems based on plasmonic photoconductors** (*Invited Paper*), Mona Jarrahi, Univ. of California, Los Angeles (USA)[10657-35]

8:30 am: **Terahertz optical diode effect in natural and artificial materials** (*Invited Paper*), Diyar Talbayev, Tulane Univ. (USA) [10657-36]

9:00 am: **Long-distance propagation and gas sensing using THz pulses** (*Invited Paper*), Tae-In Jeon, Korea Maritime and Ocean Univ. (Korea, Republic of) [10657-37]

9:30 am: **Nonlinear broadband THz spectroscopy using laser-induced gas plasma THz source** (*Invited Paper*), Masashi Yamaguchi, Rensselaer Polytechnic Institute (USA) [10657-38]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 10

LOCATION: BALLROOM LEVEL, SARASOTA 2 WED 11:00 AM TO 12:30 PM

Terahertz III

Session Chair: **Abul K. Azad**, Los Alamos National Lab. (USA)

11:00 am: **Low temperature dielectric properties of ammonium nitrate in terahertz regime** (*Invited Paper*), Abdur Rahman, Edinboro Univ. of Pennsylvania (USA); Abul Azad, David Moore, Los Alamos National Lab. (USA) [10657-39]

11:30 am: **Non-collinear and non-ellipsometric electro-optic sampling techniques for efficient terahertz wave detection** (*Invited Paper*), Masahiko Tani, Hiroyuki Kato, Daiki Gotoh, Takuro Yasumoto, Hideaki Kitahara, Takashi Furuya, Kohji Yamamoto, Univ. of Fukui (Japan); Takashi Notake, Hiroaki Minamide, RIKEN Ctr. for Advanced Photonics (Japan); Elmer S. Estacio, National Institute of Physics (Philippines) and Univ. of the Philippines Diliman (Philippines); Michael Bakunov, N.I. Lobachevsky State Univ. of Nizhni Novgorod (Russian Federation) [10657-40]

12:00 pm: **Spin-charge conversion in topological materials via terahertz emission spectroscopy** (*Invited Paper*), Elbert Chia, Nanyang Technological Univ (Singapore) [10657-41]

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10658

LOCATION: BALLROOM LEVEL, OSCEOLA 5

Tuesday–Thursday 18–19 April 2018 • Proceedings of SPIE Vol. 10658

Compressive Sensing VII: From Diverse Modalities to Big Data Analytics

Conference Chair: **Fauzia Ahmad**, Temple Univ. (USA)

Program Committee: **Moeness G. Amin**, Villanova Univ. (USA); **Gonzalo R. Arce**, Univ. of Delaware (USA); **Abdesselam Salim Bouzerdoum**, Univ. of Wollongong (Australia); **Michael J. DeWeert**, BAE Systems (USA); **Matthew A. Herman**, InView Technology Corp. (USA); **Eric L. Mokole**, Consultant (USA); **Dimitris A. Pados**, Univ. at Buffalo (USA); **Piya Pal**, Univ. of Maryland, College Park (USA); **Athina P. Petropulu**, Rutgers, The State Univ. of New Jersey (USA); **Zhijun G. Qiao**, The Univ. of Texas-Pan American (USA); **Ervin Sejdic**, Univ. of Pittsburgh (USA); **Adrian Stern**, Ben-Gurion Univ. of the Negev (Israel); **Zhi (Gerry) Tian**, George Mason Univ. (USA); **Lei (Leslie) Ying**, Univ. at Buffalo (USA); **Yimin D. Zhang**, Temple Univ. (USA)

TUESDAY 17 APRIL

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Using photoelectric effect on spark gap to detect the type of gas and light in an environment using a single sensor, Marshall Bassford, Michelle Holzemer, Ryan A. Integlia, Florida Polytechnic Univ. (USA) [10658-24]

WEDNESDAY 18 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, OSCEOLA 5 WED 8:20 AM TO 10:00 AM

CS for Spectral and Medical Imaging

Session Chair: **Fauzia Ahmad**, Temple Univ. (USA)

8:20 am: **Effect of different water situation and estimation model of chlorophyll concentration for pinus elliotii with compressive hyperspectral data**, Wenmin Li, Northwest A&F Univ. (China); Zhijun G. Qiao, The Univ. of Texas Rio Grande Valley (USA) [10658-1]

8:40 am: **Adaptive coded apertures in snapshot compressive spectral imaging**, Xu Ma, Hao Zhang, Beijing Institute of Technology (China); Xiao Ma, Gonzalo R. Arce, Univ. of Delaware (USA); Tingfa Xu, Beijing Institute of Technology (China) [10658-2]

9:00 am: **High frame-rate compressive spectral video system**, Xiao Ma, Chen Fu, Gonzalo R. Arce, Univ. of Delaware (USA) [10658-3]

9:20 am: **Snapshot optical coherence tomography**, Xin Yuan, Nokia Bell Labs (USA); Yangyang Sun, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Xuan Liu, New Jersey Institute of Technology (USA) [10658-4]

9:40 am: **Compressed sensing and differential measurements in interferometry**, Pulak Sarangi, Piya Pal, Univ. of California, San Diego (USA) [10658-5]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 2

LOCATION: BALLROOM LEVEL, OSCEOLA 5 WED 11:00 AM TO 12:00 PM

Data Analysis and Learning with Faulty Measurements

Session Chair: **Panos P. Markopoulos**, Rochester Institute of Technology (USA)

11:00 am: **Robust decomposition of 3-way tensors based on L1-norm**, Dimitris G. Chachlakis, Panos P. Markopoulos, Rochester Institute of Technology (USA) [10658-6]

11:20 am: **Selective erasures for high-dimensional robust subspace tracking**, Daniel Pimentel-Alarcon, Georgia State Univ. (USA) [10658-7]

11:40 am: **Conformity evaluation of data samples by L1norm principal-component analysis**, Ying Liu, Univ. at Buffalo (USA); Dimitris A. Pados, Florida Atlantic Univ. (USA) [10658-8]

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

SESSION 3

LOCATION: BALLROOM LEVEL, OSCEOLA 5 WED 1:30 PM TO 3:10 PM

CS Signal Processing

Session Chair: **Ali Cafer Gurbuz**, The Univ. of Alabama (USA)

1:30 pm: **Adaptive measurement design for direction of arrival estimation and target tracking**, Ali Cafer Gurbuz, The Univ. of Alabama (USA) . [10658-9]

1:50 pm: **Compressive sensing and down-sampling in radar-based human motion classifications**, Baris Erol, Villanova Univ. (USA); Mark Francesco, Arun Ravisankar, Comcast Labs. (USA); Moeness G. Amin, Villanova Univ. (USA) [10658-10]

2:10 pm: **A greedy approach for correlation-aware sparse support recovery**, Ali Koochakzadeh, Piya Pal, Univ. of California, San Diego (USA) [10658-11]

2:30 pm: **A linear discriminative analysis based fall motion detector using radar**, Sivan Zlotnikov, Patrick Somaru, Temple Univ. (USA); Panos P. Markopoulos, Rochester Institute of Technology (USA); Fauzia Ahmad, Temple Univ. (USA) [10658-12]

2:50 pm: **Constraint term refinement for compressive sensing image reconstruction**, Ligang Zou, Shuxia Li, The Univ. of Texas Rio Grande Valley (USA); Bin Zou, Junping Zhang, Harbin Institute of Technology (China); Zhijun G. Qiao, The Univ. of Texas Rio Grande Valley (USA) [10658-13]

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

SESSION 4

LOCATION: BALLROOM LEVEL, OSCEOLA 5 WED 3:40 PM TO 5:00 PM

CS for Remote Sensing, Surveillance, and Radar Imaging

Session Chair: **Bing Ouyang**, Florida Atlantic Univ. (USA)

3:40 pm: **Distinguishing one from many using super-resolution compressive sensing**, Stephen Anthony, Jonathan Mulcahy-Stanislawczyk, Eric A. Shields, Drew P. Woodbury, Sandia National Labs. (USA) . . . [10658-14]

4:00 pm: **Clutter identification based on kernel density estimation and sparse recovery**, Haokun Wang, Univ. of Pittsburgh (USA); Yijian Xiang, Washington Univ. in St. Louis (USA); Malia Kelsey, Univ. of Pittsburgh (USA); Satyabrata Sen, Oak Ridge National Lab. (USA); Arye Nehorai, Washington Univ. in St. Louis (USA); Murat Akcakaya, Univ. of Pittsburgh (USA) . [10658-15]

4:20 pm: **Compressing two ways: the initial study of an underwater inflatable co-prime sonar array (UICSA)**, Bing Ouyang, Fraser Dalgleish, Anni Dalgleish, Florida Atlantic Univ. (USA); Fauzia Ahmad, Temple Univ. (USA) [10658-16]

4:40 pm: **Performance comparison of total variation minimization and group sparse reconstructions for extended target imaging in multilayered dielectric media**, Fauzia Ahmad, Temple Univ. (USA); Wenji Zhang, Ahmad Hoorfar, Villanova Univ. (USA). [10658-17]

THURSDAY 19 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, OSCEOLA 5 THU 9:10 AM TO 10:10 AM

Big Data Processing

Session Chair: **Dimitris A. Pados**, Florida Atlantic Univ. (USA)

9:10 am: **The restricted isometry property for echo state networks**, Ashley Prater, Air Force Research Lab. (USA). [10658-18]

9:30 am: **Perturbation based sparse subspace clustering**, Ali Cafer Gurbuz, The Univ. of Alabama (USA) [10658-19]

9:50 am: **Application of sparse representation in large scale remote sensing image recognition**, Lamei Zhang, Xiao Wang, Bin Zou, Harbin Institute of Technology (China); Ligang Zou, The Univ. of Texas Rio Grande Valley (USA) [10658-20]

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

SESSION 6

LOCATION: BALLROOM LEVEL, OSCEOLA 5 THU 10:40 AM TO 11:40 AM

CS for Radio Astronomy

Session Chair: **William Chauncey Barott**, Embry-Riddle Aeronautical Univ. (USA)

10:40 am: **Optimum sparse radio telescope array beamforming**, Moeness G. Amin, Syed Hamza, Villanova Univ. (USA) [10658-21]

11:00 am: **Analysis of compressive approach to interference tagging in radio spectrometry**, William Barott, Zhurong Wang, Embry-Riddle Aeronautical Univ. (USA) [10658-22]

11:20 am: **Radio astronomical imaging using compressive sensing**, Shuimei Zhang, Yimin D. Zhang, Yujie Gu, Temple Univ. (USA) [10658-23]

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10659

LOCATION: BALLROOM LEVEL, TAMPA 2

Wednesday–Thursday 18–19 April 2018 • Proceedings of SPIE Vol. 10659

Advanced Photon Counting Techniques XII

Conference Chair: **Mark A. Itzler**, Argo AI LLC (USA)

Conference Co-Chair: **Joe C. Campbell**, Univ. of Virginia (USA)

Program Committee: **Joshua C. Bienfang**, National Institute of Standards and Technology (USA); **Gerald S. Buller**, Heriot-Watt Univ. (United Kingdom); **William H. Farr**, Facebook Inc. (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**, Leonardo MW 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); **Ivan Rech**, Politecnico di Milano (Italy)

WEDNESDAY 18 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, TAMPA 2 WED 8:45 AM TO 10:00 AM

Single-photon Imaging Without APDs

Session Chair: **Joe C. Campbell**, Univ. of Virginia (USA)

8:45 am: **Quanta image sensors: Photon-number-resolving megapixel image sensors at room temperature without avalanche gain** (*Keynote Presentation*), Eric R. Fossum, Dartmouth College (USA) [10659-1]

9:30 am: **Testing the limits of human vision with quantum states of light** (*Invited Paper*), Rebecca Holmes, Los Alamos National Lab. (USA); Michelle M. Victoria, Emily Cunningham, Ranxiao Frances Wang, Paul G. Kwiat, Univ. of Illinois (USA) [10659-3]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 2

LOCATION: BALLROOM LEVEL, TAMPA 2 WED 11:00 AM TO 12:00 PM

SPADs and Integrated Circuits I

Session Chair: **Mark Itzler**, Argo AI, LLC (USA)

11:00 am: **Advances in InP/InGaAs Geiger-mode APD focal plane arrays** (*Invited Paper*), Mohamed Digne, Alex McIntosh, Joseph Donnelly, Michael Myszkka, Jonathan Frechette, MIT Lincoln Lab. (USA) [10659-4]

11:30 am: **Fully integrated electronics for high-performance time-resolved imagers with single photon avalanche diode arrays** (*Invited Paper*), Giulia Acconcia, Alessandro Cominelli, Massimo Ghioni, Ivan Rech, Politecnico di Milano (Italy) [10659-5]

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

SESSION 3

LOCATION: BALLROOM LEVEL, TAMPA 2 WED 1:30 PM TO 3:15 PM

SPADs and Integrated Circuits II

Session Chair: **Joshua C. Bienfang**, National Institute of Standards and Technology (USA)

1:30 pm: **Smart routing logic for highly efficient readout of single photon avalanche diode arrays for time-resolved imaging**, Alessandro Cominelli, Giulia Acconcia, Massimo Ghioni, Ivan Rech, Politecnico di Milano (Italy) [10659-6]

1:55 pm: **Time-gated CMOS SPAD array in 0.16 μm BCD with shared timing electronics and background light rejection for LIDAR applications**, Davide Portaluppi, Enrico Conca, Federica A. Villa, Franco Zappa, Politecnico di Milano (Italy) [10659-7]

2:20 pm: **Towards high-speed, low-distortion time-correlated single photon counting measurements**, Alessandro Cominelli, Giulia Acconcia, Angelo Gulinatti, Massimo Ghioni, Ivan Rech, Politecnico di Milano (Italy) [10659-8]

2:45 pm: **Sine wave gating and its monolithic integration for high-performance single-photon detection** (*Invited Paper*), Jun Zhang, Univ. of Science and Technology of China (China) [10659-9]

Coffee Break Wed 3:15 pm to 3:45 pm

SESSION 4

LOCATION: BALLROOM LEVEL, TAMPA 2 WED 3:45 PM TO 5:35 PM

Novel Single-photon Detectors

Session Chair: **K. Alex McIntosh**, MIT Lincoln Lab. (USA)

3:45 pm: **Graphene-based single photon detector** (*Invited Paper*), Kin Chung Fong, Raytheon BBN Technologies (USA) [10659-10]

4:15 pm: **AllnAsSb avalanche detectors for single photon counting** (*Invited Paper*), Seth R. Bank, The Univ. of Texas at Austin (USA) ... [10659-11]

4:45 pm: **Single photon HgCdTe avalanche photodiode and integrated detector cooler assemblies for space lidar applications**, Xiaoli Sun, James B. Abshire, Michael A. Krainak, NASA Goddard Space Flight Ctr. (USA); Jeff Beck, William W. Sullivan III, DRS Technologies, Inc. (USA); Pradip Mitra, Leonardo DRS (USA); Dick Rawlings, DRS Technologies, Inc. (USA); Wei Lu, NASA Goddard Space Flight Ctr. (USA); Renny A. Fields, David A. Hinkley, Bradley Hirasuna, The Aerospace Corp. (USA) ... [10659-12]

5:10 pm: **0.16 μm BCD single-photon avalanche diode with 30 ps timing jitter, high detection efficiency and low noise**, Mirko Sanzaro, Politecnico di Milano (Italy); Paolo Gattari, STMicroelectronics SRL (Italy); Federica A. Villa, Alberto Tosi, Politecnico di Milano (Italy); Giuseppe Croce, STMicroelectronics SRL (Italy); Franco Zappa, Politecnico di Milano (Italy) [10659-13]

THURSDAY 19 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, TAMPA 2 THU 8:00 AM TO 10:30 AM

Superconducting Nanowire SPDs

Session Chair: **Robert H. Hadfield**, Univ. of Glasgow (United Kingdom)

8:00 am: **Applications of superconducting nanowire single-photon detectors: deep space optical communication, UV photon counting, and ultra-high time resolution** (*Invited Paper*), Emma Wollman, Boris A. Korzh, Jason P. Allmaras, Andrew D. Beyer, Simone Frasca, Ryan M. Briggs, Edward Ramirez, Matthew D. Shaw, Jet Propulsion Lab. (USA) [10659-14]

8:30 am: **Design of efficient superconducting nanowire single photon detectors for near-infrared wavelengths** (*Invited Paper*), Michiel J. A. de Dood, Leiden Univ. (Netherlands); Qiang Wang, Leiden Univ. (Netherlands) and Univ. Zürich (Austria); Jelmer J. Renema, Leiden Univ. (Netherlands) and Univ. of Oxford (United Kingdom) [10659-15]

9:00 am: **Superconducting nanowire materials for mid infrared single photon detection** (*Invited Paper*), Dmitry Morozov, Archan Banerjee, Kleonthis Erotokritou, Gregor Taylor, Univ. of Glasgow (United Kingdom); Nathan R. Gemmill, Univ. of Glasgow (United Kingdom) and Univ. of Sussex (United Kingdom); Dilini Hemakumara, Iain Thayne, Robert H. Hadfield, Univ. of Glasgow (United Kingdom) [10659-16]

9:30 am: **Active quenching: a new approach to the bias and readout of superconducting nanowire single photon detectors** (*Invited Paper*), Prasana Ravindran, Joseph C. Bardin, Univ. of Massachusetts Amherst (USA) [10659-17]

10:00 am: **Microwave designs of superconducting nanowires for single photon detections** (*Invited Paper*), Qing-Yuan Zhao, Nanjing Univ. (China) [10659-18]

Coffee Break Thu 10:30 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, TAMPA 2 THU 11:00 AM TO 11:55 AM

Applications of Photon Counting I

Session Chair: **Alan L. Migdall**,
National Institute of Standards and Technology (USA)

11:00 am: **Photon heterodyning and its applications** (*Invited Paper*),
Youhei Okawa, Fuminori Omura, Yuhsuke Yasutake, Susumu Fukatsu, The
Univ. of Tokyo (Japan) [10659-19]

11:30 am: **Towards nondegenerate polarization entanglement from a
waveguide down-conversion source**, Kristina Meier, Fumihiko Kaneda,
Paul G. Kwiat, Univ. of Illinois (USA) [10659-20]

Lunch BreakThu 11:55 am to 1:10 pm

SESSION 7

LOCATION: BALLROOM LEVEL, TAMPA 2 THU 1:10 PM TO 2:35 PM

Applications of Photon Counting II

Session Chair: **Mark Itzler**, Argo AI, LLC (USA)

1:10 pm: **Effect of lattice topology on photon statistics** (*Invited Paper*),
Hasan E. Kondakci, Ayman F. Abouraddy, Bahaa E. A. Saleh, CREOL, The
College of Optics and Photonics, Univ. of Central Florida (USA) [10659-21]

1:40 pm: **Geiger mode LADAR for disaster relief applications** (*Invited
Paper*), Robert Hatch, MIT Lincoln Lab. (USA) [10659-22]

2:10 pm: **ELROI: A single-photon "license plate" for satellites**,
Rebecca Holmes, David M. Palmer, Los Alamos National Lab.
(USA) [10659-23]

SESSION 8

LOCATION: BALLROOM LEVEL, TAMPA 2 THU 2:35 PM TO 3:30 PM

Single-photon 3D Imaging I

Session Chair: **Robert A. Lamb**, Leonardo MW Ltd. (United Kingdom)

2:35 pm: **Applications of single-photon depth imaging** (*Invited Paper*),
Gerald S. Buller, Aongus McCarthy, Ximing Ren, Aurora Maccarone,
}Rachael Tobin, Peter W. R. Connolly, Abderrahim Halimi, Yoann Altmann,
Yvan R. Petillot, Stephen McLaughlin, Andrew M. Wallace, Heriot-Watt
Univ. (United Kingdom); Istvan Gyongy, Robert K. Henderson, The Univ.
of Edinburgh (United Kingdom); Agata M. Pawlikowska, Robert A. Lamb,
Leonardo MW Ltd. (United Kingdom) [10659-24]

3:05 pm: **Single-photon time-gated video imaging with real-time
denoising**, Susan Chan, Heriot-Watt Univ. (United Kingdom);
Ryan E. Warburton, Photon Force Ltd. (United Kingdom) and Heriot-Watt
Univ. (United Kingdom); Eliot Bolduc, Megan Agnew, Heriot-Watt Univ. (United
Kingdom); Istvan Gyongy, Robert K. Henderson, The Univ. of Edinburgh
(United Kingdom); Jonathan Leach, Heriot-Watt Univ. (United
Kingdom). [10659-25]

Coffee Break. Thu 3:30 pm to 4:00 pm

SESSION 9

LOCATION: BALLROOM LEVEL, TAMPA 2 THU 4:00 PM TO 5:20 PM

Single-photon 3D Imaging II

Session Chair: **Gerald S. Buller**, Heriot-Watt Univ. (United Kingdom)

4:00 pm: **3D imaging and atmospheric sensing with single photon
counting** (*Invited Paper*), Robert A. Lamb, Leonardo MW Ltd. (United
Kingdom); Agata M. Pawlikowska, Leonardo MW Ltd (United Kingdom);
Philip D. Hiskett, Leonardo MW Ltd. (United Kingdom); Abderrahim Halimi,
Gerald S. Buller, Heriot-Watt Univ. (United Kingdom). [10659-26]

4:30 pm: **Time-correlated single-photon counting for single and
multiple wavelength underwater depth imaging**, Aurora Maccarone,
Aongus McCarthy, Abderrahim Halimi, Julian Tachella, Puneet S. Chhabra,
Yoann Altmann, Andrew M. Wallace, Stephen McLaughlin, Yvan R. Petillot,
Gerald S. Buller, Heriot-Watt Univ. (United Kingdom). [10659-27]

4:55 pm: **Depth imaging through obscurants using time-correlated
single-photon counting**, Rachael Tobin, Abderrahim Halimi,
Aongus McCarthy, Heriot-Watt Univ. (United Kingdom); Martin Laurenzis,
Frank Christnacher, Institut Franco-Allemand de Recherches de Saint-Louis
(France); Gerald S. Buller, Heriot-Watt Univ. (United Kingdom) [10659-28]

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10660

LOCATION: BALLROOM LEVEL, SARASOTA 2

Wednesday–Thursday 18–19 April 2018 • Proceedings of SPIE Vol. 10660

Quantum Information Science, Sensing, and Computation X

Conference Chairs: **Eric Donkor**, Univ. of Connecticut (USA); **Michael Hayduk**, Air Force 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); **Radhakrishnan Balu**, U.S. Army Research Lab. (USA); **Mishkatul Bhattacharya**, Rochester Institute of Technology (USA); **Wes Campbell**, Univ. of California, Los Angeles (USA); **Jerry Chow**, IBM Thomas J. Watson Research Ctr. (USA); **Michael L. Fanto**, Air Force Research Lab. (USA); **Louis H. Kauffman**, Univ. of Illinois at Chicago (USA); **Prem Kumar**, Northwestern Univ. (USA); **Alexander V. Sergienko**, Boston Univ. (USA); **Kathy-Anne Soderberg**, Air Force Research Lab. (USA); **Yaakov S. Weinstein**, The MITRE Corp. (USA)

WEDNESDAY 18 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SARASOTA 2 WED 1:00 PM TO 3:15 PM

Quantum Computing, Measurements and Error Correction

Session Chairs: **Michael J. Hayduk**, Air Force Research Lab. (USA); **John M. Myers**, Harvard Univ. (USA); **Samuel J. Lomonaco Jr.**, Univ. of Maryland, Baltimore County (USA)

1:00 pm: **Simulated execution of hybrid quantum computing systems** (*Keynote Presentation*), Travis S. Humble, Ronadi J. Sadlier, Keith A. Britt, Oak Ridge National Lab. (USA) [10660-1]

1:45 pm: **Ultraviolet integrated photonics** (*Invited Paper*), Michael L. Fanto, Air Force Research Lab. (USA); Paul M. Thomas, Stefan F. Preble, Rochester Institute of Technology (USA); Tsung-Ju Lu, Dirk R. Englund, Massachusetts Institute of Technology (USA); Jeffrey A. Steidle, Zihao Wang, Rochester Institute of Technology (USA) [10660-2]

2:15 pm: **Building clusters for all-optical repeaters**, Yaakov S. Weinstein, The MITRE Corp. (USA) [10660-3]

2:35 pm: **Lasers pumped quantum dynamics in nanostructured arrays for computing**, Ariela Donval, Noam Gross, Moshe Oron, KiloLambda Technologies, Ltd. (Israel) [10660-4]

2:55 pm: **Ultra-high spectral resolution spectrometer for single photon source characterization**, Lijun Ma, Oliver Slattery, Xiao Tang, National Institute of Standards and Technology (USA) [10660-5]

Coffee Break.Wed 3:15 pm to 3:45 pm

SESSION 2

LOCATION: BALLROOM LEVEL, SARASOTA 2 WED 3:45 PM TO 6:30 PM

Quantum Cryptography and Quantum Key Distribution

Session Chairs: **Louis H. Kauffman**, Univ. of Illinois at Chicago (USA); **Eric Donkor**, Univ. of Connecticut (USA)

3:45 pm: **Advanced quantum communication: Where do we go from here?** (*Keynote Presentation*), Paul G. Kwiat, Alex Hill, Dalton Chaffee, Chris Chopp, Kyle Herndon, Univ. of Illinois (USA); Daniel Gauthier, Joseph Szabo, The Ohio State Univ. (USA); Joseph C. Chapman, Kristina Meier, Chris Zeitler, Univ. of Illinois (USA) [10660-6]

4:30 pm: **Mitigating pointing requirements and turbulence effects in free-space quantum key distribution**, Mark Bashkansky, William S. Rabinovich, Rita Mahon, Mike S. Ferraro, Peter G. Goetz, U.S. Naval Research Lab. (USA); John F. Reintjes, Sotera Defense Solutions, Inc. (USA) .. [10660-7]

4:50 pm: **Practical security of semi-quantum key distribution**, Walter Krawec, Univ. of Connecticut (USA) [10660-8]

5:10 pm: **Method for self-reconstruction of holograms for secure communication**, Craig W. Babcock II, Eric Donkor, Univ. of Connecticut (USA) [10660-9]

5:30 pm: **QKD from a microsatellite: The SOTA experience**, Alberto Carrasco-Casado, Hideki Takenaka, Mikio Fujiwara, Mitsuo Kitamura, Masahide Sasaki, Morio Toyoshima, National Institute of Information and Communications Technology (Japan) [10660-10]

5:50 pm: **A Poisson model for entanglement optimization in the quantum internet**, Laszlo Gyongyosi, Budapest Univ. of Technology and Economics (Hungary) and MTA-BME Information Systems Research Group (Hungary) and Univ. of Southampton (United Kingdom); Sandor Imre, Budapest Univ. of Technology and Economics (Hungary) [10660-11]

6:10 pm: **Bell state optimizations for reliable quantum applications**, Venkateswara R. Dasari, Billy E. Geerhart III, U.S. Army Research Lab. (USA); Brian P. Williams, Travis S. Humble, Oak Ridge National Lab. (USA). [10660-12]

THURSDAY 19 APRIL

SESSION 3

LOCATION: BALLROOM LEVEL, SARASOTA 2 THU 8:30 AM TO 10:00 AM

Quantum Information Science I

Session Chairs: **Michael L. Fanto**, Air Force Research Lab. (USA);
Prem Kumar, Northwestern Univ. (USA)

- 8:30 am: **Quantum knots revisited** (*Invited Paper*), Samuel J. Lomonaco Jr., Univ. of Maryland, Baltimore County (USA) [10660-13]
- 9:00 am: **Agency and the physics of numbers**, John M. Myers, Harvard Univ. (USA); F. Hadi Madjid, Consultant (USA) [10660-14]
- 9:20 am: **Majorana fermions and representations of the artin braid group**, Louis H. Kauffman, Univ. of Illinois at Chicago (USA)..... [10660-16]
- 9:40 am: **Quantum information geometry in the space of measurements**, Warner A. Miller, Florida Atlantic Univ. (USA) [10660-17]
- Coffee Break. Thu 10:00 am to 10:40 am

SESSION 4

LOCATION: BALLROOM LEVEL, SARASOTA 2 THU 10:40 AM TO 12:05 PM

Quantum Information Science II

Session Chairs: **Yaakov S. Weinstein**, The MITRE Corp. (USA);
Prem Kumar, Northwestern Univ. (USA)

10:40 am: **Enhanced communication through quantum hyper-entanglement**, James F. Smith III, U.S. Naval Research Lab. (USA) [10660-18]

11:00 am: **High performance silicon resonator photon sources** (*Keynote Presentation*), Stefan F. Preble, Jeffrey A. Steidle, Rochester Institute of Technology (USA); Christopher C. Tison, Michael L. Fanto, Paul M. Alsing, Air Force Research Lab. (USA) [10660-19]

- 11:45 am: **Storage and retrieval of optical information in levitated cavityless optomechanics**, Pardeep Kumar, Mishkatul Bhattacharya, Rochester Institute of Technology (USA)..... [10660-21]
- Lunch/Exhibition Break Thu 12:05 pm to 1:55 pm

SESSION 5

LOCATION: BALLROOM LEVEL, SARASOTA 2 THU 1:55 PM TO 2:55 PM

Quantum Communication, and Quantum Networks

Session Chairs: **Paul M. Alsing**, Air Force Research Lab. (USA);
Kathy-Anne B. Soderberg, Air Force Research Lab. (USA)

- 1:55 pm: **Towards using trapped ions as memory nodes in a photon-mediated quantum network**, Boyan Tabakov, Jackson Bell, Daniela Bogorin, Air Force Research Lab. (USA); Benjamin Bonenfant, Northeastern Univ. (USA); Paul Cook, Lester Disney, Air Force Research Lab. (USA); Justin Phillips, Northeastern Univ. (USA); Kaitlin Poole, Laura Wessing, Kathy-Anne B. Soderberg, Air Force Research Lab. (USA) [10660-23]
- 2:15 pm: **Higher dimensional quantum communication: an efficient simulation of the propagation of the wavefront a photon**, Warner A. Miller, Florida Atlantic Univ. (USA); Paul M. Alsing, Air Force Research Lab. (USA); Doyeol Ahn, The Univ. of Seoul (Korea, Republic of)..... [10660-24]
- 2:35 pm: **Synchronization of programmable quantum and classical communication channels**, Venkateswara R. Dasari, U.S. Army Research Lab. (USA); Mee Seong Im, U.S. Military Academy (USA) [10660-26]

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10661

MONDAY LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A AND
TUESDAY-THURSDAY LOCATION: BALLROOM LEVEL, DAYTONA 2

Monday-Thursday 16-19 April 2018 • Proceedings of SPIE Vol. 10661



Thermosense: Thermal Infrared Applications XL

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

Conference Co-Chair: **Jaap de Vries**, FM Global (USA)

Program Committee: **Andrea Acosta**, Colbert Infrared Services (USA); **Nicolas P. Avdelidis**, National Technical Univ. of Athens (Greece); **Paolo Bison**, Consiglio Nazionale delle Ricerche (Italy); **Jeff R. Brown**, Embry-Riddle Aeronautical Univ. (USA); **Fred P. Colbert**, Colbert Infrared Services (USA); **Amanda K. Criner**, Air Force Research Lab. (USA); **Ralph B. Dinwiddie**, Oak Ridge National Lab. (USA); **Jason C. Fox**, National Institute of Standards and Technology (USA); **Sheng-Jen (Tony) Hsieh**, Texas A&M Univ. (USA); **Herbert Kaplan**, Honeyhill Technical Co. (USA); **Timo T. Kauppinen**, VTT Technical Research Ctr. of Finland (Finland); **Dennis H. LeMieux**, Siemens Power Generation, Inc. (USA); **Monica Lopez Saenz**, IRCAM GmbH (Germany); **Gregory B. McIntosh**, Teasdale Consultants Ltd. (Canada); **Xavier P. V. Maldague**, Univ. Laval (Canada); **Junko Morikawa**, Tokyo Institute of Technology (Japan); **Gary L. Orlove**, FLIR Systems, Inc. (USA); **Beata Oswald-Tranta**, Montan Univ. Leoben (Austria); **G. Raymond Peacock**, Temperatures.com, Inc. (USA); **Ralph A. Rotolante**, Vicon Enterprises Inc. (USA); **Andres E. Rozlosnik**, SI Termografia Infrarroja (Argentina); **Morteza Safai**, The Boeing Co. (USA); **Takahide Sakagami**, Kobe Univ. (Japan); **Steven M. Shepard**, Thermal Wave Imaging, Inc. (USA); **Sami Siikanen**, VTT Technical Research Ctr. of Finland (Finland); **Gregory R. Stockton**, Stockton Infrared Thermographic Services, Inc. (USA); **Gary E. Strahan**, Infrared Cameras, Inc. (USA); **Vladimir P. Vavilov**, National Research Tomsk Polytechnic Univ. (Russian Federation); **Joseph N. Zalameda**, NASA Langley Research Ctr. (USA)

Steering Committee Emeritus Members: **K. Elliott Cramer**, NASA Langley Research Ctr. (USA); **Robert Madding**, RPM Energy Associates (USA); **Piotr Pregowski**, Pregowski Infrared Services (Poland); **John R. Snell**, Snell Infrared (USA).

Thermosense In Memoriam Honorary Committee Members: **Lee R. Allen**, Allen Applied Infrared Technology (USA); **Ermanno G. Grinzato**, Consiglio Nazionale delle Ricerche (Italy); **Sven-Åke Ljningberg**, Univ. of Gäyle (Sweden); **Adronicus G. Kantsios**, NASA (USA)

BEST PAPER AWARDS

The Conference Chair, Co-Chair and Program Committee would like to recognize young researchers in the field with a Best Student Paper Award. This award is open to all Student authors who present in this conference. Awards will be announced later.

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM A . MON 12:15 PM TO 4:45 PM

Vendor Presentations and Reception: ThermoSense XL

Session Chairs: **Andres E. Rozlosnik**, SI Termografia Infrarroja (Argentina); **Sheng-Jen Hsieh**, Texas A&M Univ. (USA)

The Vendors Session started fourteen years ago and has become a very popular and well-attended success. This venue provides an early opportunity for exhibitors to highlight their latest technology and products to the Thermosense, IR industry, and Defense + Commercial Sensing (DCS) community in general, prior to the opening of the DCS-2018 Expo. This also enables the technical conference attendees to better prioritize their activities when visiting the Expo. It is a casual meeting with ample time for questions and answers. This session will feature brief, roughly 15 minute, presentations (technical and commercial) from hardware to software whose product lines impact thermal imaging applications and the infrared industry in general.

2018 Vendors in Presentation Order:

StingRay Optics, LLC (Booth 710)

StingRay Optics Standard Products 2018
Sam Wyman, Head of Commercial/OEM Sales

New Imaging Technologies (Booth 607)

**InGaAs with Linear and Logarithmic response;
best of both worlds**
Régis TULAZA, North America and Europe Sales Manager

Reynard Corporation (Booth 916)

Metallization Stacks and Their Applications
Chris Karp, Business Development Manager

SOFRADIR EC (Booth 806)

**Cooled and uncooled IR development for
high performances imaging**
Michel ZÉCRI, General Manager SOFRADIR EC

Electro Optical Industries, Inc. (Booth 1304)

**New Developments in Panoramic IR Surveillance
and Night Vision Testing**
Stephen Scopatz, General Manager of Electro Optical Industries

InfraTec infrared LLC (Booth 732)

Latest news of infrared cameras from InfraTec
Dr. Sven-A. Wode, Manager Business Development International

Ophir Optronics Ltd. (Booth 809)

Folded optics in Ophir zoom lenses
Dr. Nissim Asida, Ophir CTO

Telops Inc. (Booth 1125)

Telops' New Infrared Cameras and Applications
Wes Autran, Business Development Manager

SCD.USA Infrared LLC (Booth 1101)

SCD's Infrared Sensors for Industry, Science and Security
Robert McDaniel, President of SCD.USA /
Kobi Zaushnizer, VP Marketing of SCD

FLIR Systems, Inc. (Booth 915)

Overcoming the Challenges of Measuring Temperature at High Speeds with FLIR X-series Cameras
Jerry Beeny, Business Development Manager

IRCAM GmbH (Booth 1216)

Infrared Cameras for Scientific Applications
Oliver Schreer, Managing Director

4D Technology Corporation (Booth 1215)

Verifying the Quality of IR Optical Elements at the Functional Wavelength
Mark Boehm, Southeast Region Manager 4D Technology Corporation

Sensors Unlimited, Inc - A UTC Aerospace Systems Company (Booth 1301)

SWIR Imaging Update - Illustrating a Variety of Applications in the Short-Wave Infrared
Doug Malchow, Business Development Manager – Industrial

IRflex Corporation (Booth 1222)

MWIR Fiber Combiner for Multispectral Sensing
Dr. Francois Chenard, President and CTO of IRflex Corporation

Thales Cryogenics B.V. (Booth 523)

Thales Cryogenics – Update on recent developments
Kevin Giesen, Account Manager at Thales Cryogenics

Fotric Precision Instruments (Booth 1823)

Cloud-Based Professional Infrared Thermal Camera - Fotric X Series
Tony Yin, General Manager of Fotric Precision Instruments

SYMPOSIUM-WIDE PLENARY SESSION
LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

- 5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**
 - 5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)
 - 5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin
 - 6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)
- See pages 6-7 for details.*

TUESDAY 17 APRIL

OPENING REMARKS

LOCATION: BALLROOM LEVEL, DAYTONA 2 8:00 AM TO 8:15 AM
Conference Chair: **Douglas Burleigh**, La Jolla Cove Consulting (USA)
Thermosense Founder: **Robert Madding**, RPM Energy Associates (USA)

SESSION 2

LOCATION: BALLROOM LEVEL, DAYTONA 2 TUE 8:15 AM TO 12:00 PM
Spectral Analysis

Session Chairs: **Gregory B. McIntosh**, Teasdale Consultants Ltd. (USA); **Robert Madding**, RPM Energy Associates (USA)

- 8:15 am: **Gas detection using absorption properties of liquid crystals**, Karni Wolowelsky, Technion-Israel Institute of Technology (Israel); Amir Gil, Moshe Elkabets, CI Systems (Israel) Ltd. (Israel); Carmel Rotschild, Technion-Israel Institute of Technology (Israel). [10661-1]
- 8:35 am: **Methane leak near real time quantification with a hyperspectral infrared camera**, Stephanie Doz, Pierre-Yves Foucher, ONERA (France). [10661-2]
- 8:55 am: **Thermal infrared hyperspectral imaging for chemical mapping of an open mine**, Stephane Boubanga Tombet, Alexandrine Huot, Telops Inc. (Canada); Iwan Vitins, Schweizerische Geotechnische Kommission (Switzerland); Éric Guyot, Frédérick Marcotte, Martin Chamberland, Telops Inc. (Canada). [10661-3]
- 9:15 am: **Multiple spectrum vision for wildland fires**, Moulay A. Akhloufi, Univ. de Moncton (Canada); Tom Toulouse, Lucile Rossi, Univ. di Corsica (France). [10661-4]
- 9:35 am: **Human-robot synergetic harvesting for high value crops**, Dionysios Bochtis, Institute for Bio-economy and Agro-technology (IBO), Center for Research and Technology – Hellas (CERTH) (Greece); Theodore E Matikas, University of Ioannina, MSS-NDE Laboratory (Greece). [10661-42]
- Coffee Break and Dedicated Exhibition Time Tue 9:55 am to 11:00 am
- 11:00 am: **Controlling reflectivity and emissivity at mid-infrared with metal-insulator-metal nanostructure**, Ahmad Khayat Jafari, Ayrtton Bernussi, Luis Grave de Peralta, Texas Tech Univ. (USA). . . . [10661-5]
- 11:20 am: **Emissivity considerations for thermographic fieldwork: why table values don't work**, Gregory B. McIntosh, Snell Infrared Canada (Canada); Roy Huff, Snell Infrared (USA). [10661-6]
- 11:40 am: **Real time airborne gas detection using thermal hyperspectral imaging**, Stephane Boubanga Tombet, Alexandrine Huot, Éric Guyot, Vincent Farley, Frédérick Marcotte, Martin Chamberland, Telops Inc. (Canada). [10661-7]
- Lunch/Exhibition Break Tue 12:00 pm to 1:30 pm

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10661

SESSION 3

LOCATION: BALLROOM LEVEL, DAYTONA 2 TUE 1:30 PM TO 3:30 PM

Research Topics

Session Chairs: **Jaap de Vries**, FM Global (USA);
Gary L. Orlove, FLIR Systems, Inc. (USA)

1:30 pm: **In-situ reflectometry and thermometry for the laser power bed fusion: First results**, Steven E. Grantham, Brandon M. Lane, Ivan Zhirnov, Ho Yeung, Jorge Neira, Sergey Mekhontsev, National Institute of Standards and Technology (USA) [10661-8]

1:50 pm: **Deep generative adversarial networks of infrared image enhancement**, Axel-Christian Guei, Moulay A. Akhloufi, Univ. de Moncton (Canada) [10661-9]

2:10 pm: **Establishing traceable radiation thermometry with in-line imaging system at the NIST AMMT Facility**, Ivan Zhirnov, Vladimir Khromchenko, Brandon M. Lane, Steven E. Grantham, Sergey Mekhontsev, National Institute of Standards and Technology (USA) [10661-10]

2:30 pm: **Analysis of CO2 reaction of thermochemical energy storage system at high temperature by superimposed micro-scale thermal imaging method**, Junko Morikawa, Hiroki Takasu, Massimiliano Zamengo, Yukitaka Kato, Tokyo Institute of Technology (Japan) [10661-11]

2:50 pm: **Building a brain: how convolution neural networks can predict sprinkler activations**, Jaap de Vries, Stanislav Kostka, FM Global (USA) [10661-12]

3:10 pm: **Thermal diffusivity measurement of thermoplastic filaments and pellets used in additive manufacturing**, Ralph B. Dinwiddie, Oak Ridge National Lab (USA); Ahmed A. Hassen, John Lindahl, Vlastimil Kunc, Oak Ridge National Lab. (USA) [10661-40]

Coffee Break. Tue 3:30 pm to 4:00 pm

SESSION 4

LOCATION: BALLROOM LEVEL, DAYTONA 2 TUE 4:00 PM TO 5:40 PM

Materials Evaluation

Session Chairs: **Joseph N. Zalameda**, NASA Langley Research Ctr. (USA); **Ralph A. Rotolante**, Vicon Infrared (USA)

4:00 pm: **Evaluating convective heat transfer coefficients in fused deposition process using infrared imaging and neural networks**, Xunfei Zhou, Sheng-Jen Hsieh, Texas A&M Univ. (USA) [10661-13]

4:20 pm: **Visualization and analysis of boundary layer transitions using infrared thermography**, Caleb Waddle, Jeffrey T. Bolan, Christopher L. Dobbins, Zachary M. Hall, Melissa A. McDaniel, U.S. Army Aviation & Missile Research, Development & Engineering Ctr. (USA) [10661-14]

4:40 pm: **A thermography based approach to study the fatigue of high-diffusivity materials: Aluminum alloy 5754 H111**, Rosa De Finis, Davide Palumbo, Livia Maria Serio, Luigi Alberto Ciro De Filippis, Politecnico di Bari (Italy) [10661-15]

5:00 pm: **Second harmonic passive thermography generated by cyclic loading in composites**, William P. Winfree, Joseph N. Zalameda, Elizabeth D. Gregory, NASA Langley Research Ctr. (USA) [10661-16]

5:20 pm: **Real time detection of damage during quasi-static loading of a single stringer panel using passive thermography**, Joseph N. Zalameda, NASA Langley Research Ctr. (USA); Michael R. Horne, National Institute of Aerospace (USA) [10661-17]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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 rapid quantification method of the screening indicator for β -thalassemia with near-infrared spectroscopy, Tao Pan, Jiemei Chen, Lijun Peng, Lijun Yao, Jing Zhang, Jinan Univ. (China) [10661-39]

WEDNESDAY 18 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, DAYTONA 2 WED 8:00 AM TO 10:00 AM

IR NDT Theory

Session Chairs: **Sheng-Jen Hsieh**, Texas A&M Univ. (USA);
Xavier P. V. Maldague, Univ. Laval (Canada)

8:00 am: **Detection, measurement and characterization limits in active thermography**, Steven M. Shepard, Maria Beemer, Thermal Wave Imaging, Inc. (USA) [10661-18]

8:20 am: **Numerical simulation of phase images and depth reconstruction in pulsed phase thermography**, Saul Hernandez Valle, Naval Surface Warfare Ctr. Dahlgren Div. (USA); Kara Peters, North Carolina State Univ. (USA) [10661-19]

8:40 am: **Characterizing the thermal resistance at the interface between two different media using lock-in infrared thermography**, Arantza Mendioroz, Univ. del País Vasco (Spain); Jorge I. González, CINVESTAV Unidad Mérida (Mexico) and Univ. del País Vasco (Spain) [10661-20]

9:00 am: **Use of quartz halogen lamp in transient thermography imaging**, Meir Gershenson, Retired (Mexico) [10661-21]

9:20 am: **Equivalent wave field transform applied to pulse thermography in carbon composite samples**, Meir Gershenson, Self (Mexico) . . [10661-22]

9:40 am: **DMD modulated thermographic inspection**, Cody S. Lough, Samuel S. Fayad, Lan Li, Missouri Univ. of Science and Technology (USA); Jianhao Chen, Univ. of Science and Technology of China (China); Edward C. Kinzel, Missouri Univ. of Science and Technology (USA) . [10661-23]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, DAYTONA 2 WED 11:00 AM TO 11:40 AM

IR NDT of Civil Structures

Session Chairs: **Paolo Bison**, Consiglio Nazionale delle Ricerche (Italy); **Jeff R. Brown**, Embry-Riddle Aeronautical Univ. (USA); **Nicolas P. Avdelidis**, National Technical Univ. of Athens (United Kingdom)

11:00 am: **Calibration of thermal nondestructive testing methods on mock-up historic masonry**, Paolo Bison, Alessandro Bortolin, Gianluca Cadelano, Giovanni Ferrarini, Consiglio Nazionale delle Ricerche (Italy); Maria Rosa Valluzzi, Univ. degli Studi di Padova (Italy) [10661-24]

11:20 am: **Application of infrared camera for steel bridge maintenance**, Takahide Sakagami, Kobe Univ. (Japan); Yoshiaki Mizokami, Honshu-Shikoku Bridge Expressway Company Ltd (Japan); Daiki Shiozawa, Kobe Univ. (Japan); Masahiro Hayashi, Masahiro Takeguchi, Honshu-Shikoku Bridge Expressway Company Ltd (Japan) [10661-25]

Lunch/Exhibition Break Wed 11:40 am to 1:30 pm

SESSION 7

LOCATION: BALLROOM LEVEL, DAYTONA 2 WED 1:30 PM TO 2:50 PM

IR NDT Applications

Session Chairs: **Douglas Burleigh**, La Jolla Cove Consulting (USA); **Vladimir P. Vavilov**, National Research Tomsk Polytechnic Univ. (Russian Federation)

1:30 pm: **A novel optical air-coupled ultrasound NDE technique compared with infrared thermographic NDT on impacted composite materials**, Hai Zhang, Univ. Laval (Canada); Christian U. Grosse, Technische Univ. München (Germany); Nicolas P. Avdelidis, National Technical Univ. of Athens (Greece); Jan-Carl Grager, Siemens AG (Germany); Stefano Sfarra, Univ. degli Studi dell'Aquila (Italy); Clemente Ibarra-Castanedo, Xavier P. V. Maldague, Univ. Laval (Canada) [10661-30]

1:50 pm: **Lock-in inductive thermography for surface crack detection**, Beata Oswald-Tranta, Montan Univ. Leoben (Austria) [10661-27]

2:10 pm: **Infrared thermography for inspection of aramid and ultra-high-molecular-weight polyethylene armour systems**, Marc Genest, National Research Council Canada (Canada); Simon Ouellet, Kevin Williams, Defence Research and Development Canada, Valcartier (Canada) . . [10661-28]

2:30 pm: **Inspecting aviation composites at the stage of airplane manufacturing by applying 'classical' active thermal NDT, ultrasonic IR thermography and laser vibrometry**, Vladimir P. Vavilov, Daria Derusova, Arseny Chulkov, National Research Tomsk Polytechnic Univ. (Russian Federation) [10661-29]

Coffee Break. Wed 2:50 pm to 3:30 pm

SESSION 8

LOCATION: BALLROOM LEVEL, DAYTONA 2 WED 3:30 PM TO 4:30 PM

Welding/Manufacturing

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

3:30 pm: **Thermographic signal analysis of friction stir welded AA 5754 H111 joints**, Davide Palumbo, Rosa De Finis, Livia Maria Serio, Luigi Alberto Ciro De Filippis, Umberto Galietti, Politecnico di Bari (Italy) [10661-31]

3:50 pm: **Capability of infrared thermography for studying the friction stir welding process**, Livia Maria Serio, Rosa De Finis, Umberto Galietti, Luigi Alberto Ciro De Filippis, Politecnico di Bari (Italy) [10661-32]

4:10 pm: **Assessment of nugget diameter of resistance spot welding using pulse induction heating thermography**, Abdoulaye Taram, Cyrielle Roquelet, Gwenael Le Noc, Philip Meilland, Thomas Dupuy, Christine Kaczynski, ArcelorMittal Maizières Research (France); Jean Luc Bodnar, Univ. de Reims Champagne-Ardenne (France) . . [10661-33]

SESSION 9

LOCATION: BALLROOM LEVEL, DAYTONA 2 WED 4:30 PM TO 5:15 PM

40th Anniversary Presentation

Session Chairs: **Douglas Burleigh**, La Jolla Cove Consulting (USA); **Gregory B. McIntosh**, Teasdale Consultants Ltd. (Canada)

4:30 pm: **A brief history of Thermosense (Keynote Presentation)**, Robert Madding, RPM Energy Associates, LLC (USA); Gary L. Orlove, FLIR Systems, Inc. (USA) [10661-34]

THURSDAY 19 APRIL

SESSION 10

LOCATION: BALLROOM LEVEL, DAYTONA 2 THU 8:00 AM TO 8:40 AM

Biological Applications

Session Chairs: **Fred P. Colbert**, Colbert Infrared Services, Inc. (USA); **Takahide Sakagami**, Kobe Univ. (Japan)

8:00 am: **Efficiency of IR camera using for detection of hidden objects on human body**, Vyacheslav A. Trofimov, Vladislav Trofimov, Ivan Shestakov, Roman Blednov, Valentine Kovalev, M.V. Lomonosov Moscow State Univ. (Russian Federation) [10661-35]

8:20 am: **Application of infrared imaging for monitoring retinal vascular networks: an electrical circuit analogy approach**, Xunfei Zhou, Sheng-Jen Hsieh, Texas A&M Univ. (USA) [10661-36]

SESSION 11

LOCATION: BALLROOM LEVEL, DAYTONA 2 THU 8:40 AM TO 9:40 AM

Buildings

Session Chairs: **Timo T. Kauppinen**, VTT Technical Research Ctr. of Finland (Finland); **Gregory R. Stockton**, Stockton Infrared Thermographic Services, Inc. (USA)

8:40 am: **The development and experiences on certification procedure of building thermographers**, Timo Kauppinen, Mutsal (Finland); Sauli Paloniitty, Paloniitty Oy (Finland); Sami Siikanen, VTT Technical Research Ctr. of Finland Ltd. (Finland); Mikko Posio, Oulu Univ. of Applied Sciences (Finland) [10661-37]

9:00 am: **Thermal inspection in the aftermath of a hurricane: the use of image analysis for assessing property damages**, Emilio Barcelos, Florida Institute of Technology (USA) [10661-38]

9:20 am: **High-speed infrared imaging of flash mixing and streetview omniscens thermography**, Sami Siikanen, Kimmo Solehmainen, VTT Technical Research Ctr of Finland Ltd (Finland); Timo Kauppinen, Mutsal Tmi (Finland); Marko Rasi, XAMK Fiberlaboratory (Finland); Jouni Matula, Wetend Oy (Finland); Kari Pelttonen, Andritz Oy (Finland); Jari Käyhkö, XAMK Fiberlaboratory (Finland) [10661-41]

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10662

LOCATION: BALLROOM LEVEL, DAYTONA 2

Sunday–Tuesday 15–17 April 2018 • Proceedings of SPIE Vol. 10662

Smart Biomedical and Physiological Sensor Technology XV

Conference Chairs: **Brian M. Cullum**, Univ. of Maryland, Baltimore County (USA); **Douglas Kiehl**, Eli Lilly and Co. (USA); **Eric S. McLamore**, Univ. of Florida (USA)

Program Committee: **Karl S. Booksh**, Univ. of Delaware (USA); **Alper Bozkurt**, North Carolina State Univ. (USA); **Liliana Braescu**, Institut National de la Recherche Scientifique (Canada); **Jonathan C. Claussen**, Iowa State Univ. (USA); **Mikella E. Farrell**, U.S. Army Research Lab. (USA); **Claudia Gärtner**, microfluidic ChipShop GmbH (Germany); **Moinuddin Hassan**, U.S. Food and Drug Administration (USA); **Ellen L. Holthoff**, U.S. Army Research Lab. (USA); **Iiko K. Ilev**, U.S. Food and Drug Administration (USA); **K. D. Mandal**, Institute of Technology, Banaras Hindu Univ. (India); **Heather McCauley**, U.S. Food and Drug Administration (USA); **Olga S. Ovchinnikova**, Oak Ridge National Lab. (USA); **T. Joshua Pfefer**, U.S. Food and Drug Administration (USA); **Shiv K. Sharma**, Univ. of Hawai'i (USA); **Narsingh B. Singh**, Univ. of Maryland, Baltimore County (USA); **Dimitra N. Stratis-Cullum**, U.S. Army Research Lab. (USA); **Michael Weinrich**, National Institutes of Health (USA)

SUNDAY 15 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, DAYTONA 2 SUN 8:30 AM TO 10:10 AM

Advanced Materials

Session Chairs: **Narsingh Bahadur Singh**, Univ. of Maryland, Baltimore County (USA);

Olga S. Ovchinnikova, Oak Ridge National Lab. (USA)

8:30 am: **Surface modification at nanoscale; Nanoparticle-nanowire transition**, Narsingh Bahadur Singh, Univ. of Maryland, Baltimore County (USA); Ching Hua Su, NASA Marshall Space Flight Ctr. (USA); Sam Coriell, Univ. of Maryland, Baltimore County (USA); Kamdeo D. Mandal, Indian Institute of Technology, Banaras Hindu Univ. (India); Fow-Sen Choa, Bradley Arnold, Brian M. Cullum, Univ. of Maryland, Baltimore County (USA) [10662-1]

8:50 am: **Growth of bio sensor materials by physical vapor transport method**, Narsingh Bahadur Singh, David Sachs, Steven Lowery, Bradley Arnold, Brian M. Cullum, Univ. of Maryland, Baltimore County (USA); Ching Hua Su, NASA Marshall Space Flight Ctr. (USA); Kamdeo D. Mandal, Indian Institute of Technology, Banaras Hindu Univ. (India); Fow-Sen Choa, Tara Carpenter, Univ. of Maryland, Baltimore County (USA) [10662-2]

9:10 am: **Functional properties of some rare earth based double perovskite oxides for future application**, Dev Kumar Mahato, National Institute of Technology, Patna (India) [10662-3]

9:30 am: **Design and characteristics of hydroxyapatites: Effect of radiation**, Narsingh Bahadur Singh, Jayati Bhavsar, Stacey Sova, Univ. of Maryland, Baltimore County (USA); Pooja Gautam, Indian Institute of Technology, Banaras Hindu Univ. (India); Bradley Arnold, Lisa Kelly, Brian M. Cullum, Fow-Sen Choa, Univ. of Maryland, Baltimore County (USA); Kamdeo D. Mandal, Indian Institute of Technology, Banaras Hindu Univ. (India); Ching Hua Su, NASA Marshall Space Flight Ctr. (USA) [10662-4]

9:50 am: **Crystallization behavior of biochemicals: Morphologies and kinetics of complex multinary organics (Invited Paper)**, N. B. Singh, Jayram Singh, Sharda Univ. (India); Sarita Rai, Dr. Hari Singh Gour Univ. (India); Narsingh Bahadur Singh, Univ. of Maryland, Baltimore County (USA) [10662-5]

Coffee Break Sun 10:10 am to 10:40 am

SESSION 2

LOCATION: BALLROOM LEVEL, DAYTONA 2 SUN 10:40 AM TO 11:40 AM

Physiological Sensing Platforms and Phenomena

Session Chairs: **Eric S. McLamore**, Univ. of Florida (USA); **Jonathan C. Claussen**, Iowa State Univ. (USA)

10:40 am: **Mushroom biotechnology: a low cost technology to fight against malnutrition and environmental pollution**, Mohan Singh, Univ. of Allahabad (India) [10662-6]

11:00 am: **Optically induced acoustic waveguides and reflective barriers**, Daniel S. Kazal, Univ. of Maryland, Baltimore County (USA); Ellen L. Holthoff, U.S. Army Research Lab. (USA); Brian M. Cullum, Univ. of Maryland, Baltimore County (USA) [10662-7]

11:20 am: **Image processing based bio-sensing system for cancer cells detection**, Miguel A. Goenaga-Jimenez, Lisandro F. Cunci-Perez, Jenipher D. Gonzalez-Aponte, Univ. del Turabo (USA) [10662-8]

Lunch Break Sun 11:40 am to 1:40 pm

SESSION 3

LOCATION: BALLROOM LEVEL, DAYTONA 2 SUN 1:40 PM TO 3:00 PM

Advances Toward Clinical

Session Chairs: **Heather McCauley**, U.S. Food and Drug Administration (USA); **Douglas Kiehl**, Eli Lilly and Co. (USA)

1:40 pm: **Kapton polyimide-based EEG microelectrode array and interfaces for mice brainwave recordings and analysis**, Mohammad M. Islam, Deepa Gupta, Univ. of Maryland, Baltimore County (USA); Hyungwoo Nam, Univ. of Maryland, Baltimore County (USA) and Univ. of Maryland School of Medicine (USA); Mary Kay Lobo, Univ. of Maryland School of Medicine (USA); Fow-Sen Choa, Univ. of Maryland, Baltimore County (USA) [10662-9]

2:00 pm: **Sensing of vector dipoles from bathtub ECG leads for single and double sources**, Pratheek Michael, Vijay K. Jain, Univ. of South Florida (USA) [10662-10]

2:20 pm: **A system for unassisted ECG/fECG and novel VLSI architecture-and-microcells for it**, Vijay K. Jain, Univ. of South Florida (USA) .. [10662-11]

2:40 pm: **Transcranial alternating current stimulation (tACS) beating signal simulation, generation, and measurement in a brain phantom**, Mohammad M. Islam, Qinglei Meng, Fow-Sen Choa, Univ. of Maryland, Baltimore County (USA) [10662-12]

Coffee Break Sun 3:00 pm to 3:40 pm

SESSION 4

LOCATION: BALLROOM LEVEL, DAYTONA 2 SUN 3:40 PM TO 5:20 PM

Medical Monitoring at the Forefront

Session Chairs: **Douglas Kiehl**, Eli Lilly and Co. (USA);
Brian M. Cullum, Univ. of Maryland, Baltimore County (USA)

3:40 pm: **FocusLocus: ADHD management gaming system for educational achievement and social inclusion**, Stelios C. A. Thomopoulos, Tassos Kanellos, Adam Doulgerakis, Eftichia Georgiou, Maria Bessa, National Ctr. for Scientific Research Demokritos (Greece). [10662-14]

4:00 pm: **Wearable biosignal acquisition system for decision aid**, Diego P. Morales, Encarnación Castillo, Victor Toral-Lopez, Antonio Garcia, Luis Parrilla, Victor U. Ruiz, Univ. de Granada (Spain); Anke Meyer-Baese, Amirhessam Tahmassebi, Florida State Univ. (USA) [10662-15]

4:20 pm: **Handheld high resolution multispectral imaging device for study of Cushing syndrome**, Siddharth Khare, National Institutes of Health (USA); Ali Afshari, U.S. Food and Drug Administration (USA); Afrouz Anderson, Constantine A. Stratakis, Amir H. Gandjbakhche, National Institutes of Health (USA) [10662-16]

4:40 pm: **Multi-level analysis of spatio-temporal features in non-mass enhancing breast tumors**, Amirhessam Tahmassebi, Katja Pinker-Domenig, Anke Meyer-Baese, Florida State Univ. (USA) [10662-17]

5:00 pm: **Detection of the breast cancer based on the electrical impedance myography parameters using finite element method**, Md Nurul Anwar Tarek, Georgia Southern Univ. (USA); Ahmed Hasnain Jalal, Florida International Univ. (USA); Mohammad Abdul Ahad, Georgia Southern Univ. (USA) [10662-18]

MONDAY 16 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, DAYTONA 2 MON 8:30 AM TO 10:50 AM

Biosensing Platforms on the Horizon

Session Chairs: **Brian M. Cullum**, Univ. of Maryland, Baltimore County (USA); **Eric S. McLamore**, Univ. of Florida (USA)

8:30 am: **Label-free bacteria detection using controllable microporous polyelectrolyte coated long-period fiber gratings**, Fan Yang, Tzu-Lan Chang, Henry Du, Junfeng Liang, Fei Tian, Stevens Institute of Technology (USA) [10662-19]

8:50 am: **Salicylic acid (SA) detection using bi-enzyme microfluidic electrochemical (EC) sensor**, Bhuwan Kashyap, Jonathan Claussen, Ratnesh Kumar, Iowa State Univ. of Science and Technology (USA) [10662-20]

9:10 am: **Dynamic electro-optic stop and beam-separation gauge with feedback-control algorithm for its operation in a bistatic spectroscopic sensor**, Richard W. Fauconier, Precysix LLC (USA) [10662-21]

9:30 am: **Dual-functional Ag@Au core-shell nanostructures for in situ SERS study of hydrogen peroxide decomposition**, Shuyue He, Kai Liu, Fei Tian, Stevens Institute of Technology (USA) [10662-22]

9:50 am: **Real-time and label-free chemical sensing using flexible mid-infrared photonic circuits**, Pao T. Lin, Texas A&M Univ. (USA) [10662-23]

10:10 am: **Near infrared spectroscopy as a tool for in vivo analysis of human muscles**, Giuseppe Bonifazi, Antonio Currà, Alessandra Cardillo, Silvia Serranti, Riccardo Gasbarrone, Sapienza Univ. di Roma (Italy) [10662-24]

10:30 am: **High sensitivity optical method for objective assessment of the gloss of human skin**, Anna Ezerskaya, Philips Research (Netherlands) and Technische Univ. Delft (Netherlands); Arno Ras, Pascal Bloemen, Philips Research (Netherlands); Sylvania Pereira, H. Paul Urbach, Technische Univ. Delft (Netherlands); Babu Varghese, Philips Research (Netherlands) [10662-13]

SYMPOSIUM-WIDE PLENARY SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6-7 for details.

TUESDAY 17 APRIL

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Temporal and strain dependence of scattering coefficients for fiber optic sensing, Syamimi Azizan, Nor Azura Malini Ahmad Hambali, Vithyacharan Retnasamy, Mohamad Halim Abdul Wahid, Univ. Malaysia Perlis (Malaysia); Mukhzeer Mohamad Shahimin, National Defence Univ. of Malaysia (Malaysia) [10662-26]

Sol-gel channel waveguide for optical manipulation, Soon Wei Bong, Vithyacharan Retnasamy, Mohamad Halim Abdul Wahid, Nor Azura Malini Ahmad Hambali, Univ. Malaysia Perlis (Malaysia); Mukhzeer Mohamad Shahimin, National Defence Univ. of Malaysia (Malaysia) [10662-27]

Triple wavelength fiber laser employing SOA incorporated with a tapered fiber, Nik Aqilah Nik Mohd Mookran, Nor Azura Malini Ahmad Hambali, Mohamad Halim Abdul Wahid, Univ. Malaysia Perlis (Malaysia); Mukhzeer Mohamad Shahimin, National Defence Univ. of Malaysia (Malaysia) . [10662-28]

Surface variation analysis of proximal interphalangeal joint of osteoarthritis with fringe projection profilometry, Wan Mokhdzani Wan Norhaimi, Rajendaran Vairavan, Zaliman Sauli, Vithyacharan Retnasamy, Hasnizah Aris, Univ. Malaysia Perlis (Malaysia); Mukhzeer Mohamad Shahimin, National Defence Univ. of Malaysia (Malaysia) [10662-29]

Breast surface coordinate variation analysis caused by round shape tumor with fringe projection profilometry, Wan Mokhdzani Wan Norhaimi, Rajendaran Vairavan, Zaliman Sauli, Vithyacharan Retnasamy, Hasnizah Aris, Univ. Malaysia Perlis (Malaysia); Mukhzeer Mohamad Shahimin, National Defence Univ. of Malaysia (Malaysia) [10662-30]

Cadmium sulphide light emitting diodes dies performance based on different geometry, Nurul Syahidah Zaidi, Univ. Malaysia Perlis (Malaysia); Nor Azura Malini Ahmad Hambali, Univ. Malaysia Perlis (Malaysia); Mukhzeer Mohamad Shahimin, National Defence Univ. of Malaysia (Malaysia); Mohamad Halim Abdul Wahid, Univ. Malaysia Perlis (Malaysia) [10662-31]

A study on peristaltic flow of micro-polar fluids: An application to sliding hiatus hernia, Subhash Chandra, Indian Institute of Technology, Banaras Hindu Univ. (India) [10662-32]

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10663

LOCATION: BALLROOM LEVEL, SANIBEL 2

Sunday–Tuesday 15–17 April 2018 • Proceedings of SPIE Vol. 10663

Energy Harvesting and Storage: Materials, Devices, and Applications VIII

Conference Chairs: **Nibir K. Dhar**, U.S. Army Night Vision & Electronic Sensors Directorate (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); **Vijay Parameshwaran**, 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); **Chunlei Wang**, Florida International Univ. (USA); **Priyalal Wijewarnasuriya**, U.S. Army Research Lab. (USA)

SUNDAY 15 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SANIBEL 2 SUN 8:20 AM TO 10:20 AM

Energy Storage: Beyond Lithium Battery

Session Chairs: **Palani Balaya**, National Univ. of Singapore (Singapore); **Valerie Pralong**, Ctr. National de la Recherche Scientifique (France)

8:20 am: **Strategy to design new electrode materials for Na ion batteries** (*Invited Paper*), Valerie Pralong, Ctr. National de la Recherche Scientifique (France) [10663-1]

8:50 am: **Magnesium: a sustainable approach for high energy batteries** (*Invited Paper*), Robert Dominko, Ana Robba, Tanja Bancic, Jan Bitenc, Alen Vi?intin, Klemen Pirnat, National Institute of Chemistry Slovenia (Slovenia); Anna Randon Vitanova, Honda R&D Europe (Deutschland) GmbH (Germany) [10663-2]

9:20 am: **Interfacial issues in rechargeable high energy density lithium batteries** (*Invited Paper*), Xiangxin Guo, Shanghai Institute of Ceramics (China) [10663-3]

9:50 am: **Novel sulfide electrode and electrolyte materials for all-solid-state secondary batteries** (*Invited Paper*), Atsushi Sakuda, Akitoshi Hayashi, Masahiro Tatsumisago, Osaka Prefecture Univ. (Japan) [10663-4]

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

SESSION 2

LOCATION: BALLROOM LEVEL, SANIBEL 2 SUN 10:50 AM TO 11:50 AM

Energy Harvesting: Solar Energy

Session Chairs: **Vijay Parameshwaran**, U.S. Army Research Lab. (USA); **Nibir K. Dhar**, U.S. Army Night Vision & Electronic Sensors Directorate (USA)

10:50 am: **Materials for energy harvesting: from perovskites and III-V semiconductors to metal alloys** (*Invited Paper*), Marina S. Leite, Univ. of Maryland, College Park (USA) [10663-5]

11:20 am: **Solar water splitting for hydrogen generation using copper metal oxides** (*Invited Paper*), Jiangtian Li, Deryn Chu, U.S. Army Research Lab. (USA) [10663-7]

Lunch Break Sun 11:50 am to 1:30 pm

SESSION 3

LOCATION: BALLROOM LEVEL, SANIBEL 2 SUN 1:30 PM TO 3:00 PM

Energy Storage: Materials and Characterization

Session Chairs: **Valerie Pralong**, Ctr. National de la Recherche Scientifique (France); **Palani Balaya**, National Univ. of Singapore (Singapore)

1:30 pm: **Developing non-flammable sodium-ion battery for stationary applications** (*Invited Paper*), Palani Balaya, National Univ. of Singapore (Singapore) [10663-8]

2:00 pm: **In situ investigation of dynamic processes in materials for energy storage** (*Invited Paper*), Matthew McDowell, Georgia Institute of Technology (USA) [10663-9]

2:30 pm: **Applying multiscale imaging and spectroscopic techniques for studying capacity and cycle life degradation in high energy density lithium-ion cells** (*Invited Paper*), Jagjit Nanda, Rose E. Ruther, Oak Ridge National Lab. (USA) [10663-10]

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

SESSION 4

LOCATION: BALLROOM LEVEL, SANIBEL 2 SUN 3:30 PM TO 5:30 PM

Energy Harvesting: Thermoelectrics, Dielectrics and Others

Session Chairs: **Vijay Parameshwaran**, U.S. Army Research Lab. (USA); **Achyut K. Dutta**, Banpil Photonics, Inc. (USA)

3:30 pm: **A manufacturing innovation for thermoelectric power generation: selective laser melting of thermoelectric materials** (*Invited Paper*), Saniya LeBlanc, Haidong Zhang, The George Washington Univ. (USA); Ahmed El Desouky, Eaton Corp. (USA); Michael Carter, Columbia Univ. (USA) [10663-12]

4:00 pm: **III-V materials and acid-stable coatings for efficient and stable solar-to-chemical conversion** (*Invited Paper*), Georges Siddiqi, Zhenhua Pan, Qianhong Zhu, Shu Hu, Yale Univ. (USA) [10663-13]

4:30 pm: **Dielectric, electrical and magnetic properties of Bi₁/2Na₁/2Cu₃Ti₄O₁₂ ceramic synthesized by semi-wet route**, Pooja Gautam, Kamdeo D. Mandal, Indian Institute of Technology, Banaras Hindu Univ. (India) [10663-14]

4:50 pm: **Piezoelectric microstructured fibers via drawing of multimaterial preforms**, Hang Qu, Xin Lu, Maksim Skorobogatiy, Ecole Polytechnique de Montréal (Canada) [10663-15]

5:10 pm: **Modeling and analysis of energy extraction circuits for triboelectric nanogenerator based vibrational energy harvesting**, Madhav Pathak, Ratnesh Kumar, Iowa State Univ. of Science and Technology (USA) [10663-16]

MONDAY 16 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, SANIBEL 2 MON 8:00 AM TO 10:00 AM

Energy Harvesting and Storage I

Session Chairs: **Robert Dominko**,
National Institute of Chemistry Slovenia (Slovenia);
Vijay Parameshwaran, U.S. Army Research Lab. (USA)

8:00 am: **Prussian blue analogue materials for energy harvesting and storage** (*Invited Paper*), Hyun-Wook Lee, Ulsan National Institute of Science and Technology (Korea, Republic of) [10663-17]

8:30 am: **Electrolyte dictated materials design for beyond lithium ion batteries** (*Invited Paper*), Yan Yao, Univ. of Houston (USA) [10663-18]

9:00 am: **Interfacial engineering of energy conversion and storage materials using atomic layer deposition** (*Invited Paper*), Neil Dasgupta, Univ. of Michigan (USA) [10663-19]

9:30 am: **Thermal behavior and runaway of lithium batteries** (*Invited Paper*), Hans Jürgen Seifert, Karlsruhe Institut für Technologie (Germany) [10663-20]

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

SESSION 6

LOCATION: BALLROOM LEVEL, SANIBEL 2 MON 10:30 AM TO 11:20 AM

Energy Harvesting and Storage II

Session Chairs: **Hans Jürgen Seifert**,
Karlsruher Institut für Technologie (Germany);
Palani Balaya, National Univ. of Singapore (Singapore)

10:30 am: **Integration strategy of bio-safe micro-scale lithium-ion battery for implantable healthcare electronics** (*Invited Paper*), Muhammad M. Hussain, Arwa T. Kutbee, King Abdullah Univ. of Science and Technology (Saudi Arabia) [10663-21]

11:00 am: **Double smart power management with wind mini-reactor and photovoltaic cell energy harvester for Industry 4.0 IIoT devices**, Borja Pozo, IK4 Tekniker (Spain); Jose Ignacio Garate, Univ. del País Vasco (Spain); Susana Ferreiro, IK4 Tekniker (Spain) [10663-24]

TUESDAY 17 APRIL

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C ... TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Self-powered impact event sensor and counter, Jahangir S. Rastegar, Omnitek Partners, LLC (USA); Carlos M. Pereira, U.S. Army Armament Research, Development and Engineering Ctr. (USA) [10663-25]

A new highly repeatable and long duration shock-loading machines for components testing, Jahangir S. Rastegar, Jacque Fischer, Omnitek Partners, LLC (USA) [10663-26]

SYMPOSIUM-WIDE PLENARY SESSION
LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6–7 for details.

CONFERENCE 10664

LOCATION: BALLROOM LEVEL, MIAMI 2

Monday–Tuesday 16–17 April 2018 • Proceedings of SPIE Vol. 10664

Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III

Conference Chairs: **J. Alex Thomasson**, Texas A&M Univ. (USA); **Mac McKee**, Utah State Univ. (USA); **Robert J. Moorhead**, Mississippi State Univ. (USA)

Program Committee: **Atanu Basu**, Ayata (USA); **Christoph Bauer**, KWS SAAT AG (Germany); **Subodh Bhandari**, California State Polytechnic Univ., Pomona (USA); **Andrew N. French**, Agricultural Research Service (USA); **Yufeng Ge**, Univ. of Nebraska–Lincoln (USA); **Cheryl McCarthy**, Univ. of Southern Queensland (Australia); **Seth C. Murray**, Texas A&M Univ. (USA); **Haly Neely**, Texas A&M Univ. (USA); **Boyan Peshlov**, Climate Corp. (USA); **Carl Salvaggio**, Rochester Institute of Technology (USA); **Michael Sama**, Univ. of Kentucky (USA); **Sindhuja Sankaran**, Washington State Univ. (USA); **Ajay Sharda**, Kansas State Univ. (USA); **Yeyin Shi**, Univ. of Nebraska–Lincoln (USA)

Conference Cosponsor:



MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, MIAMI 2 MON 8:15 AM TO 11:40 AM

Collecting Reliable Image Data with UAVs

Session Chair: **J. Alex Thomasson**, Texas A&M Univ. (USA)

8:15 am: **Implications of sensor inconsistencies and remote sensing error in the use of small unmanned aerial systems for generation of information products for agricultural management** (*Invited Paper*), Mac McKee, Alfonso F. Torres-Rua, Ayman Nassar, Mahyar Aboutaleb, Utah State Univ. (USA) [10664-1]

8:45 am: **Ground-truthing of UAV-based remote sensing data of citrus plants**, Subodh Bhandari, Amar Raheja, Antonio Espinas, Dat Do, Mehdi Ansari Ezabadi, Joseph Wolf, Tristan Sherman, Frank Pham, California State Polytechnic Univ., Pomona (USA) [10664-2]

9:05 am: **Quality assessment of radiometric calibration of UAV image mosaics**, Cody Bagnall, John A. Thomasson, Chao Sima, Texas A&M Univ. (USA); Chenghai Yang, U.S. Dept. of Agriculture (USA) [10664-3]

9:25 am: **Correction of in-flight luminosity variations in multispectral UAS images, using a luminosity sensor and camera pair for improved biomass estimation in precision agriculture**, Jean-Marc Gilliot, AgroParisTech (France) and Univ. Paris-Saclay (France); Joël Michelin, AgroParisTech (France) and Univ. Paris-Saclay (France); Romain Faroux, AIRINOV (France); Luis Mario Domenzain, Parrot S.A. (France) and AIRINOV (France) [10664-4]

9:45 am: **An exploration of vicarious and in-scene calibration techniques for small unmanned aircraft systems**, Baabak Mamaghani, Ryan Connal, Ryan Hartzell, Kevin Kha, Geoffrey Sasaki, Evan Marcellus, Jackson Knappen, Timothy Bauch, Nina Raqueno, Carl Salvaggio, Rochester Institute of Technology (USA) [10664-5]

10:05 am: **Behavior of vegetation/soil indices and radiometric temperature in shaded and sunlit pixels and evaluation of different shadow compensation methods using UAV high-resolution imagery over vineyards**, Mahyar Aboutaleb, Alfonso F. Torres-Rua, Mac McKee, Utah State Univ. (USA); William Kustas, U.S. Dept. of Agriculture (USA); Héctor Nieto, IRTA (Spain) [10664-6]

Coffee Break Mon 10:25 am to 10:55 am

10:55 am: **Studying CO₂ from plant respiration in controlled and natural environment: How can plant breeding industry benefit from it?** (*Keynote Presentation*), Magda Mandic, Thermo Fisher Scientific (Germany); Mehmet Senbayram, Institute of Plant Nutrition and Soil Science, Univ. of Harran (Turkey); Christoph Bauer, KWS SAAT SE (Germany); Nadine Ruehr, Karlsruhe Institute of Technology (KIT), Institute of Meteorology and Climate Research (Germany); Jelka Braden-Behrens, Georg-August-Univ. Göttingen (Germany) [10664-7]

Lunch Break Mon 11:40 am to 12:50 pm

SESSION 2

LOCATION: BALLROOM LEVEL, MIAMI 2 MON 12:50 PM TO 2:40 PM

Proximal and Remote Sensing for Phenotyping

Session Chair: **Robert J. Moorhead**, Mississippi State Univ. (USA)

12:50 pm: **Detection of pea flowering using proximal and aerial remote sensing** (*Invited Paper*), Sindhuja Sankaran, Chongyuan Zhang, Afef Marzougui, Rebecca McGee, Lav Khot, Washington State Univ. (USA) [10664-8]

1:20 pm: **Vinobot and vinoculer: from real to simulated platforms**, Ali Shafiekhani, Felix B. Fritsch, Guilherme DeSouza, Univ. of Missouri (USA) [10664-34]

1:40 pm: **Phenotyping of sorghum panicles using unmanned aerial system (UAS) data**, Anjin Chang, Jinha Jung, Junho Yeom, Junho Yeom, Texas A&M Univ. Corpus Christi (USA); Muriio Maeda, Juan Landivar, Texas A&M AgriLife Research and Extension Ctr. (USA) [10664-9]

2:00 pm: **Estimating plant heights using UAV-based LIDAR data and photogrammetry**, Ahmed F. Elaksher, Subodh Bhandari, Christian Limones, California State Polytechnic Univ., Pomona (USA) [10664-10]

2:20 pm: **Calibrated plant height estimates with structure from motion from fixed-wing UAV images**, Xiongzhe Han, J. Alex Thomasson, William Rooney, Ace Pugh, David Horne, Lonesome Malambo, Jinha Jung, Anjin Chang, Dale Cope, Texas A&M Univ. (USA) [10664-11]

SESSION 3

LOCATION: BALLROOM LEVEL, MIAMI 2 MON 2:40 PM TO 4:50 PM

Thermal and Hyperspectral Imaging from UAVs

Session Chair: **Mac McKee**, Utah State Univ. (USA)

2:40 pm: **Inter-comparison of thermal measurements using ground-based sensors, airborne thermal cameras, and eddy covariance radiometers**, Alfonso F. Torres-Rua, Utah State Univ. (USA); Héctor Nieto, IRTA (Spain); Christopher Parry, Univ. of California, Davis (USA); Manal Elarab, Utah State Univ. (USA) and MicaSense, Inc. (USA); Mac McKee, Utah State Univ. (USA); William Kustas, Agricultural Research Service (USA) .. [10664-12]

3:00 pm: **A detailed study on accuracy of uncooled thermal cameras by exploring the data collection workflow**, Tiebiao Zhao, Haoyu Niu, Andreas Anderson, Yangquan Chen, Univ. of California, Merced (USA) [10664-13]

Coffee Break Mon 3:20 pm to 3:50 pm

3:50 pm: **Image quality and accuracy of different thermal sensor at varying operation parameters**, Ajay Sharda, Harman S. Sangha, Kansas State Univ. (USA) [10664-14]

4:10 pm: **A low-cost method for collecting hyperspectral measurements from a small unmanned aircraft system**, Ali Hamidisepehr, Michael Sama, Univ. of Kentucky (USA) [10664-15]

4:30 pm: **Hyperspectral detection of methane stressed vegetation**, Margot Accettura, Carl Salvaggio, Timothy Bauch, Rochester Institute of Technology (USA); Joe Mallia, NYSEARCH / NGA (USA) [10664-16]

SYMPOSIUM-WIDE PLENARY SESSION
LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6–7 for details.

TUESDAY 17 APRIL

SESSION 4

LOCATION: BALLROOM LEVEL, MIAMI 2 TUE 8:00 AM TO 10:00 AM

Detecting Yield, Disease, and Water Stress from UAVs

Session Chair: **Robert J. Moorhead**, Mississippi State Univ. (USA)

8:00 am: **Cotton vegetation and fruiting detection for yield prediction using UAVs** (*Invited Paper*), Alison McCarthy, Joseph Foley, Univ. of Southern Queensland (Australia); Warwick Waters, Cotton Research and Development Corp. (Australia) [10664-17]

8:30 am: **Multispectral remote sensing for yield estimation using high-resolution imagery from an unmanned aerial vehicle**, Mahyar Aboutaleb, Alfonso F. Torres-Rua, Niel Allen, Utah State Univ. (USA) [10664-18]

8:50 am: **Disease detection and mitigation in a cotton crop with UAV remote sensing**, J. Alex Thomasson, Texas A&M Univ. (USA); Xiwei Wang, Nanjing Forestry Univ. (China); Tianyi Wang, Texas A&M Univ. (USA); Chenghai Yang, Agricultural Research Service (USA); Robert L. Nichols, Cotton Inc. (USA) [10664-19]

9:10 am: **Instrumentation of an unmanned aerial system for detection of healthy and unhealthy crops** (*Invited Paper*), Stephen Andrew Gadsden, Univ. of Guelph (Canada); Stephen A. Wilkerson, York College of Pennsylvania (USA) [10664-35]

9:40 am: **Experimental approach to detect water stress in ornamental plants using UAV-imagery**, Ana de Castro, Instituto de Agricultura Sostenible (Spain); Joe M. Maja, Clemson Univ. (USA); Jim Owen, Virginia Polytechnic Institute and State Univ. (USA); James Robbins, Univ. of Arkansas Cooperative Extension Service (USA); Jose Peña, Institute of Agricultural Sciences (Spain) [10664-20]

Coffee Break and Dedicated Exhibition Time Tue 10:00 am to 11:00 am

SESSION 5

LOCATION: BALLROOM LEVEL, MIAMI 2 TUE 11:00 AM TO 12:00 PM

Analytics for UAV-based Crop Management

Session Chair: **Mac McKee**, Utah State Univ. (USA)

11:00 am: **Machine learning techniques for the assessment of citrus plant health using UAV-based digital images**, Subodh Bhandari, Amar Raheja, Dat Do, Frank Pham, California State Polytechnic Univ., Pomona (USA) [10664-21]

11:20 am: **Unmanned aerial system based cotton genotype selection using machine learning**, Jinha Jung, Akash Ashapure, Texas A&M Univ. Corpus Christi (USA); Murilo Maeda, Juan Landivar, Texas A&M AgriLife Research (USA); Anjin Chang, Junho Yeom, Texas A&M Univ. Corpus Christi (USA); Steven Hague, Wayne Smith, Texas A&M Univ. (USA) [10664-36]

11:40 am: **Evaluation of multispectral unmanned aerial systems for irrigation management**, José L. Chávez, Colorado State Univ. (USA); Huihui Zhang, Agricultural Research Service (USA); Maria C. Capurro, Colorado State Univ. (USA); Jon Altenhofen, Northern Colorado Water Conservancy District (USA); Allan A. Andales, Colorado State Univ. (USA) [10664-23]

Lunch/Exhibition Break Tue 12:00 pm to 1:50 pm

SESSION 6

LOCATION: BALLROOM LEVEL, MIAMI 2 TUE 1:50 PM TO 3:10 PM

Innovative UAV Applications

Session Chair: **J. Alex Thomasson**, Texas A&M Univ. (USA)

1:50 pm: **UAV videos to extend research to producers**, Louis Wasson, Geosystems Research Institute (USA); Brien Henry, Mississippi State Univ. (USA); Robert Moorhead, Geosystems Research Institute (USA) ... [10664-25]

2:10 pm: **A comparison of sustainable forest management metrics generated from unmanned and manned aerial systems**, Michael McClelland II, Jan van Aardt, Rochester Institute of Technology (USA) [10664-26]

2:30 pm: **Evaluating UAVs under a multi-platform system in modeling crop characteristics**, Gregory Rouze, Matthew Wiethorn, Haly Neely, Cristine Morgan, Chenghai Yang, Texas A&M Univ. (USA) [10664-27]

2:50 pm: **Evaluating the capabilities of Sentinel-2 and Tracram RGB+3 formulti-temporal detection of thrips on capsicum**, Jayantrao D. Mohite, Tata Consultancy Services Ltd. (India); Arvind Gauns, Dr. Balasaheb Sawant Kokan Krishi Vidyapeeth (India); Navin Twarakavi, Srinivasu Pappula, Tata Consultancy Services Ltd. (India) [10664-28]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C ... TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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 neural net algorithmic approach for inferring annual CO₂ fluxes from long term measurements, Asen Radov, Milton Halem, Univ. of Maryland, Baltimore County (USA) [10664-31]

Using hyperspectral sensors for crop vegetation status monitoring in precision agriculture, Marius Cristian Luculescu, Luciana Cristea, Sorin Constantin Zamfira, Attila Laszlo Boer, Transilvania Univ. of Brasov (Romania) [10664-32]

MoniSCAN: Software for multispectral monitoring of the crops vegetation status, Marius Cristian Luculescu, Luciana Cristea, Sorin Constantin ZAMFIRA, Attila Laszlo Boer, Transilvania Univ. of Brasov (Romania) [10664-33]

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10665

LOCATION: BALLROOM LEVEL, MIAMI 2

Tuesday–Wednesday 17–18 April 2018 • Proceedings of SPIE Vol. 10665

Sensing for Agriculture and Food Quality and Safety X

Conference Chairs: **Moon S. Kim**, USDA Agricultural Research Service (USA); **Kuanglin Chao**, USDA Agricultural Research Service (USA); **Bryan A. Chin**, Auburn Univ. (USA); **Byoung-Kwan Cho**, Chungnam National Univ. (Korea, Republic of)

Program Committee: **Arun K. Bhunia**, Ctr. for Food Safety Engineering, Purdue Univ. (USA); **Suming Chen**, National Taiwan Univ. (Taiwan); **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 17 APRIL

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Isolation of highly selective phage-displayed oligopeptide probes for detection of listeria monocytogenes in samples containing clorox and chlorine dioxide, I-Hsuan Chen, Yuzhe Liu, Songtao Du, Shin Horikawa, Tung-Shi Huang, Bryan A. Chin, Sang-Jin Suh, Jianguo Xi, Auburn Univ. (USA) [10665-22]

Comparing capture of bacterial pathogens in liquid streams by different bio-receptors immobilized biomolecular filter, Songtao Du, I-Hsuan Chen, Yuzhe Liu, Jianguo Xi, Xu Lu, Shin Horikawa, Sang-Jin Suh, Tung-Shi Huang, Bryan A. Chin, Auburn Univ. (USA) [10665-23]

Quantitative characterization of Raman imaging data for detection of food adulteration, Santosh Lohumi, Lalit M. Kandpal, Chungnam National Univ. (Korea, Republic of); Hoonsoo Lee, Moon S. Kim, Jianwei Qin, Agricultural Research Service (USA); Cho, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of) [10665-24]

Applications of convolutional neural networks (CNN) for food quality and safety using hyperspectral imaging, Hoonsoo Lee, Agricultural Research Service (USA); Cho, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of); Moon S. Kim, Agricultural Research Service (USA) . . . [10665-25]

Olive fruit ripening evaluation and quality assessment by hyperspectral sensing devices, Giuseppe Bonifazi, Riccardo Gasbarrone, Silvia Serranti, Sapienza Univ. di Roma (Italy) [10665-26]

Kiwifruits ripening assessment by portable hyperspectral devices, Giuseppe Bonifazi, Riccardo Gasbarrone, Silvia Serranti, Sapienza Univ. di Roma (Italy) [10665-27]

Non-destructive method to detect artificially ripened banana using hyperspectral sensing and RGB imaging, Mithun B.S., Sujit Shinde, Karan Bhavsar, Arijit Chowdhury, Kavya Gupta, Brojeshwar Bhowmick, Sanjay Kimbahune, Tata Consultancy Services Ltd. [10665-28]

Signal recovery for compressive spectrometers, Chih-Cheng Lu, Industrial Technology Research Institute (Taiwan); Kevin Chen, Google (USA); Li-Ren Huang, Industrial Technology Research Institute (Taiwan); H. T. Kung, Harvard Univ. (USA) [10665-29]

Evaluation of SERS nanoparticle substrates for detection of bacillus serotypes, Jeehwa Hong, Mirae Oh, Jianwei Qin, Sagar Dhakal, Hoonsoo Lee, Moon S. Kim, Agricultural Research Service (USA); Hyunjeong Cho, NAQS (Korea, Republic of) [10665-30]

Estimating paddy yields in North Korea using COMS geostationary satellite and GRAMI-rice model, Jong-Min Yeom, Korea Aerospace Research Institute (Korea, Republic of); Jonghna Ko, Chonnam National Univ. (Korea, Republic of) [10665-31]

Discrimination of mixture of South Korean and imported rice using hyperspectral reflectance imaging, Changyeun Mo, Jongguk Lim, Giyoung Kim, National Institute of Agricultural Sciences (Korea, Republic of); Moon Kim, Agricultural Research Service (USA); Jungsook Kang, Kwon Kyung-Do, National Institute of Agricultural Sciences (Korea, Republic of) [10665-32]

Study of visible and near-infrared imaging spectroscopy for the inspection of peeled potato tubers, Thomas Arnold, Martin De Biasio, CTR Carinthian Tech Research AG (Austria) [10665-33]

WEDNESDAY 18 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, MIAMI 2 WED 8:00 AM TO 10:20 AM

Hyperspectral and Multispectral Imaging for Foods

Session Chair: **Seung-Chul Yoon**,
USDA Agricultural Research Service (USA)

8:00 am: **Study of visible imaging and near-infrared imaging spectroscopy for plant root phenotyping**, Thomas Arnold, CTR Carinthian Tech Research AG (Austria) [10665-1]

8:20 am: **Development of online whole-surface apple inspection system using line-scan hyperspectral imaging technology**, Insuck Baek, Stephen Andrew Gadsden, Univ. of Maryland, Baltimore County (USA); Moon S. Kim, Agricultural Research Service (USA) [10665-2]

8:40 am: **Continuous gradient temperature Raman spectroscopy of unsaturated fatty acids: applications for fish lipids and rendered meat source identification**, C. Leigh Broadhurst, Walter F. Schmidt, Julie K. Nguyen, Jianwei Qin, Kuanglin Chao, Moon S. Kim, Agricultural Research Service (USA) [10665-3]

9:00 am: **Hyperspectral imaging for measuring symptom of chilling stress of watermelon leaves**, Eunsoo Park, Chungnam National Univ. (Korea, Republic of); Hoonsoo Lee, Moon S. Kim, Agricultural Research Service (USA); Cho, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of) [10665-4]

9:20 am: **Quality measurement of bell peppers using hyperspectral near infrared imaging**, Anisur Rahman, Hyungjin Bae, Chungnam National Univ. (Korea, Republic of); Hoonsoo Lee, Insuck Baek, Moon S. Kim, Agricultural Research Service (USA); Changyeun Mo, Rural Development Administration (Korea, Republic of); Cho, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of) [10665-5]

9:40 am: **Multimode optical imaging for food quality and safety applications**, Fartash Vasefi, SafetySpect Inc. (USA); Danielle Rosen, Chapman Univ. (USA); Nicholas Booth, Hesam Hafizi, Li Kang, SafetySpect Inc. (USA); Rosalee Hellberg, Chapman Univ. (USA); Daniel L. Farkas, SafetySpect Inc. (USA) [10665-34]

10:00 am: **Hyperspectral fluorescence imaging for disease monitoring and yield estimation of mandarin orange**, Jayoung Lee, Chungnam National Univ. (Korea, Republic of); Irina T. Rodriguez, Univ. de Córdoba (Spain); Hyungjin Bae, Jihoon Bae, Chungnam National Univ. (Korea, Republic of); Hee-Young Lee, Life & Technology (Korea, Republic of); Ana G. Varo, Dolores P. Marin, Univ. de Córdoba (Spain); Cho, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of) [10665-6]

Coffee Break and Dedicated Exhibition Time Wed 10:20 am to 11:20 am

SESSION 2

LOCATION: BALLROOM LEVEL, MIAMI 2 WED 11:20 AM TO 12:00 PM

Sensing for Food Quality and Safety I

Session Chair: **Shin Horikawa**, Auburn Univ. (USA)

11:20 am: **Detection of azo color additives in spice powder using near-infrared Raman imaging system**, Sagar Dhakal, Kuanglin Chao, Moon S. Kim, Agricultural Research Service (USA) [10665-7]

11:40 am: **MCT-based shortwave infrared hyperspectral imaging system for the detection and quantification of adulterants in powder samples**, Hoonsoo Lee, Jianwei Qin, Agricultural Research Service (USA); Cho, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of); Moon S. Kim, Agricultural Research Service (USA) [10665-8]

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

SESSION 3

LOCATION: BALLROOM LEVEL, MIAMI 2 WED 1:10 PM TO 2:50 PM

Sensing for Food Quality and Safety II

Session Chair: **Shin Horikawa**, Auburn Univ. (USA)

1:10 pm: **Infrared fingerprint profiles of compatible and incompatible interactions of the rice blast pathogen using FTIR spectroscopy**, Mirae Oh, Jinyoung Y. Barnaby, Hoonsoo Lee, Yulin Jia, Moon S. Kim, Agricultural Research Service (USA) [10665-9]

1:30 pm: **Direct, surface-scanning detection of pathogenic bacteria using a wireless biosensor**, Shin Horikawa, Yuzhe Liu, Songtao Du, I-Hsuan Chen, Xu Lu, Bryan A. Chin, Auburn Univ. (USA) [10665-10]

1:50 pm: **Capture and identification of salmonella typhimurium from large volumes of water using phage filter**, Xu Lu, Songtao Du, Shin Horikawa, I-Hsuan Chen, Yuzhe Liu, Bryan A. Chin, Auburn Univ. (USA) [10665-11]

2:10 pm: **The combination of magnetoelastic (ME) wireless biosensing with surface swab sampling**, Yuzhe Liu, Songtao Du, Shin Horikawa, I-Hsuan Chen, Jianguo Xi, Xu Lu, Tung-Shi Huang, Bryan A. Chin, Auburn Univ. (USA) [10665-12]

2:30 pm: **Reconfigurable instrument for measuring variations of capacitor's dielectric: an application to olive oil quality monitoring**, Santiago Juarez, F. J. Romero-Maldonado, Inmaculada Ortiz-Gomez, Diego P. Morales, A. Salinas-Castillo, Univ. de Granada (Spain); Amirhessam Tahmassebi, Anke Meyer-Bäse, Florida State Univ. (USA); Encarnación Castillo, A. García, Univ. de Granada (Spain) [10665-13]

SESSION 4

LOCATION: BALLROOM LEVEL, MIAMI 2 WED 2:50 PM TO 4:40 PM

High Throughput Inspection

Session Chair: **Xu Lu**, Auburn Univ. (USA)

2:50 pm: **Non-targeted and targeted Raman imaging detection of chemical contaminants in food powders**, Jianwei Qin, Moon S. Kim, Kuanglin Chao, Sagar Dhakal, Agricultural Research Service (USA); Cho, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of) [10665-14]

3:10 pm: **Real-time machine vision system for online detection of wooden breast myopathy in chicken fillets**, Seung-Chul Yoon, Brian Bowker, Kurt Lawrence, Hong Zhuang, Agricultural Research Service (USA) [10665-15]

Coffee Break Wed 3:30 pm to 4:00 pm

4:00 pm: **Real-time sorting of melon seed using hyperspectral shortwave infrared imaging**, Collins Wakholi, Chungnam National Univ. (Korea, Republic of); Hoonsoo Lee, Insuck Baek, Agricultural Research Service (USA); Eunsoo Park, Chungnam National Univ. (Korea, Republic of); Moon S. Kim, Agricultural Research Service (USA); Hyungjin Bae, Cho, Byoung-Kwan Cho, Chungnam National Univ. (Korea, Republic of) [10665-16]

4:20 pm: **Development of high speed dual-camera system for batch screening of aflatoxin contamination of corns using multispectral fluorescence imaging**, Deok Han, Haibo Yao, Mississippi State Univ. (USA); Christopher Ramezanpour, Secure Food Solutions (USA); Zuzana Hruska, Russell Kincaid, Mississippi State Univ. (USA); Kanniah Rajasekaran, Deepak Bhatnagar, Agricultural Research Service (USA) [10665-17]

SESSION 5

LOCATION: BALLROOM LEVEL, MIAMI 2 WED 4:40 PM TO 5:40 PM

Visible and Near Infrared Imaging For Foods

Session Chair: **Byoung-Kwan Cho**, Chungnam National Univ. (Korea, Republic of)

4:40 pm: **Rapid and non-destructive detection of aflatoxin contamination of peanut kernels using visible/near-infrared (Vis/NIR) spectroscopy**, Feifei Tao, Haibo Yao, Zuzana Hruska, Mississippi State Univ. (USA); Yongliang Liu, Kanniah Rajasekaran, Deepak Bhatnagar, Agricultural Research Service (USA) [10665-18]

5:00 pm: **Rapid determination of starch content of potato and sweet potato by using NIR hyperspectral chemical imaging**, Wenhao Su, Da-Wen Sun, Univ. College Dublin (Ireland) [10665-19]

5:20 pm: **Miniature near infrared spectroscopy spectrometer and information and communication technologies to guarantee the integrity of the EU high added-value acorn Iberian pig ham**, Ana Garrido-Varo, Dolores C. Pérez-Marín, Cecilia Riccioli, Emiliano de Pedro, Univ. de Córdoba (Spain); Tom Fearn, Univ. College London (United Kingdom) [10665-20]

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10666

LOCATION: BALLROOM LEVEL, TAMPA 3


Monday-Tuesday 16-17 April 2018 • Proceedings of SPIE Vol. 10666

Three-Dimensional Imaging, Visualization, and Display 2018

Conference Chairs: **Bahram Javidi**, Univ. of Connecticut (USA); **Jung-Young Son**, Konyang Univ. (Korea, Republic of); **Osamu Matoba**, Kobe Univ. (Japan)

Conference Co-Chairs: **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); **Jun Arai**, NHK Japan Broadcasting Corp. (Japan); **V. Michael Bove Jr.**, MIT Media Lab. (USA); **Michael T. Eismann**, Air Force Research Lab. (USA); **Pietro Ferraro**, Institute of Applied Science & Intelligent Systems (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); **Janusz Konrad**, Boston Univ. (USA); **Thomas J. Naughton**, National Univ. of Ireland, Maynooth (Ireland); **Wolfgang Osten**, Univ. Stuttgart (Germany); **Min-Chul Park**, Korea Institute of Science and Technology (Korea, Republic of); **David J. Rabb**, Air Force Research Lab. (USA); **José Manuel Rodríguez Ramos**, Univ. de La Laguna (Spain); **Toralf Scharf**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Sumio Yano**, Shimane Univ. (Japan); **Zeev Zalevsky**, Bar-Ilan Univ. (Israel)

Conference Cosponsor: 

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, TAMPA 3 MON 8:00 AM TO 10:00 AM

3D Imaging

Session Chairs: **Jung-Young Son**, Konyang Univ. (Korea, Republic of); **Bahram Javidi**, Univ. of Connecticut (USA)

8:00 am: **Design options for 360 degree viewable table-top digital color holographic displays** (*Invited Paper*), Jin-Woong Kim, Keehoon Hong, Yongjun Lim, Jae-Han Kim, Minsik Park, Electronics and Telecommunications Research Institute (Korea, Republic of) [10666-1]

8:25 am: **Enhanced 3D performance by biconvex electrowetting lenticular lens structure** (*Invited Paper*), Yong Hyub Won, Junoh Kim, Cheoljoong Kim, Dooseub Shin, Junsik Lee, Gyohyun Koo, Jee Hoon Sim, KAIST (Korea, Republic of) [10666-2]

8:50 am: **3D TV based on integral photography** (*Invited Paper*), Masahiro Kawakita, Hisayuki Sasaki, Kazuhiro Hara, Naoto Okaichi, Hayato Watanabe, Masanori Kano, Jun Arai, Tomoyuki Mishina, NHK Japan Broadcasting Corp. (Japan) and NHK Science & Technology Research Labs. (Japan) [10666-3]

9:15 am: **Development of spatial light modulator with ultra fine pixel pitch for electronic holography** (*Invited Paper*), Chi-Sun Hwang, Yong Hae Kim, Gi Heon Kim, Jong-Heon Yang, Sanghoon Cheon, Seong M. Cho, Kyunghye Choi, Ji Hun Choi, Jae-Eun Pi, Chi-Young Hwang, Hee Ok Kim, Won-Jae Lee, Electronics and Telecommunications Research Institute (Korea, Republic of); Han Byeol Kang, Kyung Hee Univ. (Korea, Republic of) [10666-4]

9:40 am: **Full-parallax 3D display from stereo-plenoptic camera system**, Seokmin Hong, Amir Ansari, Genaro Saavedra, Manuel Martínez-Corral, Univ. de València (Spain) [10666-5]

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

SESSION 2

LOCATION: BALLROOM LEVEL, TAMPA 3 MON 10:30 AM TO 11:55 AM

3D Image Acquisition and Processing I

Session Chair: **Chrysanthe Preza**, The Univ. of Memphis (USA)

10:30 am: **Ray-space processing for omnidirectional FTV** (*Invited Paper*), Masayuki Tanimoto, Nagoya Univ. (Japan); Hirokuni Kurokawa, Univ. of Aizu (Japan) [10666-6]

10:55 am: **Compressive sensing with a block-strategy for fast image acquisitions**, Thibault Leportier, Korea Institute of Science and Technology (Korea, Republic of); Vladyslav Selotkin, Korea Institute of Science and Technology (Korea, Republic of) and National Technical Univ. of Ukraine (Ukraine); Myungha Kim, Seokyeong University (Korea, Republic of); Jung-Young Son, Konyang Univ. (Korea, Republic of); Min-Chul Park, Korea Institute of Science and Technology (Korea, Republic of) and Univ. of Science & Technology (Korea, Republic of) [10666-7]

11:15 am: **Visual acuity enhancement by wave front phase correction in multi-view autostereoscopic displays**, David Carmona-Ballester, Lara Diaz, Juan Trujillo, Univ. de La Laguna (Spain); Óscar Gómez-Cárdenes, Woptix S.L. (Spain); Ángela Hernández Delgado, Univ. de La Laguna (Spain); Juan José Fernández-Valdivia, Óscar Casanova, Daniel Waló, José Manuel Rodríguez-Ramos, Woptix S.L. (Spain) [10666-8]

11:35 am: **Computational reconstruction technique in integral imaging with enhanced visual quality**, Kotaro Inoue, Byeongwoo Cho, Hui Yun, Myungjin Cho, Hankyong National Univ. (Korea, Republic of) [10666-9]

Lunch Break Mon 11:55 am to 1:20 pm

SESSION 3

LOCATION: BALLROOM LEVEL, TAMPA 3 MON 1:20 PM TO 2:55 PM

3D Visualization and Related Technologies

Session Chair: **Osamu Matoba**, Kobe Univ. (Japan)

1:20 pm: **Exploring the limits of integral microscopy: Resolution and depth of field** (*Invited Paper*), Manuel Martínez-Corral, Anabel Llavador, Genaro Saavedra, Univ. de València (Spain); Jorge García-Sucerquia, Univ. Nacional de Colombia Sede Medellín (Colombia); Nicolò Incardona, Univ. de València (Spain) [10666-10]

1:45 pm: **Seeing the sound we hear: Optical technologies for visualizing sound wave** (*Invited Paper*), Yasuhiro Oikawa, Kenji Ishikawa, Kohei Yatabe, Waseda Univ. (Japan); Takashi Onuma, Hayato Niwa, Photron Ltd. (Japan) [10666-11]

2:10 pm: **Optical 3D visualization under inclement weather conditions** (*Invited Paper*), Myungjin Cho, Hankyong National Univ. (Korea, Republic of); Bahram Javidi, Univ. of Connecticut (USA) [10666-12]

2:35 pm: **Cloud based medical data visualization and management using server platform and web rendering**, Qi Zhang, SUNY Canton (USA) [10666-13]

Coffee Break Mon 2:55 pm to 3:15 pm

SESSION 4

LOCATION: BALLROOM LEVEL, TAMPA 3 MON 3:15 PM TO 4:50 PM

3D Image Acquisition and Processing II

Session Chair: **Adrian Stern**, Ben-Gurion Univ. of the Negev (Israel)

3:15 pm: **Depth and width reproducibility of integral photography from multi-view stereoscopic image** (*Invited Paper*), Sumio Yano, Yuta Katayose, Shimane Univ. (Japan); Hyoung Lee, Konyang Univ. (Korea, Republic of); Min-Chul Park, Korea Institute of Science and Technology (Korea, Republic of) [10666-14]

3:40 pm: **Plenoptic imaging techniques to improve accuracy and robustness of 3D object tracking** (*Invited Paper*), Jae Woo Kim, Seong-Jun Bae, Seongjin Park, Do Hyung Kim, Electronics and Telecommunications Research Institute (Korea, Republic of) [10666-15]

4:05 pm: **Forming aerial 3D images with smooth motion parallax in combination of arc 3D display with AIRR** (*Invited Paper*), Hirotsugu Yamamoto, Utsunomiya Univ. (Japan) and Japan Science and Technology Agency (Japan); Kazuki Kawai, Utsunomiya Univ. (Japan); Haruki Mizushima, Shiro Suyama, Tokushima Univ. (Japan) [10666-16]

4:30 pm: **3D sensor technology for crime scene documentation**, Philip Engström, Swedish National Forensic Ctr. – NFC (Sweden) .. [10666-17]

SYMPOSIUM-WIDE PLENARY SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C
MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6–7 for details.

TUESDAY 17 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, TAMPA 3 TUE 8:00 AM TO 10:05 AM

Digital Holography in Metrology and Imaging

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

8:00 am: **Digital holography under non paraxial conditions** (*Invited Paper*), Simon Thibault, Charles Pichette, Michel Piché, Pierre Marquet, Univ. Laval (Canada) [10666-18]

8:25 am: **Random phase modulation for three-dimensional sensing and imaging** (*Invited Paper*), Takanori Nomura, Wakayama Univ. (Japan) [10666-19]

8:50 am: **Automated quantification of cardiomyocytes beating profile with time-lapse digital holographic microscopy** (*Invited Paper*), Inkyu Moon, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of) [10666-20]

9:15 am: **Three-dimensional imaging based on common-path off-axis incoherent digital holography** (*Invited Paper*), Osamu Matoba, Xiangyu Quan, Kobe Univ. (Japan); Yasuhiro Awatsuji, Kyoto Institute of Technology (Japan) [10666-21]

9:40 am: **Upconversion crystal in electro-holographic displays** (*Invited Paper*), Jung-Young Son, Konyang Univ. (Korea, Republic of); Beom-Ryeol Lee, Electronics and Telecommunications Research Institute (Korea, Republic of); Min-Chul Park, Korea Institute of Science and Technology (Korea, Republic of); Hyoung Lee, Jina Byeon, Konyang Univ. (Korea, Republic of) [10666-22]

Coffee Break and Dedicated Exhibition Time Tue 10:05 am to 11:00 am

SESSION 6

LOCATION: BALLROOM LEVEL, TAMPA 3 TUE 11:00 AM TO 11:45 AM

Human Factor

Session Chair: **Jung-Young Son**, Konyang Univ. (Korea, Republic of)

11:00 am: **Monocular depth sense in a light field display** (*Invited Paper*), Beom-Ryeol Lee, Electronics and Telecommunications Research Institute (Korea, Republic of) and Univ. of Science & Technology (Korea, Republic of); Hyoung Lee, Jung-Young Son, Konyang Univ. (Korea, Republic of); Sumio Yano, Shimane Univ. (Japan); Wookho Son, Electronics and Telecommunications Research Institute (Korea, Republic of) [10666-23]

11:25 am: **Microstereopsis is good, but orthostereopsis is better: precision alignment task performance and viewer discomfort with a stereoscopic 3D display**, John P. McIntire, Paul Havig II, Lawrence K. Harrington, Steve T. Wright, Air Force Research Lab. (USA); Scott N. J. Watamaniuk, Wright State Univ. (USA); Eric Heft, Air Force Research Lab. (USA) [10666-24]

THE FUMIO OKANO BEST 3D PAPER PRIZE SESSION
LOCATION: BALLROOM LEVEL, TAMPA 3 11:45 AM TO 11:50 AM

Conference Chairs: **Bahram Javidi**, Univ. of Connecticut (USA);
Jung-Young Son, Konyang Univ. (Korea, Republic of);
Osamu Matoba, Kobe Univ. (Japan)

The Fumio Okano Best 3D Paper Prize, sponsored by NHK-ES, and presented annually in memory of Dr. Fumio Okano for his enduring contributions to the field of 3D TV and Display.

Lunch/Exhibition Break Tue 11:50 am to 1:15 pm

SESSION 7

LOCATION: BALLROOM LEVEL, TAMPA 3 TUE 1:15 PM TO 3:10 PM

3D Image and Related Technology I

Session Chair: **Manuel Martinez-Corral**, Univ. de València (Spain)

1:15 pm: **Non-line-of-sight 3D imaging** (*Invited Paper*), Andreas Velten, Marco La Manna, Ji-Hyun Nam, Xiaochun Liu, Univ. of Wisconsin-Madison (USA) [10666-25]

1:40 pm: **Augmented reality integration of fused LiDAR and spatial mapping**, Matt Selleck, David Burke, Chase Johnston, Georgia Tech Research Institute (USA) [10666-26]

2:00 pm: **Computational and computational-optical approaches to improve 3D imaging in fluorescence microscopy** (*Invited Paper*), Chrysanthe Preza, The Univ. of Memphis (USA) [10666-27]

2:25 pm: **Characterizing three dimensional open cell structures without segmentation**, Joe Nurre, Thomas E. Dufresne, Procter & Gamble Co. (USA); John N. Gideon, Univ. of Michigan (USA) [10666-28]

2:45 pm: **3D topography of reflective samples by single-shot digital holographic microscopy** (*Invited Paper*), Jorge Garcia-Sucerquia, Raul Castañeda, Univ. Nacional de Colombia Sede Medellín (Colombia) [10666-29]

Coffee Break Tue 3:10 pm to 4:00 pm

SESSION 8

LOCATION: BALLROOM LEVEL, TAMPA 3 TUE 4:00 PM TO 6:20 PM

3D Image and Related Technology II

Session Chair: **Takanori Nomura**, Wakayama Univ. (Japan)

4:00 pm: **3D reconstructions from spectral light fields** (*Invited Paper*), Vladimir Farber, Yaniv Oiknine, Isaac August, Adrian Stern, Ben-Gurion Univ. of the Negev (Israel) [10666-30]

4:25 pm: **Diffraction-free light sheets with arbitrary beam profiles**, Hasan E. Kondakci, Ayman F. Abouraddy, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA) [10666-31]

4:45 pm: **High-resolution spatial image display with multiple UHD projectors**, Hayato Wantanabe, Masahiro Kawakita, Naoto Okaichi, Hisayuki Sasaki, Tomoyuki Mishina, NHK Japan Broadcasting Corp. (Japan) [10666-33]

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10666

5:05 pm: **3D integral microscopy based in far-field detection**, Gabriele Scrofani, Jorge Sola-Pikabea, Anabel LLavador, Emilio Sánchez-Ortiga, Juan Carlos Barreiro, Genaro Saavedra, Univ. de València (Spain); Jorge Garcia-Sucerquia, Univ. Nacional de Colombia Sede Medellín (Colombia); Nicolò Incardona, Manuel Martínez-Corral, Univ. de València (Spain)[10666-34]

5:25 pm: **Matching-based depth camera and mirrors for 3D reconstruction** (*Invited Paper*), Trong Nguyen Nguyen, Univ. de Montréal (Canada); Huu Hung Huynh, Univ. of Science and Technology - The Univ. of Danang (Viet Nam); Jean Meunier, Univ. de Montréal (Canada) [10666-35]

5:55 pm: **Fundamental limits of three-dimensional imaging and sensing from scattering surfaces** (*Invited Paper*), Amit Ashok, Liang-Chih Huang, College of Optical Sciences, The Univ. of Arizona (USA); Sumanta Pattanaik, Univ. of Central Florida (USA); Eric W. Clarkson, College of Optical Sciences, The Univ. of Arizona (USA) [10666-32]

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Methods of voxel data rendering for visualizing on multi-layer volumetric displays, Kriss Osmanis, Lightspace Technologies SIA (Latvia) . . . [10666-36]

Indigenous development of optical sensor for 3D imaging, Arup Banerjee, Neeraj Dubey, Sudipto Dasgupta, Space Applications Ctr. (India); Mitanshi Gaur, GlobalTech Pvt. Ltd. (India); Usha Mehta, Nirma Univ. (India) [10666-37]

An overview of three-dimensional object visualization and detection in low light illumination using integral imaging, Adam S. Markman, Bahram Javidi, Xin Shen, Univ. of Connecticut (USA) [10666-38]

Depth estimation of computational reconstruction in integral imaging by considering the pixel blink rate, Kotaro Inoue, Byeongwoo Cho, Hui Yun, Myungjin Cho, Hankyong National Univ. (Korea, Republic of) [10666-39]

3D resolution enhancement of integral imaging using resolution priority integral imaging and depth priority integral imaging, Hui Yun, Kotaro Inoue, Byeongwoo Cho, Myungjin Cho, Hankyong National Univ. (Korea, Republic of) [10666-40]

Depth resolution enhancement of computational reconstruction of integral imaging, Byeongwoo Cho, Hui Yun, Kotaro Inoue, Myungjin Cho, Hankyong National Univ. (Korea, Republic of) [10666-41]

Digital holographic sound imaging for frequency estimation of piezoelectric vibrator, Sudheesh K. Rajput, Indian Institute of Technology Patna (India); Osamu Matoba, Kobe Univ. (Japan) [10666-42]

An overview of flexible sensing integral imaging for three-dimensional profilometric reconstruction with occlusion removal, Xin Shen, Bahram Javidi, Adam S. Markman, Univ. of Connecticut (USA) . . . [10666-43]

Polarization imaging and measurement using laser speckles, Arun Anand, Swapnil Mahajan, Vismay Trivedi, Vani Chhaniwal, The Maharaja Sayajirao Univ. of Baroda (India); Zeev Zalavesky, Bar-Ilan Univ. (Israel); Bahram Javidi, Univ. of Connecticut (USA) [10666-44]

Copyright protection of plenoptic images by robust reversible watermarking, Amir Ansari, Seokmin Hong, Genaro Saavedra, Manuel Martínez-Corral, Univ. de València (Spain) [10666-45]

CONFERENCE 10667

LOCATION: BALLROOM LEVEL, TAMPA 3

Tuesday–Thursday 17–19 April 2018 • Proceedings of SPIE Vol. 10667

Dimensional Optical Metrology and Inspection for Practical Applications VII

Conference Chairs: **Kevin G. Harding**, Optical Metrology Solutions (USA); **Song Zhang**, Purdue Univ. (USA)

Program Committee: **Motoharu Fujigaki**, Univ. of Fukui (Japan); **Khaled J. Habib**, Kuwait Institute for Scientific Research (Kuwait); **Damien P. Kelly**, Technische Univ. Ilmenau (Germany); **Peter Kühmstedt**, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); **Beiwen Li**, Iowa State Univ. (USA); **Rongguang Liang**, College of Optical Sciences, The Univ. of Arizona (USA); **Georges T. Nehmetallah**, The Catholic Univ. of America (USA); **Gunther Notni**, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); **Lei Tian**, Boston Univ. (USA); **Joseph D. Tobiasson**, Micro Encoder Inc. (USA); **Zhaoyang Wang**, The Catholic Univ. of America (USA); **Jiangtao Xi**, Univ. of Wollongong (Australia)

TUESDAY 17 APRIL

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Translating rotational frequency through chromatic detection utilizing COMSOL multiphysics, Damon Plyler, Wyatt Roach, Ryan A. Integlia, Florida Polytechnic Univ. (USA) [10667-25]

360-degree shape measurement system by using structured-light 3D scanners and least-squares fitting, Carlos Ricardo Contreras Pico, Univ. Santo Tomás (Colombia) and Institución Educativa Técnico Dámaso Zapata (Colombia); Jaime Enrique Meneses Fonseca, Univ. Industrial de Santander (Colombia) [10667-26]

360-degree shape measurement system using a simple setup with a structured-light 3D scanner, applications in oil industry, Carlos Ricardo Contreras Pico, Univ. Santo Tomás (Colombia); Jaime Enrique Meneses Fonseca, Univ. Industrial de Santander (Colombia) [10667-27]

WEDNESDAY 18 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, TAMPA 3 WED 8:00 AM TO 10:00 AM

Optical Metrology Analysis

Session Chair: **Song Zhang**, Purdue Univ. (USA)

8:00 am: **2D and 3D computational optical imaging using deep convolutional neural networks (DCNNs)**, Thanh C. Nguyen, George Nehmetallah, The Catholic Univ. of America (USA) [10667-1]

8:20 am: **Correction of errors in the phase maps recovered by temporal phase unwrapping for fringe projection profilometry**, Naixin Li, Jiangtao Xi, Yanguang Yu, Qinghua Guo, Jun Tong, Philip O. Ogunbona, Univ. of Wollongong (Australia) [10667-2]

8:40 am: **3D shape measurement by thermal fringe projection: optimization of infrared (IR) projection parameters**, Martin Landmann, Friedrich-Schiller-Univ. Jena (Germany); Stefan Heist, Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Anika Brahm, Simon Schindewolf, Peter Kühmstedt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Gunther Notni, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) and Univ. of Technology (Germany) [10667-3]

9:00 am: **A new method for separating the speckle pattern embedded into fringe patterns for fringe projection profilometry**, Yiwei Zhang, Jiangtao Xi, Jun Tong, Yanguang Yu, Qinghua Guo, Philip O. Ogunbona, Univ. of Wollongong (Australia) [10667-4]

9:20 am: **High performance, low latency 3D sensor network for live full object reconstruction**, Christoph Munkelt, Matthias Heinze, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Tobias Zimmermann, Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Peter Kühmstedt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) [10667-5]

9:40 am: **Motion-induced error compensation for phase shifting profilometry**, Song Zhang, Ziping Liu, Purdue Univ. (USA) [10667-6]

Coffee Break and Dedicated Exhibition Time Wed 10:00 am to 11:00 am

SESSION 2

LOCATION: BALLROOM LEVEL, TAMPA 3 WED 11:00 AM TO 12:10 PM

Optical Metrology Methods I

Session Chair: **Gunther Notni**, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany)

11:00 am: **A novel method for 3D shape measurement of objects in motion (Invited Paper)**, Chengpu Duan, Jiangtao Xi, Jun Tong, Philip O. Ogunbona, Yanguang Yu, Qinghua Guo, Univ. of Wollongong (Australia) [10667-7]

11:30 am: **High-accuracy, real-time 3D shape measurement with double-pattern pulse width modulation techniques**, Song Zhang, Purdue Univ. (USA) [10667-8]

11:50 am: **High-speed 3D shape measurement by GOGO projection of aperiodic sinusoidal fringes: a performance analysis**, Stefan Heist, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Martin Landmann, Patrick Dietrich, Friedrich-Schiller-Univ. Jena (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Peter Kühmstedt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Gunther Notni, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) and Technische Univ. Ilmenau (Germany) . . . [10667-9]

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

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10667

SESSION 3

LOCATION: BALLROOM LEVEL, TAMPA 3 WED 1:40 PM TO 3:10 PM

Optical Metrology Methods II

Session Chair: **Kevin G. Harding**, Optical Metrology Solutions (USA)

1:40 pm: **Recent research on high-resolution 3D range geometry compression** (*Invited Paper*), Song Zhang, Purdue Univ. (USA) . . . [10667-10]

2:10 pm: **3D shape measurement of glass and transparent plastics with a thermal 3D system in the mid wave infrared**, Anika Brahm, Simon Schindwolf, Martin Landmann, Stefan Heist, Peter Kühmstedt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Gunther Notni, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) and Technische Univ. Ilmenau (Germany) [10667-11]

2:30 pm: **Improved line of light measurements on shiny and transparent surfaces**, Kevin G. Harding, Optical Metrology Solutions (USA) . . . [10667-12]

2:50 pm: **Generation and evaluation of hyperspectral 3D surface models based on a structured light system with hyperspectral snapshot mosaic sensors**, Stefan Heist, Friedrich-Schiller-Univ. Jena (Germany); Chen Zhang, Technische Univ. Ilmenau (Germany); Karl Reichwald, Technische Univ. Ilmenau (Germany) and Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Peter Kühmstedt, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); Gunther Notni, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany) and Technische Univ. Ilmenau (Germany) [10667-13]

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

SESSION 4

LOCATION: BALLROOM LEVEL, TAMPA 3 WED 3:40 PM TO 5:00 PM

Optical Metrology Applications

Session Chair: **Jiangtao Xi**, Univ. of Wollongong (Australia)

3:40 pm: **Superfast, high-resolution dynamic 3D strain measurement of robotic flapping wings**, Beiwen Li, Iowa State Univ. of Science and Technology (USA) [10667-14]

4:00 pm: **Measurement of creep strain in polymers by means of electronic speckle pattern shearing interferometry**, Juan Benito Pascual Francisco, Orlando Susarrey Huerta, Alexandre V. Michtchenko, Omar Barragán-Pérez, Instituto Politécnico Nacional (Mexico) [10667-15]

4:20 pm: **Hand portable 3D mapper applied to pit quantification on aerospace parts**, Erik Novak, 4D Technology Corp. (USA); Kevin G. Harding, Optical Metrology Solutions (USA); Shawn McDermed, 4D Technology Corp. (USA) [10667-16]

4:40 pm: **Three-dimensional digitization of archaeological objects by using a Kinect sensor**, Carlos Ricardo Contreras Pico, Univ. Santo Tomás (Colombia) and Institución Educativa Técnico Dámaso Zapata (Colombia); Jaime Enrique Meneses Fonseca, Univ Industrial de Santander (Colombia); Juan José Barrios Arlante, Univ. Santo Tomás (Colombia) [10667-28]

THURSDAY 19 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, TAMPA 3 THU 9:00 AM TO 10:00 AM

Additive Methods for Micro Electronic or Flexible Features

Session Chair: **Kevin G. Harding**, Optical Metrology Solutions (USA)

9:00 am: **Error mapping method for multi-axis additive manufacturing system**, Rajesh Ramamurthy, Vadim Bromberg, GE Global Research (USA); Kevin G. Harding, Optical Metrology Solutions (USA); Timothy Fiorillo, GE Global Research (USA) [10667-17]

9:20 am: **Self-aligned epitaxial silicon nano-wire arrays for sensor applications**, Jung-Hwan Hyung, Jae Hong Park, National Nanofab Ctr. (Korea, Republic of) [10667-18]

9:40 am: **Nanoparticle electrospray laser deposition for additive manufacturing of microlayers on rigid or flexible substrates**, Eduardo Castillo Orozco, Ranganathan Kumar, Aravinda Kar, Univ. of Central Florida (USA) [10667-19]

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

SESSION 6

LOCATION: BALLROOM LEVEL, TAMPA 3 THU 10:30 AM TO 11:10 AM

Advanced Additive Manufacturing Methods

Session Chair: **Kevin G. Harding**, Optical Metrology Solutions (USA)

10:30 am: **Additive manufacturing of lightweight mirrors**, Nikola Dudukovic, Wen Chen, Bryan D. Moran, William A. Steele, Eric B. Duoss, Christopher M. Spadaccini, Tayyab I. Suratwala, Rebecca Dylla-Spears, Lawrence Livermore National Lab. (USA) . . [10667-22]

10:50 am: **Structured light as an enhancement tool for low contrast features**, Kevin G. Harding, Optical Metrology Solutions (USA) . . . [10667-23]

CONFERENCE 10668

LOCATION: BALLROOM LEVEL, SANIBEL 3

Monday–Tuesday 16–17 April 2018 • Proceedings of SPIE Vol. 10668

Mobile Multimedia/Image Processing, Security, and Applications 2018

Conference Chairs: **Sos S. Agaian**, The Univ. of Texas at San Antonio (USA); **Sabah A. Jassim**, The Univ. of Buckingham (United Kingdom)

Conference Co-Chairs: **Stephen P. DelMarco**, BAE Systems (USA); **Vijayan K. Asari**, Univ. of Dayton (USA)

Program Committee: **David Akopian**, The Univ. of Texas at San Antonio (USA); **Cesar Bandera**, BanDeMar Networks (USA); **Reiner Creutzburg**, Fachhochschule Brandenburg (Germany); **Eliza Yingzi Du**, Qualcomm Inc. (USA); **Frederic Dufaux**, Lab. des Signaux et Systèmes, CNRS (France); **Touradj Ebrahimi**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Erlan H. Feria**, College of Staten Island (USA); **Artyom M. Grigoryan**, The Univ. of Texas at San Antonio (USA); **Phalguni Gupta**, Indian Institute of Technology Kanpur (India); **Jonathan G. Hixson**, U.S. Army Night Vision & Electronic Sensors Directorate (USA); **Balvinder Kaur**, U.S. Army Research, Development and Engineering Command (USA); **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); **Viacheslav Voronin**, Don State Technical Univ. (Russian Federation); **Yue Wu**, Raytheon BBN Technologies (USA); **Yufeng Zheng**, Alcorn State Univ. (USA); **Yicong Zhou**, Univ. of Macau (Macao, China)

MONDAY 16 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, SANIBEL 3 MON 8:00 AM TO 10:10 AM

Innovative Image Processing Techniques

Session Chair: **Sabah A. Jassim**,
The Univ. of Buckingham (United Kingdom)

8:00 am: **Mathematical aspects of transit photometry for small UAV detection in video** (*Invited Paper*), Stephen P. DelMarco, Helen F. Webb, BAE Systems (USA) [10668-1]

8:30 am: **One approach to the formation of content from the data obtained during the integration of digital images obtained in different electromagnetic ranges**, Evgeny A. Semenishchev, Vyacheslav V. Voronin, Don State Technical Univ. (Russian Federation) [10668-2]

8:50 am: **Methods of interpolation of three-dimensional structures obtained during the analysis of CT and MRI data**, Evgeny A. Semenishchev, Vyacheslav V. Voronin, Don State Technical Univ. (Russian Federation) [10668-3]

9:10 am: **Topological data analysis to improve exemplar-based inpainting**, Ahmed Al-jaberi, Aras T. Asaad, Naseer Al-Jawad, Sabah A. Jassim, The Univ. of Buckingham (United Kingdom) [10668-4]

9:30 am: **Colourizing monochrome images**, Ahmed Al-jaberi, Naseer Al-jawad, Sabah A. Jassim, The Univ. of Buckingham (United Kingdom) [10668-5]

9:50 am: **Autonomous navigation of controlled game environment matrix utilizing point comparison of real and ideal image regions**, Mehrube Mehrubeoglu, Doina Morales, Texas A&M Univ. Corpus Christi (USA) [10668-19]

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

SESSION 2

LOCATION: BALLROOM LEVEL, SANIBEL 3 MON 10:30 AM TO 12:10 PM

Image Analysis Techniques

Session Chair: **Stephen P. DelMarco**, BAE Systems (USA)

10:30 am: **Multi-feature fusion based approach for robust face recognition**, Almabrok Essa, Vijayan K. Asari, Univ. of Dayton (USA) [10668-6]

10:50 am: **Processing global and local features in convolutional neural network (CNN) and primate visual systems**, Yufeng Zheng, Alcorn State Univ. (USA); Jun Huang, Tianwen Chen, Yang Ou, Wu Zhou, The Univ. of Mississippi Medical Ctr. (USA) [10668-7]

11:10 am: **Book title recognition for smart library with deep learning**, Jinshan Tang, Ziming Wang, Michigan Technological Univ. (USA); Liang Lei, Chongqing Univ. of Science and Technology (China) [10668-8]

11:30 am: **HFKSegNet: Holistic and generalized finger knuckle ROI segmentation network**, Gaurav Jaswal, National Institute of Technology, Hamirpur (India); Aditya Nigam, Indian Institute of Technology Mandi (India); Ravinder Nath, National Institute of Technology, Hamirpur (India) [10668-9]

11:50 am: **A multi-level kidney tumor classification based on roughness measure**, Rahul Rajendran, Shishir Paramathma Rao, Karen Panetta, Tufts Univ. (USA); Sos S. Agaian, The City Univ. of New York (USA); Michael Liss, The Univ. of Texas Health Science Ctr. at San Antonio (USA) [10668-10]

Lunch Break Mon 12:10 pm to 1:40 pm

SESSION 3

LOCATION: BALLROOM LEVEL, SANIBEL 3 MON 1:40 PM TO 3:00 PM

Multimedia Algorithms and Systems

Session Chair: **Sabah A. Jassim**,
The Univ. of Buckingham (United Kingdom)

1:40 pm: **Fixation oriented object segmentation using mobile eye tracker**, Qianwen Wan, Karen Panetta, Aleksandra Kaszowska, Holly Taylor, Tufts Univ. (USA); Sos S. Agaian, The City Univ. of New York (USA) [10668-11]

2:00 pm: **Non-informative frames detection for multispectral images**, Sergey Makov, Don State Technical Univ. (Russian Federation) [10668-12]

2:20 pm: **Specular reflection detection algorithm for endoscopic images**, Viacheslav V. Voronin, Evgeny A. Semenishchev, Don State Technical Univ. (Russian Federation); Sos S. Agaian, The City Univ. of New York (USA) [10668-13]

2:40 pm: **Human Detection in Infrared Imagery using Intensity Distribution, Gradient and Texture Features**, Hussin K. Ragb, Theus H. Aspiras, Vijayan K. Asari, Univ. of Dayton (USA) [10668-14]

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

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10668

SESSION 4

LOCATION: BALLROOM LEVEL, SANIBEL 3 MON 3:30 PM TO 4:50 PM

Image Security, Authentication and Digital Forensics

Session Chair: **Sos S. Agaian**,
The Univ. of Texas at San Antonio (USA)

3:30 pm: **Dual-luminance-transfer-based camouflage object detection**, Long Bao, Karen Panetta, Tufts Univ. (USA); Sos S. Agaian, The City Univ. of New York (USA) [10668-15]

3:50 pm: **Data-independent versus data-dependent dimension reduction for gait-based gender classification**, Tahir Hassan, The Univ. of Buckingham (United Kingdom); Azhin Sabir, Koya Univ. (Iraq); Sabah A. Jassim, The Univ. of Buckingham (United Kingdom) [10668-16]

4:10 pm: **Topological data analysis as image steganalysis technique**, Rasber D. Rashid, Koya Univ. (Iraq); Aras T. Asaad, Sabah A. Jassim, The Univ. of Buckingham (United Kingdom) [10668-17]

4:30 pm: **Inpainting using neural network in medical image analysis**, Viacheslav V. Voronin, Don State Technical Univ. (Russian Federation); Gevorg Karapetyan, Institute for Informatics and Automation Problems (Armenia); Sos S. Agaian, The City Univ. of New York (USA) [10668-18]

SYMPOSIUM-WIDE PLENARY SESSION LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6-7 for details.

TUESDAY 17 APRIL

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C ... TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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 comprehensive study on three-dimensional image quality metrics, Srijiith Rajeev, Karen Panetta, Tufts Univ. (USA); Sos S. Agaian, The City Univ. of New York (USA) [10668-20]

Multi-level exposure-aware image enhancement, Shishir Paramathma Rao, Rahul Rajendran, Karen Panetta, Tufts Univ. (USA); Sos S. Agaian, The City Univ. of New York (USA) [10668-21]

Multi-sensor image mosaicking for smart cities face classification, Shreyas Kamath K. M., Karen Panetta, Tufts Univ. (USA); Sos S. Agaian, The City Univ. of New York (USA) [10668-22]

Image reconstruction by gradients and means, Artyom M. Grigoryan, Sos S. Agaian, The Univ. of Texas at San Antonio (USA) [10668-23]

A deep learning modeling approach to prostate cancer detection and Gleason grading, Clara M. Mosquera-Lopez, Rodrigo Escobar, The Univ. of Texas at San Antonio (USA); Sos S. Agaian, The City Univ. of New York (USA) [10668-24]

Enhancement of 3-D medical images by transforming images to 2-D grayscale images, Artyom M. Grigoryan, Aparna John, The Univ. of Texas at San Antonio (USA); Sos S. Agaian, The Univ. of Texas at San Antonio (USA) and The City Univ. of New York (USA) [10668-25]

Re-coloring of grayscale images: models with aesthetic and golden proportions, Artyom M. Grigoryan, Sos S. Agaian, The Univ. of Texas at San Antonio (USA) [10668-26]

Face-It-Up: A scientific app for face processing using mobile devices and machine learning APIs, Oge Marques, Jhanon James, Florida Atlantic Univ. (USA); Emilio Barcelos, Florida Institute of Technology (USA) [10668-28]

Cancer detection and analysis in whole-slide images: parametric transfer learning in deep learning neural networks, Shilpana Sathyanarayana, The Univ. of Texas Health Science Ctr. at San Antonio (USA); Foram Sanghavi, Tufts Univ. (USA); Sos S. Agaian, The City Univ. of New York (USA) [10668-29]

Is there a map in our head: An image processing based pointing error analytic technique for mobile eye tracker, Qianwen Wan, Aleksandra Kaszowska, Shishir Paramathma Rao, Karen Panetta, Holly Taylor, Tufts Univ. (USA); Sos S. Agaian, The City Univ. of New York (USA) [10668-30]

Face description using anisotropic gradient: thermal infrared face recognition, Qianwen Wan, Shishir Paramathma Rao, Karen Panetta, Tufts Univ. (USA); Sos S. Agaian, The City Univ. of New York (USA) [10668-31]

CONFERENCE 10669

LOCATION: BALLROOM LEVEL, CAPTIVA 2

Sunday–Tuesday 15–17 April 2018 • Proceedings of SPIE Vol. 10669

Computational Imaging III

Conference Chairs: **Abhijit Mahalanobis**, Lockheed Martin Missiles and Fire Control (USA); **Amit Ashok**, College of Optical Sciences, The Univ. of Arizona (USA); **Lei Tian**, Boston Univ. (USA); **Jonathan C. Petrucci**, Univ. at Albany (USA)

Program Committee: **Oliver Cossairt**, Northwestern Univ. (USA); **Michael E. Gehm**, Duke Univ. (USA); **Ulugbek Kamilov**, Mitsubishi Electric Research Labs. (USA); **Jun Ke**, Beijing Institute of Technology (China); **Chrysanthe Preza**, The Univ. of Memphis (USA); **Adrian Stern**, Ben-Gurion Univ. of the Negev (Israel); **Andreas Velten**, Univ. of Wisconsin-Madison (USA); **Laura Waller**, Univ. of California, Berkeley (USA); **Ge Wang**, Rensselaer Polytechnic Institute (USA); **Abbie Watnik**, U.S. Naval Research Lab. (USA); **Zeev Zalevsky**, Bar-Ilan Univ. (Israel); **Yunhui Zhu**, Virginia Polytechnic Institute and State Univ. (USA)

SUNDAY 15 APRIL

SESSION 1

LOCATION: BALLROOM LEVEL, CAPTIVA 2 SUN 8:30 AM TO 10:00 AM

Machine Learning

Session Chair: **Jonathan C. Petrucci**, Univ. at Albany (USA)

8:30 am: **Learning the 3D shape of objects from examples** (*Invited Paper*), Demetri Psaltis, Ecole Polytechnique Fédérale de Lausanne (Switzerland) [10669-1]

9:00 am: **A deep learning approach for microscope design**, Roarke Horstmeyer, Charité Universitätsmedizin Berlin (Germany) and Humboldt-Univ. zu Berlin (Germany); Richard Chen, Y Combinator (USA); Benjamin Judkewitz, Charité Universitätsmedizin Berlin (Germany) and Humboldt-Univ. zu Berlin (Germany) [10669-2]

9:20 am: **PlumeNET: A convolutional neural network for plume classification in thermal imagery**, Christian W. Smith, Julia R. Dupuis, William J. Marinelli, Physical Sciences Inc. (USA) [10669-3]

9:40 am: **Breast cancer screening using convolutional neural network and follow-up digital mammography**, Yufeng Zheng, Alcorn State Univ. (USA); Clifford Yang, Aleksey Merkulov, Univ. of Connecticut Health Ctr. (USA) [10669-4]

Coffee Break Sun 10:00 am to 10:30 am

SESSION 2

LOCATION: BALLROOM LEVEL, CAPTIVA 2 SUN 10:30 AM TO 12:30 PM

Computational Methods for 3D Imaging I

Session Chair: **Lei Tian**, Boston Univ. (USA)

10:30 am: **Three-dimensional integral imaging for gesture recognition under occlusions** (*Invited Paper*), Filiberto Pla, Pedro Latorre Carmona, Eva Salvador-Balaguer, Univ. Jaume I (Spain); Bahram Javidi, Univ. of Connecticut (USA) [10669-5]

11:00 am: **3D displays based on integral imaging and their related content capture techniques** (*Invited Paper*), Ginni Grover, Intel Corp. (USA) [10669-6]

11:30 am: **High spatial resolution time-of-flight imaging**, Fengqiang Li, Northwestern Univ. (USA); Huaijin Chen, Adithya Pediredla, Rice Univ. (USA); Chiakai Yeh, Kuan He, Northwestern Univ. (USA); Ashok Veeraraghavan, Rice Univ. (USA); Oliver Cossairt, Northwestern Univ. (USA) [10669-7]

11:50 am: **Evaluation of plenoptic depth algorithm performance for measuring scene spectra captured by a Fresnel zone light field spectral imager**, Jack A. Shepherd, Anthony L. Franz, Carlos D. Diaz, Air Force Institute of Technology (USA) [10669-8]

12:10 pm: **Temporal super-resolution in full waveform LiDAR**, Jun Ke, Beijing Institute of Technology (China); Edmund Lam, The Univ. of Hong Kong (Hong Kong, China) [10669-9]

Lunch Break Sun 12:30 pm to 1:30 pm

SESSION 3

LOCATION: BALLROOM LEVEL, CAPTIVA 2 SUN 1:30 PM TO 3:30 PM

Computational Methods for 3D Imaging II

Session Chair: **Abhijit Mahalanobis**, Lockheed Martin Missiles and Fire Control (USA)

1:30 pm: **Two-dimensional scattering and digital holography from isolated aerosol particles** (*Invited Paper*), Stephen Holler, Fordham Univ. (USA); Matthew J. Berg, Kansas State Univ. (USA); Yuli Heinson, Washington Univ. in St. Louis (USA); Osku Kempainen, Kansas State Univ. (USA) [10669-33]

2:00 pm: **Applications of inverse scattering principles for holographic imaging** (*Invited Paper*), YongKeun Park, KAIST (Korea, Republic of) [10669-10]

2:30 pm: **Motion resolved quantitative phase imaging**, Michael R. Kellman, Zachary F. Phillips, David Ren, Michael Lustig, Laura Waller, Univ. of California, Berkeley (USA) [10669-11]

2:50 pm: **Incoherent structured illumination system with a tunable 3D pattern**, Ana Doblaz, The Univ. of Memphis (USA); Jorge Sola-Pikabea, Univ. de València (Spain); Hasti Shabani, The Univ. of Memphis (USA); Genaro Saavedra, Manuel Martínez-Corral, Univ. de València (Spain); Chrysanthe Preza, The Univ. of Memphis (USA) [10669-12]

3:10 pm: **Sensing around the next corner**, Martin Laurenzis, Institut Franco-Allemand de Recherches de Saint-Louis (France); Andreas Velten, Ji-Hyun Nam, Marco La Manna, Mohit Gupta, Univ. of Wisconsin-Madison (USA); Diego Gutierrez, Adrian Jarabo, Univ. de Zaragoza (Spain); Mauro Buttaviva, Alberto Tosi, Politecnico di Milano (Italy) [10669-13]

Coffee Break Sun 3:30 pm to 4:00 pm

SESSION 4

LOCATION: BALLROOM LEVEL, CAPTIVA 2 SUN 4:00 PM TO 6:00 PM

Compressive Sensing

Session Chair: **Amit Ashok**, College of Optical Sciences, The Univ. of Arizona (USA)

4:00 pm: **Coherence recovery: Extracting coherent channels from incoherent sums** (*Invited Paper*), Michael E. Gehm, Joel A. Greenberg, Duke Univ. (USA) [10669-14]

4:30 pm: **An overview of NATO SET-232 joint activities on computational imaging and compressive sensing systems** (*Invited Paper*), Todd W. Du Bosq, Sanjeev Agarwal, U.S. Army Night Vision & Electronic Sensors Directorate (USA); Judith Dijk, TNO Defence, Security and Safety (Netherlands); John S. Furey, U.S. Army Engineer Research and Development Ctr. (USA); Alper Gungor, Huseyin Guven, ASELSAN A.S. (Turkey); Terence L. Haran, Georgia Tech Research Institute (USA); Martin Laurenzis, Institut Franco-Allemand de Recherches de Saint-Louis (France); Abhijit Mahalanobis, Lockheed Martin Missiles and Fire Control (USA); Gabriela Paunescu, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Jonathan A. Piper, Defense Science and Technology Ctr. (United Kingdom); Endre Repasi, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Yunlong Sheng, Univ. Laval (Canada) . . [10669-15]

COMMERCIAL + SCIENTIFIC SENSING AND IMAGING

CONFERENCE 10669

5:00 pm: **High performance image completion using sparsity based algorithms**, Jin Zhou, Chiman Kwan, Signal Processing, Inc. (USA) [10669-16]

5:20 pm: **An efficient parallel algorithm for single-pixel image reconstruction**, Oguzhan Fatih Kar, Alper Güngör, Serhat Ilbey, H. Emre Güven, ASELSAN A.S. (Turkey) [10669-17]

5:40 pm: **Video compressive sensing using Russian dolls ordering of Hadamard basis for multi-scale sampling of a scene in motion using a single pixel camera**, Vladislav Kravets, Adrian Stern, Ben-Gurion Univ. of the Negev (Israel) [10669-18]

MONDAY 16 APRIL

SESSION 5

LOCATION: BALLROOM LEVEL, CAPTIVA 2 MON 8:00 AM TO 10:10 AM

Computational Imaging Outside the Visible Regime

Session Chair: **Lei Tian**, Boston Univ. (USA)

8:00 am: **Computational imaging from nanoscopic to astronomical scales** (*Invited Paper*), Oliver Cossairt, Northwestern Univ. (USA) . . [10669-19]

8:30 am: **Fourier ptychography at short wavelength with a synchrotron-based microscope**, Antoine Wojdyla, Markus P. Benk, Kenneth A. Goldberg, Patrick P. Naulleau, Lawrence Berkeley National Lab. (USA) [10669-20]

8:50 am: **Exploiting k-space/frequency duality in Fourier optics towards real-time compression-less terahertz imaging**, Hichem Guerboukha, Kathirvel Nallappan, Maksim Skorobogatiy, Ecole Polytechnique de Montréal (Canada) [10669-21]

9:10 am: **Four-dimensional x-ray computed tomography reconstruction by feature based iterative algorithms for fast dynamic processes**, Ziling Wu, Yunhui Zhu, Ling Li, Ting Yang, Virginia Polytechnic Institute and State Univ. (USA) [10669-22]

9:30 am: **Artifact reduction in propagation-based x-ray phase imaging using focusing polycapillary optics**, Weiyan Sun, Carolyn A. MacDonald, Jonathan C. Petruccelli, Univ. at Albany (USA) [10669-23]

9:50 am: **Computational resolution enhancement for mesh-based x-ray phase imaging**, Congxiao He, Sean Starr-Baier, Carolyn A. MacDonald, Jonathan C. Petruccelli, Univ. at Albany (USA) [10669-24]

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

SESSION 6

LOCATION: BALLROOM LEVEL, CAPTIVA 2 MON 10:40 AM TO 12:30 PM

Novel Systems and Algorithms

Session Chair: **Jonathan C. Petruccelli**, Univ. at Albany (USA)

10:40 am: **Using a multimode fiber to measure the spectral phase of ultrafast optical pulses** (*Invited Paper*), Hui Cao, Yale Univ. (USA) . [10669-25]

11:10 am: **Near-field SAR imaging with dynamic metasurface antennas using an adapted range migration algorithm**, Aaron V. Diebold, Laura Pulido-Mancera, Timothy Sleasman, Michael Boyarsky, Mohammadreza F. Imani, David R. Smith, Duke Univ. (USA) [10669-26]

11:30 am: **The inversion of highly singular linear equations with application to imaging and spectral imaging**, Harvey C. Schau, Meridian Systems, LLC (USA) [10669-27]

11:50 am: **Computational imaging for reducing peak irradiance on focal planes**, Jacob Wirth, Rochester Institute of Technology (USA); Abbie T. Watnik, U.S. Naval Research Lab. (USA); Grover A. Swartzlander, Rochester Institute of Technology (USA) [10669-28]

12:10 pm: **Measuring a detection sensitivity metric for non-shift invariant computational imaging systems**, Bradley L. Preece, David P. Haefner, U.S. Army RDECOM CERDEC NVESD (USA); George Nehmetallah, The Catholic Univ. of America (USA) [10669-29]

SYMPOSIUM-WIDE PLENARY SESSION LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C MON 5:00 PM TO 7:00 PM

5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**

5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)

5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin

6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)

See pages 6–7 for details.

TUESDAY 17 APRIL

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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Machine learning for challenging tumor detection and classification in breast cancer, Ignacio Alvarez Illán, Anke Mayer-Baese, Amirhessam Tahmassebi, Florida State Univ. (USA) [10669-31]

Revisiting local features for retrieving small objects in heavily cluttered background, Daniel Manger, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany) [10669-32]

CONFERENCE 10670

LOCATION: BALLROOM LEVEL, SARASOTA 1

Monday–Tuesday 16–17 April 2018 • Proceedings of SPIE Vol. 10670

Real-Time Image and Video Processing 2018

Conference Chairs: **Nasser Kehtarnavaz**, The Univ. of Texas at Dallas (USA); **Matthias F. Carlsohn**, Computer Vision and Image Communication at Bremen (Germany)

Program Committee: **Mohamed Akil**, ESIEE (France); **Guillermo Botella**, Univ. Complutense de Madrid (Spain); **Philip P. Dang**, U.S. Dept. of Commerce (USA); **Touradj Ebrahimi**, Ecole Polytechnique Fédérale de Lausanne (Switzerland); **Barak Fishbain**, Technion-Israel Institute of Technology (Israel); **Sergio R. Goma**, Qualcomm Inc. (USA); **Christos Grecos**, Central Washington Univ. (USA); **Reinhard Koch**, Christian-Albrechts-Univ. zu Kiel (Germany); **Volodymyr Ponomaryov**, Instituto Politécnico Nacional (Mexico); **Luis Salgado**, Univ. Politécnica de Madrid (Spain); **Sergio Saponara**, Univ. di Pisa (Italy); **Mukul V. Shirvaikar**, The Univ. of Texas at Tyler (USA); **Athanassios N. Skodras**, Univ. of Patras (Greece); **Bogdan Smolka**, Silesian Univ. of Technology (Poland)

MONDAY 16 APRIL

OPENING REMARKS

LOCATION: BALLROOM LEVEL, SARASOTA 1 8:20 AM TO 8:30 AM

Conference Chairs: **Nasser Kehtarnavaz**, The Univ. of Texas at Dallas (USA); **Matthias F. Carlsohn**, Computer Vision and Image Communication at Bremen (Germany)

SESSION 1

LOCATION: BALLROOM LEVEL, SARASOTA 1 MON 8:30 AM TO 10:10 AM

Real-Time Algorithms I

Session Chair: **Nasser Kehtarnavaz**,
The Univ. of Texas at Dallas (USA)

8:30 am: **On the parallel classification system using hyperspectral images for remote sensing applications**, Beatriz P. Garcia-Salgado, Volodymyr I. Ponomaryov, Cesar M. A. Robles-Gonzalez, Instituto Politécnico Nacional (Mexico); Sergiy Sadovnychiy, Instituto Mexicano del Petróleo (Mexico)..... [10670-1]

8:50 am: **Robust enhancement technique for color images corrupted by impulsive noise**, Bogdan Smolka, Silesian Univ. of Technology (Poland)..... [10670-2]

9:10 am: **Blind image sharpness metric based on edge and texture features**, Priti Maheshwary, AISECT Univ. (India); Mukul V. Shirvaikar, The Univ. of Texas at Tyler (USA); Christos Grecos, Central Washington Univ. (USA)..... [10670-3]

9:30 am: **Extraction of vital signs using real time video analysis for neonatal monitoring**, Bhushan Lohani, Mukul V. Shirvaikar, Premananda Indic, The Univ. of Texas at Tyler (USA)..... [10670-4]

9:50 am: **Real time demosaicking and superresolution of multispectral images**, Ljubomir Jovanov, Wilfried Philips, Univ. Gent (Belgium) ... [10670-5]

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

SESSION 2

LOCATION: BALLROOM LEVEL, SARASOTA 1 MON 10:40 AM TO 12:00 PM

Real-Time Hardware Implementation

Session Chair: **Mukul V. Shirvaikar**, The Univ. of Texas at Tyler (USA)

10:40 am: **An efficient dense descriptor applied to 3D vision implemented on parallel computing**, Dario I. Rosas-Miranda, Volodymyr I. Ponomaryov, Cesar M. A. Robles-Gonzalez, Instituto Politécnico Nacional (Mexico)..... [10670-6]

11:00 am: **Computationally efficient blood vessels segmentation in fundus image on shared memory parallel machines**, Mohamed Akil Sr., Yaroub Elloumi, ESIEE Paris (France)..... [10670-7]

11:20 am: **Slanted windows with plane smoothness for dense real-time stereo**, Oscar M. Rahnama, Philip Torr, Univ. of Oxford (United Kingdom)..... [10670-8]

11:40 am: **A high-speed driver for silicon photonics Mach-Zender modulator for high data-rate transfer of particle collision images in high energy physics and in medical physics**, Sergio Saponara, Univ. di Pisa (Italy); Guido Magazzu, Istituto Nazionale di Fisica Nucleare (Italy); Gabriele Ciarpì, Univ. di Pisa (Italy)..... [10670-9]

Lunch Break..... Mon 12:00 pm to 1:30 pm

SESSION 3

LOCATION: BALLROOM LEVEL, SARASOTA 1 MON 1:30 PM TO 3:10 PM

Real-Time Algorithms II

Session Chair: **Matthias F. Carlsohn**, Computer Vision and Image Communication at Bremen (Germany)

1:30 pm: **A computationally efficient pipeline for 3D point cloud reconstruction from video sequences**, Chih-Hsiang Chang, Nasser Kehtarnavaz, The Univ. of Texas at Dallas (USA)..... [10670-10]

1:50 pm: **Real-time lung segmentation from whole-body CT scans using Adaptive Vision Studio: a visual programming software suite**, Jakub Nalepa, Michal Czardybon, Maksym Walczak, Future Processing (Poland)..... [10670-11]

2:10 pm: **Evolutionary cortical surface segmentation**, Maksym Walczak, Jakub Nalepa, Michal Kawulok, Wojciech Dudzik, Future Processing (Poland); Bogdan Smolka, Silesian Univ. of Technology (Poland)..... [10670-12]

2:30 pm: **Real-time multi-beam SEM image stitching**, Shammi Rahangdale, Technische Univ. Delft (Netherlands); Lennard Voortman, Leiden Univ. (Netherlands); Pieter Kruit, Technische Univ. Delft (Netherlands) ... [10670-13]

2:50 pm: **Performance analysis of real-time DNN inference on Raspberry Pi**, Delia Velasco-Montero, Jorge Fernández-Berni, Ricardo Carmona-Galán, Ángel Rodríguez-Vázquez, Instituto de Microelectrónica de Sevilla (Spain)..... [10670-14]

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

SESSION 4

LOCATION: BALLROOM LEVEL, SARASOTA 1 MON 3:40 PM TO 4:40 PM

Real-Time Video Systems

Session Chair: **Christos Grecos**, Central Washington Univ. (USA)

3:40 pm: **Computational efficiency of optic disk detection on fundus image: A survey**, Sofien Ben Sayadia, Univ. de Monastir (Tunisia); Yaroub Elloumi, École des Ponts ParisTech (France) and ESIEE Paris (France) and Univ. Paris-EST (France); Mohamed Akil Sr., ESIEE Paris (France); Mohamed Hédi Bedoui, Univ. de Monastir (Tunisia)..... [10670-15]

4:00 pm: **Impact of segment size on dynamic adaptive video streaming over HTTP (DASH) over LAN network**, Ibrahim R. Alzahrani, Abbas Amira, Naeem Ramzan, Univ. of the West of Scotland (United Kingdom).... [10670-16]

4:20 pm: **Real-time image and video processing for advanced services on-board vehicles for passenger transport**, Sergio Saponara, Univ. di Pisa (Italy)..... [10670-17]

CONFERENCE 10670

SYMPOSIUM-WIDE PLENARY SESSION LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C MON 5:00 PM TO 7:00 PM

- 5:00 to 5:15 pm: **Welcome, Awards, and Acknowledgements**
- 5:15 to 5:50 pm: **Air Force Research Laboratory: Reflections of a Century, Projections for the Future**
Dr. Morley O. Stone, Chief Technology Officer, Air Force Research Lab. (USA)
- 5:50 to 6:25 pm: **Innovation for a Secure Future**
Ray O. Johnson, Bessemer Venture Partners, Executive in Residence and former Sr. VP and CTO of Lockheed Martin
- 6:25 to 7:00 pm: **The Inevitable and Imperative Rise of Directed Energy Weapons**
Henry A. "Trey" Obering III, Executive Vice President, Directed Energy Innovation Services Officer, Booz | Allen | Hamilton; Past Director, Missile Defense Agency and Lieutenant General, U.S. Air Force (Retired)
- See pages 6–7 for details.*

TUESDAY 17 APRIL

TUESDAY POSTER SESSION

LOCATION: BALLROOM LEVEL, OSCEOLA BALLROOM C . . . TUE 6:00 PM TO 8:00 PM

All symposium attendees – You are invited to attend the evening Interactive Poster Session to view the high-quality posters and engage the authors in discussion. Enjoy light refreshments while networking with colleagues in your field. Authors may set up their posters between 10:00 am and 5:00 pm the day of their poster session. Special daytime previewing prior to the session from 10:00 am to 5:00 pm. Attendees are required to wear their conference registration badges to access the Osceola Ballroom to view the posters.

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 accompany their posters from 6:00 to 8:00 pm to answer questions from attendees. All posters and other materials must be removed no later than 8:30 pm. Any posters or materials left behind 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.

Real-time kinematics for accurate geolocalization of images in telerobotic applications, Sergio Saponara, Univ. di Pisa (Italy) . . . [10670-18]

Single removal haze using dual-sparsity decomposition, Ruxi Xiang, Xifang Zhu, Feng Wu, Hui Li, Xiaoyan Jiang, Changzhou Institute of Technology (China) . . . [10670-19]

Real-time stereovision framework for underwater drone maneuvering, Boguslaw Cyganek, AGH Univ. of Science and Technology (Poland); Bogdan Smolka, Silesian Univ. of Technology (Poland) . . . [10670-20]

Person re-identification by semi-supervised dictionary rectification learning, Zongyuan Ding, Hongyuan Wang, Changzhou Univ. (China); Fuhua Chen, West Liberty Univ. (USA); Soulan Liu, Tongguang Ni, Changzhou Univ. (China) . . . [10670-21]

Research and application of vehicle detection algorithm based on YOLO, Hongyuan Wang, Wei Yang, Ji Zhang, Suolan Liu, Zhongbao Zhang, Shoubing Chen, Cui Jin, Changzhou Univ. (China) . . . [10670-22]

The algorithm of person re-identification using sparse reduction, Hongyuan Wang, Wenwen Zhang, Kanbara Sun, Lei Geng, Rush King, Tongguang Ni, Jianwu Wan, Changzhou Univ. (China) . . . [10670-23]

Discriminative deep transfer metric learning for cross-domain person re-identification, Tongguang Ni, Hongyuan Wang, Changzhou Univ. (China) . . . [10670-24]



Topical Tracks

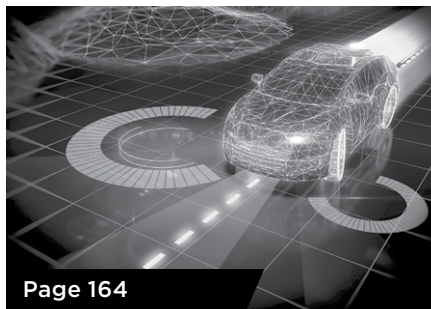
We are highlighting three important topics within the program so that you can easily find the applicable content. These areas continue to emerge as popular areas of interest with exciting new developments that are impacting our world. Come learn, collaborate, and network to help move your projects forward and plan for the future. Learn about:

- Emerging technologies
- Ground-breaking research
- Innovative products
- And more



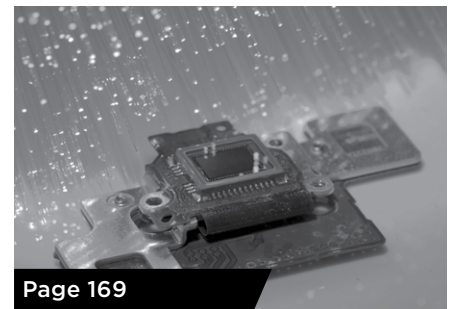
Agricultural Applications

Explore agricultural applications of sensing, imaging, and photonics technologies, including UAVs, hyperspectral imaging, phenotyping, infrared thermography, and more.



Unmanned Autonomous Systems (UAS)

Hear sensing, imaging, and photonics technologies research for unmanned autonomous systems (UAS) applications at SPIE Defense + Commercial Sensing. Hear the latest research that can be used to enhance air, ground, and underwater UAS such as LiDAR, infrared, multispectral and hyperspectral imaging, and more.



Cyber-Physical Systems / The Internet of Things

Learn from experts about the latest advancements in sensors, sensor fusion, big data, deep learning, cyber security, and other and related photonics research critical to advancing cyber-physical systems and the Internet of Things.



Agricultural Applications

Explore agricultural applications of sensing, imaging, and photonics technologies, including UAVs, hyperspectral imaging, phenotyping, infrared thermography, and more.

PAPERS ARE LISTED BY START DATE AND TIME

Implications of sensor inconsistencies and remote sensing error in the use of small unmanned aerial systems for generation of information products for agricultural management

Paper 10664-1

Mac McKee, Utah State Univ. (USA), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 1: Collecting Reliable Image Data with UAVs
Monday, April 16, 2018, 8:15 AM

Quality assessment of radiometric calibration of UAV image mosaics

Paper 10664-3

Cody Bagnall, Texas A&M Univ. (USA), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 1: Collecting Reliable Image Data with UAVs
Monday, April 16, 2018, 9:05 AM

Correction of in-flight luminosity variations in multispectral UAS images, using a luminosity sensor and camera pair for improved biomass estimation in precision agriculture

Paper 10664-4

Jean-Marc Gilliot, AgroParisTech (France), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 1: Collecting Reliable Image Data with UAVs
Monday, April 16, 2018, 9:25 AM

Progress towards low resolution visible spectrometry with COTS components

Paper 10657-5

Alexander Scheeline, SpectroClick, Inc. (USA), et al.
Conference 10657: Next-Generation Spectroscopic Technologies XI
Session 1: Smartphone Spectroscopy
Monday, April 16, 2018, 10:00 AM

Detection of pea flowering using proximal and aerial remote sensing

Paper 10664-8

Sindhuja Sankaran, Washington State Univ. (USA), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 2: Proximal and Remote Sensing for Phenotyping
Monday, April 16, 2018, 12:50 PM

Phenotyping of sorghum panicles using unmanned aerial system (UAS) data

Paper 10664-9

Anjin Chang, Texas A&M Univ. Corpus Christi (USA), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 2: Proximal and Remote Sensing for Phenotyping
Monday, April 16, 2018, 1:40 PM

Inter-comparison of thermal measurements using ground-based sensors, airborne thermal cameras, and eddy covariance radiometers

Paper 10664-12

Alfonso F. Torres-Rua, Utah State Univ. (USA), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 3: Thermal and Hyperspectral Imaging from UAVs
Monday, April 16, 2018, 2:40 PM

Enhanced pedestrian safety awareness at crosswalks via networked lidar, thermal imaging, and sensors

Paper 10643-13

Zachary A. Weingarten, Florida Polytechnic Univ. (USA), et al.
Conference 10643: Autonomous Systems: Sensors, Vehicles, Security and the Internet of Everything
Session 2: Object Sensing for Detection, Classification, and Autonomous Operations
Monday, April 16, 2018, 2:40 PM

A low-cost method for collecting hyperspectral measurements from a small unmanned aircraft system

Paper 10664-15

Ali Hamidisepehr, Univ. of Kentucky (USA), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 3: Thermal and Hyperspectral Imaging from UAVs
Monday, April 16, 2018, 4:10 PM

Hyperspectral data analysis of the world's leading agricultural crops

Paper 10639-40

Prasad S. Thenkabail, U.S. Geological Survey (USA), et al.
Conference 10639: Micro- and Nanotechnology Sensors, Systems, and Applications X
Session 8: Remote Sensing Techniques and Applications
Tuesday, April 17, 2018, 8:30 AM

Disease detection and mitigation in a cotton crop with UAV remote sensing

Paper 10664-19

J. Alex Thomasson, Texas A&M Univ. (USA), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 4: Detecting Yield, Disease, and Water Stress from UAVs
Tuesday, April 17, 2018, 8:50 AM

Applications of hyperspectral image analysis for precision agriculture

Paper 10639-42

Stan Martin, Bayer CropScience LP (USA), et al.
Conference 10639: Micro- and Nanotechnology Sensors, Systems, and Applications X
Session 8: Remote Sensing Techniques and Applications
Tuesday, April 17, 2018, 9:10 AM

Experimental approach to detect water stress in ornamental plants using UAV-imagery

Paper 10664-20

Ana de Castro, Instituto de Agricultura Sostenible (Spain), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 4: Detecting Yield, Disease, and Water Stress from UAVs
Tuesday, April 17, 2018, 9:40 AM

Design-optimization and performances of multispectral (VIS-SWIR) photodetector and its array

Paper 10656-21

Jaydeep Dutta, Banphil Photonics, Inc. (USA), et al.
Conference 10656: Image Sensing Technologies: Materials, Devices, Systems, and Applications V
Session 5: Advanced Photodetectors and Focal Plane Array (FPA)
Tuesday, April 17, 2018, 9:50 AM

Evaluation of multispectral unmanned aerial systems for irrigation management

Paper 10664-23

José L. Chávez, Colorado State Univ. (USA), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 5: Analytics for UAV-based Crop Management
Tuesday, April 17, 2018, 12:00 PM

UAV videos to extend research to producers

Paper 10664-25

Louis Wasson, Geosystems Research Institute (USA), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 6: Innovative UAV Applications
Tuesday, April 17, 2018, 1:50 PM

Evaluating UAVs under a multi-platform system in modeling crop characteristics

Paper 10664-27

Gregory Rouze, Texas A&M Univ. (USA), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 6: Innovative UAV Applications
Tuesday, April 17, 2018, 2:30 PM

Evaluating the capabilities of Sentinel-2 and Tetracam RGB+3 for multi-temporal detection of thrips on capsicum

Paper 10664-28

Jayantrao D. Mohite, Tata Consultancy Services Ltd. (India), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 6: Innovative UAV Applications
Tuesday, April 17, 2018, 2:50 PM

Using hyperspectral sensors for crop vegetation status monitoring in precision agriculture

Paper 10664-32

Marius Cristian Luculescu, Transilvania Univ. of Brasov (Romania), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session PTue: Poster Session
Tuesday, April 17, 2018, 6:00 PM

MoniSCAN: Software for multispectral monitoring of the crops vegetation status

Paper 10664-33

Marius Cristian Luculescu, Transilvania Univ. of Brasov (Romania), et al.
Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session PTue: Poster Session
Tuesday, April 17, 2018, 6:00 PM

Isolation of highly selective phage-displayed oligopeptide probes for detection of listeria monocytogenes in samples containing clorex and chlorine dioxide

Paper 10665-22

I-Hsuan Chen, Auburn Univ. (USA), et al.
Conference 10665: Sensing for Agriculture and Food Quality and Safety X
Session PTue: Poster Session
Tuesday, April 17, 2018, 6:00 PM

Applications of convolutional neural networks (CNN) for food quality and safety using hyperspectral imaging

Paper 10665-25

Hoonsoo Lee, Agricultural Research Service (USA), et al.
Conference 10665: Sensing for Agriculture and Food Quality and Safety X
Session PTue: Poster Session
Tuesday, April 17, 2018, 6:00 PM

Non-destructive method to detect artificially ripened banana using hyperspectral sensing and RGB imaging

Paper 10665-28

Mithun B.S., Tata Consultancy Services Ltd. (India), et al.
Conference 10665: Sensing for Agriculture and Food Quality and Safety X
Session PTue: Poster Session
Tuesday, April 17, 2018, 6:00 PM

Estimating paddy yields in North Korea using COMS geostationary satellite and GRAMI-rice model

Paper 10665-31

Jong-Min Yeom, Korea Aerospace Research Institute (Korea, Republic of), et al.
Conference 10665: Sensing for Agriculture and Food Quality and Safety X
Session PTue: Poster Session
Tuesday, April 17, 2018, 6:00 PM

Study of visible imaging and near-infrared imaging spectroscopy for plant root phenotyping

Paper 10665-1

Thomas Arnold, CTR Carinthian Tech Research AG (Austria), et al.
Conference 10665: Sensing for Agriculture and Food Quality and Safety X
Session 1: Hyperspectral and Multispectral Imaging for Foods
Wednesday, April 18, 2018, 8:00 AM

Continuous gradient temperature Raman spectroscopy of unsaturated fatty acids: applications for fish lipids and rendered meat source identification

Paper 10665-3

C. Leigh Broadhurst, Agricultural Research Service (USA), et al.
Conference 10665: Sensing for Agriculture and Food Quality and Safety X
Session 1: Hyperspectral and Multispectral Imaging for Foods
Wednesday, April 18, 2018, 8:40 AM

MCT-based shortwave infrared hyperspectral imaging system for the detection and quantification of adulterants in powder samples

Paper 10665-8

Hoonsoo Lee, Agricultural Research Service (USA), et al.
Conference 10665: Sensing for Agriculture and Food Quality and Safety X
Session 2: Sensing for Food Quality and Safety I
Wednesday, April 18, 2018, 11:40 AM

Non-targeted and targeted Raman imaging detection of chemical contaminants in food powders

Paper 10665-14

Jianwei Qin, Agricultural Research Service (USA), et al.
Conference 10665: Sensing for Agriculture and Food Quality and Safety X
Session 4: High Throughput Inspection
Wednesday, April 18, 2018, 2:50 PM

Miniature near infrared spectroscopy spectrometer and information and communication technologies to guarantee the integrity of the EU high added-value acorn Iberian pig ham

Paper 10665-20

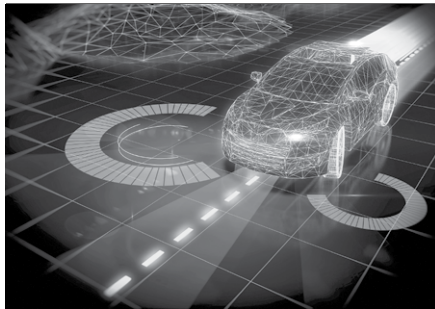
Ana Garrido-Varo, Univ. de Córdoba (Spain), et al.
Conference 10665: Sensing for Agriculture and Food Quality and Safety X
Session 5: Visible and Near Infrared Imaging For Foods
Wednesday, April 18, 2018, 5:20 PM

Necessary steps for the systematic calibration of a multispectral imaging system to achieve a targetless workflow in reflectance estimation: a study of Parrot SEQUOIA for precision agriculture

Paper 10644-42

Author(s): Luis Mario Domenzain, Parrot S.A. (France), et al.
Conference 10644: Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XXIV
Session 9: Applications
Thursday, April 19, 2018, 8:20 AM

Unmanned Autonomous Systems (UAS)



Unmanned Autonomous Systems (UAS)

Hear sensing, imaging, and photonics technologies research for unmanned autonomous systems (UAS) applications at SPIE Defense + Commercial Sensing. Hear the latest research that can be used to enhance air, ground, and underwater UAS such as LiDAR, infrared, multispectral and hyperspectral imaging, and more.

PAPERS ARE LISTED BY START DATE AND TIME

Implications of sensor inconsistencies and remote sensing error in the use of small unmanned aerial systems for generation of information products for agricultural management

Paper 10664-1

Mac McKee, Utah State Univ. (USA), et al. Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III Session 1: Collecting Reliable Image Data with UAVs Monday, April 16, 2018, 8:15 AM

Ground vehicle power line spectral sensing using GIS

Paper 10645-1

Mark W. Roberson, Goldfinch Sensor Technologies and Analytics LLC (USA), et al. Conference 10645: Geospatial Informatics, and Motion Imagery Analytics VIII Session 1: Geospatial Analytics I Monday, April 16, 2018, 9:00 AM

Quality assessment of radiometric calibration of UAV image mosaics

Paper 10664-3

Cody Bagnall, Texas A&M Univ. (USA), et al. Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III Session 1: Collecting Reliable Image Data with UAVs Monday, April 16, 2018, 9:05 AM

Safety enforcement for the verification of autonomous systems

Paper 10643-2

Dionisio de Niz, Carnegie Mellon Univ. — Software Engineering Institute (USA), et al. Conference 10643: Autonomous Systems: Sensors, Vehicles, Security and the Internet of Everything Session 1: Cyber and Software Security for Autonomous Operations Monday, April 16, 2018, 9:30 AM

Quadcopter sensing of magnetic and electric field with geospatial analytics

Paper 10645-3

Mark W. Roberson, Goldfinch Sensor Technologies and Analytics LLC (USA), et al. Conference 10645: Geospatial Informatics, and Motion Imagery Analytics VIII Session 1: Geospatial Analytics I Monday, April 16, 2018, 9:40 AM

Maintaining trusted platform in a cyber-contested environment

Paper 10643-6

David Hadcock, Alion Science and Technology Corp. (USA), et al. Conference 10643: Autonomous Systems: Sensors, Vehicles, Security and the Internet of Everything Session 1: Cyber and Software Security for Autonomous Operations Monday, April 16, 2018, 11:00 AM

CNN-based thermal infrared person detection by domain adaptation

Paper 10643-8

Christian Herrmann, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany), et al. Conference 10643: Autonomous Systems: Sensors, Vehicles, Security and the Internet of Everything Session 2: Object Sensing for Detection, Classification, and Autonomous Operations Monday, April 16, 2018, 1:20 PM

UAV-based LiDAR and gamma probe with real-time data processing and downlink for survey of nuclear disaster locations

Paper 10629-11

Thomas Hinterhofer, RIEGL Laser Measurement Systems GmbH (Austria), et al. Conference 10629: Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing XIX Session 4: Radiological, Nuclear Sensing Monday, April 16, 2018, 1:30 PM

A robotic orbital emulator with lidar-based SLAM and AMCL for multiple entity pose estimation

Paper 10641-13

Dan Shen, Intelligent Fusion Technology, Inc. (USA), et al. Conference 10641: Sensors and Systems for Space Applications XI Session 3: Perception and Autonomy for Aerospace Applications Monday, April 16, 2018, 2:10 PM

Improved video change detection for UAVs

Paper 10643-11

Thomas Müller, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany), et al. Conference 10643: Autonomous Systems: Sensors, Vehicles, Security and the Internet of Everything Session 2: Object Sensing for Detection, Classification, and Autonomous Operations Monday, April 16, 2018, 2:00 PM

Targeted 3D modeling from UAV imagery

Paper 10645-13

Abe Martin, Brigham Young Univ. (USA), et al. Conference 10645: Geospatial Informatics, and Motion Imagery Analytics VIII Session 4: Geolocation and Registration Monday, April 16, 2018, 2:40 PM

Inter-comparison of thermal measurements using ground-based sensors, airborne thermal cameras, and eddy covariance radiometers

Paper 10664-12

Alfonso F. Torres-Rua, Utah State Univ. (USA), et al. Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III Session 3: Thermal and Hyperspectral Imaging from UAVs Monday, April 16, 2018, 2:40 PM

Finding common ground by unifying autonomy indices to understand needed capabilities

Paper 10641-15

Trevor J. Bihl, Air Force Institute of Technology (USA), et al.

Conference 10641: Sensors and Systems for Space Applications XI
Session 3: Perception and Autonomy for Aerospace Applications
Monday, April 16, 2018, 2:50 PM

Enhanced pedestrian safety awareness at crosswalks via networked lidar, thermal imaging, and sensors

Paper 10643-13

Zachary A. Weingarten, Florida Polytechnic Univ. (USA), et al.

Conference 10643: Autonomous Systems: Sensors, Vehicles, Security and the Internet of Everything
Session 2: Object Sensing for Detection, Classification, and Autonomous Operations
Monday, April 16, 2018, 2:40 PM

Coherent 24 GHz radar system for micro-Doppler studies

Paper 10633-17

Duncan A. Robertson, Univ. of St. Andrews (United Kingdom), et al.

Conference 10633: Radar Sensor Technology XXII
Session 4: Micro-Doppler Exploitation
Monday, April 16, 2018, 4:00 PM

Recognizing objects in 3D data with distinctive self-similarity features

Paper 10648-12

Suya You, U.S. Army Research Lab. (USA), et al.

Conference 10648: Automatic Target Recognition XXVIII
Session 3: Advanced Algorithm in ATR II
Monday, April 16, 2018, 4:10 PM

A low-cost method for collecting hyperspectral measurements from a small unmanned aircraft system

Paper 10664-15

Ali Hamidisepehr, Univ. of Kentucky (USA), et al.

Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 3: Thermal and Hyperspectral Imaging from UAVs
Monday, April 16, 2018, 4:10 PM

Opto-acoustic intensity probes for seabed target tracking and detection

Paper 10628-18

Cameron A. Matthews, Naval Surface Warfare Ctr. Panama City Div. (USA), et al.

Conference 10628: Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XXIII
Session 9: Synthetic Aperture Sonar (SAS) I
Tuesday, April 17, 2018, 4:00 AM

Fractal analysis of seafloor textures for target detection in synthetic aperture sonar imagery

Paper 10628-20

Thomas Nabelek, Univ. of Missouri (USA), et al.

Conference 10628: Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XXIII
Session 9: Synthetic Aperture Sonar (SAS) I
Tuesday, April 17, 2018, 4:40 AM

2020: Faster than real time tactical ISR from the dismount, faster than real time strategic ISR to the dismount

Paper 10635-17

Richard M. Buchter, U.S. Army Research Lab. (USA), et al.

Conference 10635: Ground/Air Multisensor Interoperability, Integration, and Networking for Persistent ISR IX
Session 5: Deep Learning and Data Analytics: Learning
Tuesday, April 17, 2018, 8:20 AM

A history and overview of mobility modeling for autonomous unmanned ground vehicles

Paper 10643-17

Phillip J. Durst, U.S. Army Engineer Research and Development Ctr. (USA), et al.

Conference 10643: Autonomous Systems: Sensors, Vehicles, Security and the Internet of Everything
Session 3: Networks and the IOT for Autonomous Systems I
Tuesday, April 17, 2018, 9:20 AM

Experimental approach to detect water stress in ornamental plants using UAV-imagery

Paper 10664-20

Ana de Castro, Instituto de Agricultura Sostenible (Spain), et al.

Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 4: Detecting Yield, Disease, and Water Stress from UAVs
Tuesday, April 17, 2018, 9:40 AM

Design-optimization and performances of multispectral (VIS-SWIR) photodetector and its array

Paper 10656-21

Jaydeep Dutta, Banpil Photonics, Inc. (USA), et al.

Conference 10656: Image Sensing Technologies: Materials, Devices, Systems, and Applications V
Session 5: Advanced Photodetectors and Focal Plane Array (FPA)
Tuesday, April 17, 2018, 9:50 AM

Mission critical decentralized resilient and intelligent control for networked heterogeneous unmanned autonomous systems

Paper 10643-19

Hao Xu, Univ. of Nevada, Reno (USA), et al.

Conference 10643: Autonomous Systems: Sensors, Vehicles, Security and the Internet of Everything
Session 4: Networks and the IOT of Autonomous Systems II
Tuesday, April 17, 2018, 11:00 AM

Analysis of noise impact on distributed average consensus

Paper 10646-20

Boyuan Li, Univ. of Calgary (Canada), et al.

Conference 10646: Signal Processing, Sensor/Information Fusion, and Target Recognition XXVII
Session 5: Information Fusion Methodologies and Applications III
Tuesday, April 17, 2018, 12:00 PM

Probabilistic models for assured position, navigation and timing

Paper 10643-24

Andres Molina-Markham, The MITRE Corp. (USA), et al.

Conference 10643: Autonomous Systems: Sensors, Vehicles, Security and the Internet of Everything
Session 5: Autonomous Operations, Artificial Intelligence, and Navigation I
Tuesday, April 17, 2018, 2:00 PM

A comparison of sustainable forest management metrics generated from unmanned and manned aerial systems

Paper 10664-26

Michael McClelland, Rochester Institute of Technology (USA), et al.

Conference 10664: Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III
Session 6: Innovative UAV Applications
Tuesday, April 17, 2018, 2:10 PM

Automated, near real-time inspection of imagery using commercial sUAS

Paper 10640-5

Chris Kawatsu, Soar Technology, Inc. (USA), et al.

Conference 10640: Unmanned Systems Technology XX
Session 1: Perception
Tuesday, April 17, 2018, 2:20 PM

Regional sensing with an open-path dual comb spectroscopy and a UAS

Paper 10629-31

Ian Coddington, National Institute of Standards and Technology (USA), et al.

Conference 10629: Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing XIX
Session 8: Vapor, Aerosol Detection
Tuesday, April 17, 2018, 2:30 PM

Unmanned Autonomous Systems (UAS)

Automated data interpretation, tasking, and coordination of UAS imaging

Paper 10640-6

Sandra M. Klute, TORC Robotics (USA), et al.
Conference 10640: Unmanned Systems Technology XX
Session 1: Perception
Tuesday, April 17, 2018, 2:40 PM

UAVs for wildland fires

Paper 10643-23

Moulay A. Akhoulfi, Univ. de Moncton (Canada), et al.
Conference 10643: Autonomous Systems: Sensors, Vehicles, Security and the Internet of Everything
Session 5: Autonomous Operations, Artificial Intelligence, and Navigation I
Tuesday, April 17, 2018, 2:40 PM

Resilient detection of multiple targets using a distributed algorithm with limited information sharing

Paper 10652-12

Jing Wang, Bradley Univ. (USA), et al.
Conference 10652: Disruptive Technologies in Information Sciences
Session 2: Advanced Networking
Tuesday, April 17, 2018, 3:40 PM

Integrating ground surveillance with aerial surveillance for enhanced amateur drone detection

Paper 10652-13

Jian Wang, Embry-Riddle Aeronautical Univ. (USA), et al.
Conference 10652: Disruptive Technologies in Information Sciences
Session 2: Advanced Networking
Tuesday, April 17, 2018, 4:00 PM

DRESH: DRone EnSnaring mesh

Paper 10640-9

David Erickson, Defence Research and Development Canada, Suffield (Canada), et al.
Conference 10640: Unmanned Systems Technology XX
Session 2: Special Topics
Tuesday, April 17, 2018, 4:10 PM

Mapping and reconnaissance imager, night-enhanced, for sensing of contaminants, oil, and unseen threats (MARINE SCOUT)

Paper 10631-17

Toomas H. Allik, Active EO Inc. (USA), et al.
Conference 10631: Ocean Sensing and Monitoring X
Session 4: Oil Spill Detection
Tuesday, April 17, 2018, 4:20 PM

Collaborative Unmanned Aerial Systems for Effective and Efficient Airborne Surveillance

Paper 10652-14

Xiaoping Wang, Air Force Engineering University (China), et al.
Conference 10652: Disruptive Technologies in Information Sciences
Session 2: Advanced Networking
Tuesday, April 17, 2018, 4:20 PM

blindBike: an assistive bike navigation system for low-vision persons

Paper 10640-10

Lynne L. Grewe, California State Univ., East Bay (USA), et al.
Conference 10640: Unmanned Systems Technology XX
Session 2: Special Topics
Tuesday, April 17, 2018, 4:30 PM

Large-scale parallel simulations of distributed detection algorithms for collaborative autonomous sensor networks

Paper 10652-15

Anton Y. Yen, Lawrence Livermore National Lab. (USA), et al.
Conference 10652: Disruptive Technologies in Information Sciences
Session 2: Advanced Networking
Tuesday, April 17, 2018, 4:40 PM

An ultrasmall 3D lidar for small autonomous drone based on an integrated 2-axis MEMS scanner

Paper 10636-14

Dingkang Wang, Univ. of Florida (USA), et al.
Conference 10636: Laser Radar Technology and Applications XXIII
Session 4: Compact Laser Radar Systems
Tuesday, April 17, 2018, 5:00 PM

Automatic voice control system for UAV-based accessories

Paper 10640-26

Filip Rezac, CESNET z.s.p.o. (Czech Republic), et al.
Conference 10640: Unmanned Systems Technology XX
Session PS1: Posters-Tuesday
Tuesday, April 17, 2018, 6:00 PM

Improving autonomy capabilities with temporal world models

Paper 10640-27

Philip R. Osteen, U.S. Army Research Lab. (USA), et al.
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Thomas Alicia, U.S. Army (USA), et al.

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Adam Stambler, Near Earth

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Autonomous vehicles and cybersecurity: a paradigm for problem and solution assessment and a sensing approach to problem detection

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Jeremy Straub, North Dakota State Univ. (USA), et al.
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Maintaining trusted platform in a cyber-contested environment

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Certificates, code signing and digital signatures

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Enhanced pedestrian safety awareness at crosswalks via networked lidar, thermal imaging, and sensors

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Zachary A. Weingarten, Florida Polytechnic Univ. (USA), et al.
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REGISTRATION

Onsite Registration and Badge Pick-up Hours

Location: Exhibition Level

Sunday 15 April	7:00 am to 5:00 pm
Monday 16 April.	7:00 am to 5:00 pm
Tuesday 17 April.	7:30 am to 5:00 pm
Wednesday 18 April	7:30 am to 5:00 pm
Thursday 19 April.	7:30 am to 2:00 pm

CONFERENCE REGISTRATION

Includes admission to all conference sessions, plenaries, panels, and poster sessions; admission to the SPIE Exhibition and industry sessions; Welcome Reception and other networking events; one paid lunch; daily coffee breaks; dessert snacks on Tuesday and Wednesday; and a choice of online proceedings or online collections.

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 the Course Desk 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.

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 up to 60% 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

Location: 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.

RECEIPT 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.

BADGE CORRECTIONS

Badge corrections can be made by the SPIE Cashier. Please have your badge removed from the badge holder and marked with your changes before approaching the counter.

REFUND INFORMATION

There is a US\$50 service charge for processing refunds. Requests for refunds must be received by 5 April 2018; all registration fees will be forfeited after this date. Membership dues, SPIE Digital Library subscriptions, or Special Events purchased are not refundable.

U.S. GOVERNMENT CREDIT CARDS

U.S. Government credit card users: have your purchasing officer contact the credit card company and get prior authorization before attempting to register. Advise your purchasing agent that SPIE is considered a 5968 company for authorization purposes.

GENERAL INFORMATION

AUTHOR / PRESENTER INFORMATION

Speaker Check-In and Preview Station

Location: Ballroom Level, Gainesville 1

Sunday through Thursday. 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.

Poster Setup Instructions

Location: Ballroom Level, Osceola Ballroom C

Tuesday 17 April. 10:00 am to 5:00 pm

- 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.

FOOD AND BEVERAGE SERVICES

Coffee Breaks

Ballroom Level. Sunday, Monday, and Thursday afternoon

Level 1 Tuesday through Thursday morning
Various locations throughout the Exhibition Hall

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

Location: Exhibition Hall, Level 1

Tuesday through Thursday during exhibition hours

Hot and cold snacks, hot entrees, deli sandwiches, salads, and pastries are available for purchase including espresso and beverages. Cash and credit cards accepted.

Lunch Vouchers

Registered conference attendees receive one lunch voucher good for use Tuesday or Wednesday from 11-1 pm.

Desserts

Complimentary tickets for dessert snacks are included in course and conference attendee registration packets.



The poster features a central sun icon with rays of varying lengths. To the right of the sun, the text reads "International Day of Light" in a large, bold font, with "16 May" below it. Further right, there are three overlapping photographs: the top one shows a group of people looking at a large globe; the middle one shows a person in a field; the bottom one shows a person in a field. At the bottom left, there is a paragraph of text about the International Day of Light, followed by a bold statement: "SPIE supports the International Day of Light to promote awareness of life-saving, life-enhancing light." Below this, it says "SPIE IDL GRANTS • FREE IDL MATERIALS • SPIE PHOTO CONTEST". At the bottom left, it provides the website "www.spie.org/IDL". At the bottom right, there are the logos for UNESCO and SPIE.

International Day of Light
16 May


Following the highly successful International Year of Light and Light-based Technologies 2015, The International Day of Light was proclaimed at the General Conference of UNESCO in November 2017 and the first celebration will take place on 16 May 2018.

The broad theme of light will allow many different sectors of society around the world to participate in activities every 16 May to raise awareness of science and technology, art and culture, and their importance in achieving the goals of UNESCO — education, equality and peace.

SPIE supports the International Day of Light to promote awareness of life-saving, life-enhancing light.

SPIE IDL GRANTS • FREE IDL MATERIALS • SPIE PHOTO CONTEST

For more information: www.spie.org/IDL

 **SPIE**

ONSITE SERVICES

Internet Access - Wireless

Location: Exhibition Level Lobby and Ballroom Level

Complimentary wireless internet access provided in meeting rooms and lobbies on level 1 and level 3. Instructions will be posted onsite.

SPIE Conference and Exhibition App

Search and browse the program, special events, participants, exhibitors, courses, and more. Free Conference App available for iPhone and Android phones.



SPIE Bookstore

Location: Osceola Lobby, Level 3

Stop by the SPIE Bookstore to browse the latest SPIE Press Books, proceedings, and educational materials. While there, get a t-shirt or educational toy to bring home to the family.

SPIE Education Services

Location: Exhibition Lobby, Level 1

Browse course offerings or learn more about SPIE courses available in portable formats such as Online and customized, In-company courses.

SPIE Press Room

Location: Flagler Room, Ballroom Level
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.

GROUND TRANSPORTATION

Once you are in Orlando you can choose from a large selection of rental vehicles, taxis, limousines and public transportation. Travel by car is also convenient with a number of major highways flowing into Central Florida and throughout the rest of the state. Orlando's public transportation system, LYNX, is a great way to get around town.

Mears Transportation - Orlando's largest shared ride shuttle service to and from Orlando International Airport (MCO) direct to your hotel. \$23 one-way or \$37 round trip. Discount may be available.

Mears Taxi Service - from MCO to Hotel is approximately \$53 one-way.
Super Shuttle - Shared ride shuttle service direct from MCO to your hotel. Approximately \$18 round trip.

LYNX - provides public transportation services for Orange, Seminole and Osceola counties. Starting at \$2.25 for single ride or \$8 for 7-day pass.

Additional Transportation Information

SPIE Luggage & Coat Check

Complimentary luggage and package storage are available for hotel guests at the hotel Bell Desk.

Concierge Kiosk

Hotel lobby, Near Front Desk

Let our concierge assist you with pointing out the most popular things to do in Kissimmee, planning your trip, coordinating transportation, booking tickets online, reserving restaurant tables and golf tee times and fulfilling special requests.

Contact us at GaylordPalmsConcierge@GaylordHotels.com

Child Care Services

Kids Night Out

Hotel Childcare Services, Event Childcare Services and Hotel Pet Sitting since 1998. You can make reservations through our Kissimmee concierge staff or call 1-407-828-0920. There is a four-hour child care minimum, and reservations must be made at least 24 hours in advance.

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: +1 407-586-2860

Lost and Found


Location: Exhibition Lobby, Level 1- Cashier
Open during Registration Hours

Found items will be kept at the Cashier. At the end of the meeting, all found items will be turned over to the Gaylord Palms Guest Services, +1 407-586-0000 or dial "0" from a House Phone.

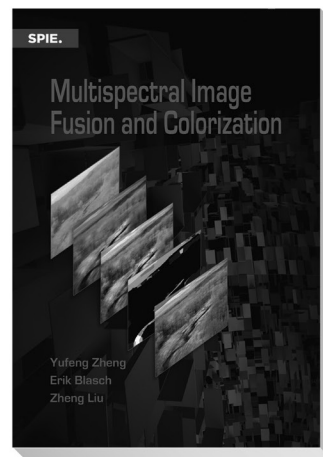
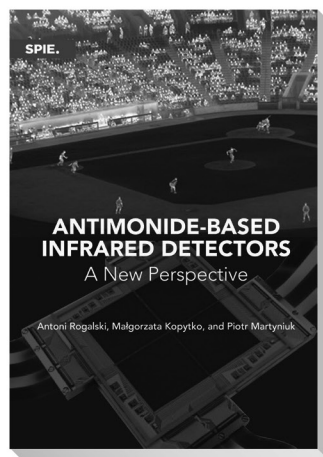
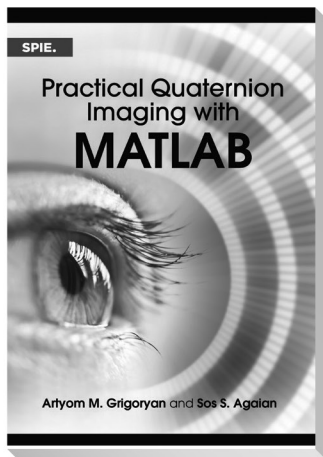
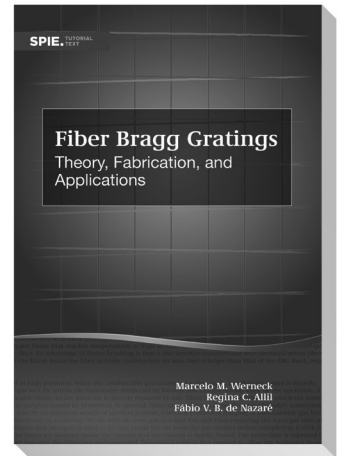
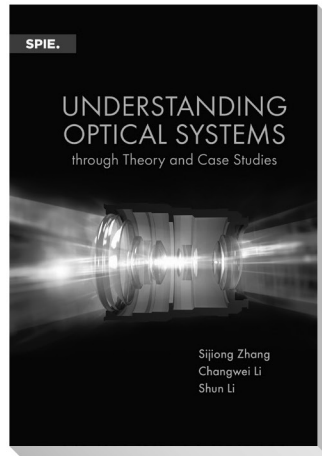
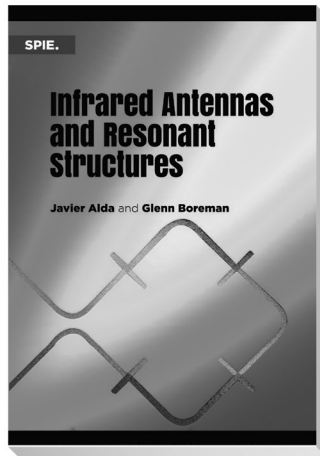
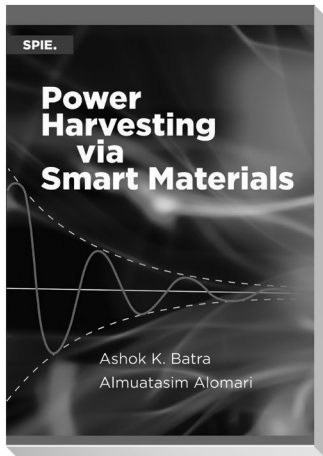
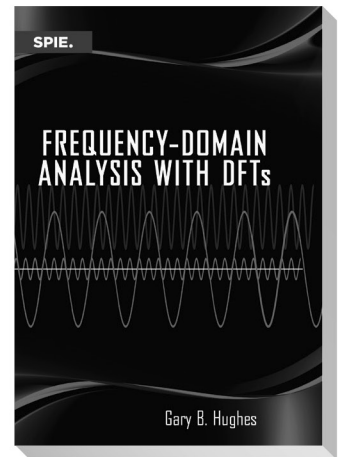
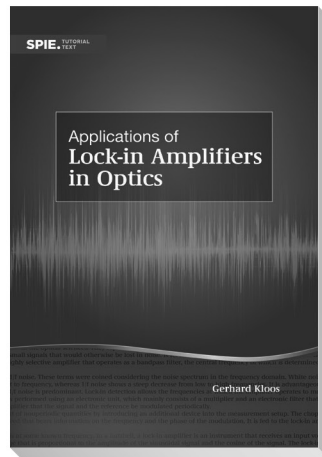
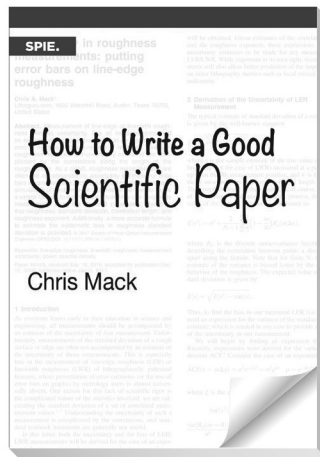
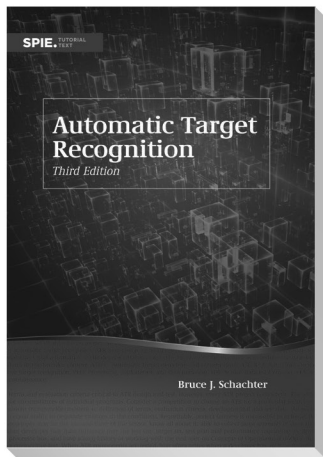
PARKING

Resort self-parking is \$22.00 a day; valet parking is available for \$29.00 a day. (Tax is additional.) Rates are subject to change. Please note that special rates may apply for groups or special events.

CAR RENTAL

 Hertz Car Rental is the selected as the official car rental agency for this Event. To reserve a car, identify yourself as a Defense + Commercial Sensing conference attendee using the Hertz Meeting Code CV# 029B0023. 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. CV# 029B0023.

NEW BOOKS FROM SPIE



Proceedings.

Paid conference registration includes online Proceedings of SPIE. In the tables below you will find product order numbers to use on the registration form.

Available as part of registration:

Online Proceedings Volume—access to a single conference proceedings volume via the SPIE Digital Library. Available as papers are published.

Online Proceedings Collection—access to multiple related proceedings volumes via the SPIE Digital Library. Available as papers are published.

Conference Attendees: You may purchase additional online collections for \$175 each or additional online proceedings volumes for \$60 each. Print conference proceedings volumes are also available; see pricing below.

Accessing Online Proceedings

To access your proceedings:

- Go to <http://spiedigitallibrary.org> and sign in. If you do not have an SPIE account, create one using the email address you used to register for the conference.
- Click the My Account link at the top of the page, then find the My Conference Proceedings tab, which will show your available proceedings volumes.

You can also access this content via your organization's SPIE Digital Library account.

For assistance, contact SPIE:

Email: SPIEDsupport@spie.org

Phone (North America): +1 888 902 0894

Phone (Rest of World): +1 360 685 5580

Online Proceedings Collections

Conference Attendees: The price for additional online proceedings volumes is \$60 each.

Product Order Number	Collection Title/Included Volumes <small>(See next page for volume titles and editors)</small>	Price for separate purchase
		Meeting Attendees
DLC691	Defense and Security 2018: IR Sensors and Systems <i>Volumes #: 10624, 10625, 10626, 10627</i>	\$175.00
DLC692	Defense and Security 2018: Defense, Homeland Security, and Law Enforcement; and Intelligence, Surveillance, and Reconnaissance <i>Volumes #: 10628, 10629, 10630, 10631, 10632, 10633, 10634, 10635</i>	\$175.00
DLC693	Defense and Security 2018: Laser Sensors and Systems; and Next-Generation Sensors and Systems <i>Volumes #: 10636, 10637, 10638, 10639, 10640, 10641, 10642, 10643, 10654</i>	\$175.00
DLC694	Defense and Security 2018: Sensor Data and Information Exploitation; Imagery and Pattern Analysis; and Information Systems and Networks <i>Volumes #: 10644, 10645, 10646, 10647, 10648, 10649, 10650, 10651, 10652, 10653, 10660</i>	\$175.00

Product Order Number	Collection Title/Included Volumes <small>(See next page for volume titles and editors)</small>	Price for separate purchase
		Meeting Attendees
DLC695	Commercial and Scientific Sensing and Imaging 2018: Imaging and Sensing Technologies <i>Volumes #: 10643, 10654, 10655, 10656, 10657, 10658, 10659, 10660</i>	\$175.00
DLC696	Commercial and Scientific Sensing and Imaging 2018: Sensing for Industry, Environment, and Health <i>Volumes #: 10661, 10662, 10663, 10664, 10665</i>	\$175.00
DLC697	Commercial and Scientific Sensing and Imaging 2018: Imaging and Data Visualizations <i>Volumes #: 10644, 10649, 10650, 10666, 10667, 10668, 10669, 10670</i>	\$175.00

Online Proceedings Volumes

Conference Attendees: The price for additional online proceedings volumes is \$60 each.

Product Order Number		Volume Title/Volume Editors	Price for separate Print purchase
Print Volume	Online Volume		Meeting Attendees
10654	DL 10654	Fiber Optic Sensors and Applications XV <i>Alexis Mendez, Christopher S. Baldwin, Henry H. Du</i>	\$78.75
10655	DL 10655	Polarization: Measurement, Analysis, and Remote Sensing XIII <i>David B. Chenault, Dennis H. Goldstein</i>	\$60.00
10656	DL 10656	Image Sensing Technologies: Materials, Devices, Systems, and Applications V <i>Nibir K. Dhar, Achyut K. Dutta</i>	\$90.00
10657	DL 10657	Next-Generation Spectroscopic Technologies XI <i>Mark A. Druy, Richard A. Crocombe, Steven M. Barnett, Luisa T.M. Profeta, Abul K. Azad</i>	\$67.50
10658	DL 10658	Compressive Sensing VII: From Diverse Modalities to Big Data Analytics <i>Fauzia Ahmad</i>	\$52.50
10659	DL 10659	Advanced Photon Counting Techniques XII <i>Mark A. Itzler, Joe C. Campbell</i>	\$52.50
10660	DL 10660	Quantum Information Science, Sensing, and Computation X <i>Eric Donkor, Michael Hayduk</i>	\$52.50
10661	DL 10661	Thermosense: Thermal Infrared Applications XL <i>Douglas Burleigh, Jaap de Vries</i>	\$60.00
10662	DL 10662	Smart Biomedical and Physiological Sensor Technology XV <i>Brian M. Cullum, Douglas Kiehl, Eric S. McLamore</i>	\$60.00

Product Order Number		Volume Title/Volume Editors	Price for separate Print purchase
Print Volume	Online Volume		Meeting Attendees
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