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TECHNOLOGIES

- Unmanned/Unattended Sensors and Sensor Networks
- Electro-Optical and Infrared Systems: Technology and Applications
- Electro-Optical Remote Sensing
- Technologies for Optical Countermeasures
- Advanced Free-Space Optical Communication Techniques and Applications
- Emerging Technologies
- Millimetre Wave and Terahertz Sensors and Technology
- Optical Materials and Biomaterials in Security and Defence Systems Technology
- Counterterrorism, Crime Fighting, Forensics and Surveillance
- Quantum Technologies and Quantum Information Science
- High Power Lasers: Technology and Systems, Platforms, Effects
- Target and Background Signatures
- Virtual Programme Track on Hyperspectral Sensing

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PLAN TO PARTICIPATE

The Organising Committee of the 14th SPIE Security + Defence invites you to submit papers to this exciting meeting: this event crosses the divide between fundamental optical science and the application of the underpinning technologies in advanced defence and security systems. This symposium will be co-located with the 24th SPIE Remote Sensing symposium, which enhances opportunities to identify new partners for collaboration from related fields of activity.Take the opportunity to learn about the latest scientific results in both topics " Defence & Security" and "Remote sensing"

This unique symposium will offer many opportunities to network with colleagues from a variety of disciplines in academia, industry, and government from all over the world, whilst still maintaining a distinctly European focus. SPIE Security + Defence will consider all aspects of this evolving field of optronics and photonics:

- **Materials**
- **Optical devices**
- **Enabling technologies**
- **Advanced concepts**
- **Sensors (including their design, fabrication and exploitation)**
- **Nanotechnology**
- **Bio-inspiration and bio-mimetics**
- **Signal processing and control**
- **Laser technologies and their application (including high-power devices and applications)**
- **Electro-optic systems and concepts**
- **Modelling and simulation**
- **Quantum information science and technology**
- **Emerging security and defence requirements**
- **Target and background signatures**
- **Human observer performance**
- **Autonomy in sensing**
- **Cyber defence**

Other relevant topics are also welcome to ensure a vibrant meeting. Engineers and researchers from government, military, academia and the commercial sector will discuss current status and future directions of a wide range of R&D projects. Participation from academic institutes is especially encouraged; graduate and undergraduate student researchers are invited to submit their work and interact with international leaders. All papers presented at this event will appear in the SPIE Digital Library.

We look forward to seeing you at Security + Defence 2017 where opportunities abound for combining cutting-edge science and technology with the beauty of the city of Warsaw.

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Contents

BEST STUDENT PAPER AWARDS

As a committed supporter of excellence in student research, SPIE supports Best Student Paper Awards at SPIE conferences across the globe. In addition to cash prizes and award certificates, winners receive SPIE Digital Library downloads and complimentary SPIE Student Membership.

The awards are designed to encourage and acknowledge excellence in oral and poster student paper presentations. Best student papers will be recognized within each of the Remote Sensing and Security + Defence conferences.

In order to be considered for this award, the student must meet the following requirements:
- Student must be the presenting author at the conference and must make their oral presentation as scheduled
- Student must be the leading author of the manuscript
- Papers submitted by graduate and undergraduate students are eligible
- Student must enter the best student paper award by responding to an award announcement e-mail

The best student award announcement will follow the acceptance notification and will include all details necessary to enter and qualify for the competition. A panel of experts will evaluate the papers, both for quality and content.

RECIPIENTS OF THE 2016 BEST STUDENT PAPER AWARDS

Electro-Optical and Infrared Systems: Technology and Applications

9987-17: **Classifying objects in LWIR imagery via CNNs,** Iain Rodger, Heriot-Watt Univ. (United Kingdom)

Electro-Optical Remote Sensing: Emerging Imaging and Sensing Technologies

9988-1: **Real-time tracking around a corner,** Jonathan Klein, Institut Franco-Allemand de Recherches de Saint-Louis (France) and Univ. Bonn (Germany)

High-Power Lasers 2015: Technology and Systems

9990-9: **Comparative study of DPAL and XPAL systems and selection principal of parameters,** Wei Huang, Chinese Academy of Sciences (China) and Univ. of Chinese Academy of Sciences (China)

Emerging Imaging and Sensing Technologies

9992-26: **Depth imaging in highly scattering underwater environments using time-correlated single photon counting,** Aurora Maccarone, Heriot-Watt Univ. (United Kingdom)

Millimetre Wave and Terahertz Sensors and Technology

9993-17: **Terahertz waveguides based on multichannel sapphire shaped crystals,** Gleb Katyba, Bauman Moscow State Technical Univ. (Russian Federation) and Institute of the Solid State Physics RAS (Russian Federation)

Optics and Photonics for Counterterrorism, Crime Fighting and Defence

9995-22: **Deep person re-identification in aerial images,** Arne Schumann, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

Quantum Information Science and Technology

9996-13: **Generation and analysis of correlated pairs of photons on board a nanosatellite,** Rakhitha Chandrasekara, Ctr. for Quantum Technologies (Singapore)

Target and Background Signatures

9997-22: **Computationally efficient target classification in multispectral image data with deep neural networks,** Lukas Cavigelli, ETH Zürich (Switzerland)

Conferences 9986, 9989, 9991, 9994, 10002, 10006 received no entries.

Target and Background Signatures (SD101)

Conference Chairs: **Karin U. Stein,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Ric Schleijpen,** TNO Defence, Security and Safety (Netherlands)

Programme Committee: **Joanne B. Culpepper,** Defence Science and Technology Group (Australia); **Willem H. Gunter,** Institute for Maritime Technology (South Africa); **Daniela H. Heinrich,** Norwegian Defence Research Establishment (Norway); **Katrin Idla,** Tallinn Univ. of Technology (Estonia); **Hans M. Kariis,** Swedish Defence Research Agency (Sweden); **Alexander Schwarz,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Miranda van Iersel,** TNO Defence, Security and Safety (Netherlands); **Peter Wellig,** Armasuisse (Switzerland)

This conference deals with algorithmic and experimental approaches for distinguishing the weak signal of a target from a cluttered background of images covering the spectral region from the visible up to the thermal infrared. Making this distinction requires characterization of the target properties and characterization of the backgrounds. Knowledge of target and background signatures is essential for various applications such as systems engineering and evaluation (e.g. electro-optical sensors or for camouflage design), operational planning and development of ATR algorithms. The conference also covers methods for assessing the influence of signature reduction and signature management at different levels such as platform signature, tactical application and operational capabilities.

Contributions are invited on the following topics and those related to them:

- signature modeling and validation
- background properties
- aided and automatic target typing, classification, and discrimination
- low signal-to-clutter ratio processing
- tracking in complex backgrounds
- signature management
- advances in algorithms for sensor signal and data processing
- simulation and performance evaluation
- sensor data fusion, multiple source integration
- adaptive processing methods
- artificial intelligence techniques for target – background discrimination
- processing multi-/hyperspectral data
- multisensor signature prediction model
- camouflage effectiveness
- signatures in relation to drone/UAV detection
- human observer performance.

IMPORTANT DATES:

Abstract Due Date:
13 MARCH 2017

Manuscript Due Date:
14 AUGUST 2017

Electro-Optical and Infrared Systems: Technology and Applications (SD102)

Conference Chairs: **David A. Huckridge,** Ridgeway Consulting (United Kingdom); **Reinhard Ebert, Helge Bürsing,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

Programme Committee: **Christopher C. Alexay,** StingRay Optics, LLC (United States); **Gisele Bennett,** Georgia Institute of Technology (United States); **Piet Bijl,** TNO Defence, Security and Safety (Netherlands); **Rainer Breiter,** AIM INFRAROT-MODULE GmbH (Germany); **David J. Clarke,** Placing Value Co.,Ltd (Thailand); **Judith Dijk,** TNO Defence, Security and Safety (Netherlands); **Bernd Eberle,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Natan S. Kopeika,** Ben-Gurion Univ. of the Negev (Israel); **Robert A. Lamb,** SELEX ES (United Kingdom); **Stephen T. Lee,** Thales Optronics Ltd. (United Kingdom); **Stanley R. Rotman,** Ben-Gurion Univ. of the Negev (Israel); **Armin L. Schneider,** Institut Franco-Allemand de Recherches de Saint-Louis (France); **Philip J. Soan,** Defence Science and Technology Lab. (United Kingdom)

Developments in electro-optic and infrared systems are key to providing enhanced capability to military forces as well as commercial systems. Advances in these technologies have been aimed not only at increasing system performance but also in making the systems accessible to more users through reductions in size, weight, and cost. These improvements will produce operational benefits in current applications as well as opening up new applications for E-O and IR systems in military, industrial and medical environments.

In particular size, weight and cost issues are important for robotic and remote control vehicles, e.g. drones, which are proliferating on the battlefield. Many of these are smaller than conventional vehicles and lower cost. Therefore, there is a need to develop small and low cost EO/IR payload sensors for these vehicles. These vehicles are also difficult to detect and there is a need to develop EO/IR sensors that can detect, recognize and identify such vehicles at useful ranges.

EO and IR systems are likely to benefit from recent advances in material research, for example new carbon based materials, nano-materials and metamaterials. These new materials promise new EO properties that could significantly change the way EO and IR systems are designed and built, e.g. new detector systems with enhanced properties or negative refractive index materials which could radically change the way optics are designed.

Computational Imaging, e.g. Pupil Plane Encoding, Coded Aperture Imaging, Compressive Imaging, etc, is another family of emerging technologies that will radically alter the way sensor systems are designed. These techniques combine optics and processing to provide a useable output from the sensor and can provide functionality not possible or practical with conventional system designs. Computational Imaging will require developments in specialist sub-components, non-standard optics design and algorithm development to reconstruct the image.

Quantum techniques are also being investigated to assess their potential for sensing systems. Quantum Imaging and Ghost Imaging are examples of quantum techniques being investigated by different teams. Any Quantum system will require specialist components e.g. sources, optics, detectors, electronics and processing as well as providing scope for unconventional system design.

Advanced technology by itself is not sufficient to give new and/or advanced capabilities, systems have to be designed and developed in a way that will enable their reliable and cost effective manufacture. This will involve adopting rigorous development and system engineering techniques. These are as crucial for the successful exploitation of sensor technology as the detector, optics and electronics.

This conference is aimed at bringing together researchers in the fields of E-O and IR sensor technologies, including related materials technologies, and those developing systems for defence and dual-use applications. Presentations on active and passive technologies and systems are of interest, covering the wavebands from UV to LWIR.

Papers are solicited in the following areas:

- advanced materials for EO/IR, e.g metamaterials, nano-materials, carbon based materials and their application
- focal plane array detector technologies, covering wavebands UV to LWIR including multi-band FPAs

- detector packaging, temperature stabilization and integration technologies
- passive imaging: technology, modelling, system design and hardware
- active imaging: technology, modelling, system design and hardware
- applications of active and passive EO and/or IR systems
  - military
  - industrial
  - medical
- novel sensor technologies and their applications
- integrated and miniaturized sensors – reduced size, weight, power and cost for applications such as robotic and remote control vehicles and the dismounted soldier
- computational imaging: techniques, components, designs and algorithms
- broadband, multiband and hyperspectral sensors
- polarisation sensitive sensors
- detector packaging, temperature stabilization and integration technologies
- imaging through the atmosphere
- signal and image processing
- modelling of EO/IR systems and sub-systems
- compressive sensing in imaging systems
- quantum sensing components and system designs: theory and implementation
- defence and security applications of EO and IR
- system integration design and development issues
- system engineering approaches.

Special Session on Reduced Size, Weight, Power + Cost (SWAP+C) Systems

There is significant effort on development of robotic vehicles for land, sea and air e.g. drones/UAVs. Already a significant number of such vehicles, particularly drones have been deployed, numbers of deployed systems will increase over the coming years. Many of these are much smaller than manned vehicles and have much smaller payload capacity. Therefore, smaller, lighter and lower power payloads, including EO/IR systems are required. These robotic vehicles are also much lower cost than manned vehicles and so payloads should also aim to be low cost. Similarly, there is a need to increase the capability of the dismounted soldier – smaller, lighter, low power and low cost systems will facilitate this.

Papers are invited for a proposed Session dedicated to technological advances aimed at reducing the size, weight, power and cost (SWAP+C) of EO/IR systems.

IMPORTANT DATES:

Abstract Due Date:
13 MARCH 2017

Manuscript Due Date:
14 AUGUST 2017

Electro-Optical Remote Sensing (SD103)

Conference Chairs: **Gary Kamerman,** FastMetrix, Inc. (United States); **Ove Steinvall,** Swedish Defence Research Agency (Sweden)

Programme Committee: **Robert J. Grasso,** RJG Consulting (United States); **Laurent Hespel,** ONERA (France); **Dennis K. Killinger,** Univ. of South Florida (United States); **Martin Laurenzis,** Institut Franco-Allemand de Recherches de Saint-Louis (France); **Peter Lutzmann,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Kenneth J. McEwan,** Defence Science and Technology Lab. (United Kingdom); **Vasyl Molebny,** National Taras Shevchenko Univ. of Kyiv (Ukraine); **Philip St John Russell,** Max-Planck-Institut für die Physik des Lichts (Germany); **Peter N. Randall,** QinetiQ Ltd. (United Kingdom); **Philippe Réfrégier,** Institut Fresnel (France); **Knut Stenerssen,** Norwegian Defence Research Establishment (Norway); **Monte D. Turner,** Air Force Research Lab. (United States)

Over the last half century, electro-optical remote sensing has developed into an essential military technology. The efficiency and efficacy of thermal imagers, light amplification sights, laser designators and rangefinders, and video trackers have been well established. New technologies now permit thermal imaging systems to operate in new spectral domains with improved efficiency. Passive RF devices can image through walls, and laser systems have moved past simple rangefinders to permit high-fidelity, three-dimensional imaging at extended ranges. Synthetic aperture optical radar has the potential to significantly extend the range of three-dimensional imaging. Laser Doppler vibrometry can now identify vehicles well beyond visual ranges. Passive hyperspectral imaging and remote laser spectroscopy can identify material types and even detect the presence of specific chemical species.

Meanwhile, fully automatic target detection, recognition, and identification have been highly desirable, but equally elusive objectives. The development of advanced and affordable signal and high-speed data processing, coupled with these new sensing technologies, now opens the opportunity for both automatic and autonomous target detection, recognition and identification. High-speed digital processing and advanced algorithms enable the fusion of the data from multiple sensors having different resolutions, perspectives and modes of operation at the pixel, feature or detection level to enhance the recognition and identification process.

These advances are coming available at a very opportune time. Low-intensity conflicts, unconventional warfare, urban combat, border security and the continued rise in terrorism has created a need for new and innovative application of these technologies in very unconventional ways. As a result, these technologies are finding their way into civil defense, law enforcement and counter-terrorism efforts.

This conference will focus on new and improved methods, techniques, and applications of electro-optical remote sensing. Recent advances which make electro-optical remote sensing technically or economically viable for an even wider variety of applications will be emphasized. However, the development of technology cannot be effective without serious consideration of the applications of that technology.

Papers on military, industrial, and commercial applications are solicited, including:

- robotics, 2D and 3D machine vision, autonomous land vehicle navigation and control, spacecraft docking system, collision avoidance for ground vehicles, aircraft and marine vessels
- robotics, 2D and 3D machine vision, autonomous land vehicle navigation and control, spacecraft docking system, collision avoidance for ground vehicles, aircraft and marine vessels
- remote detection and analysis of chemical explosives, mine-like objects, weapons of mass destruction, water and air pollution
- compact sensor systems suitable for unmanned air vehicles, umqanned ground vehicles and/or unmanned underwater vehicles
- automatic target detection, recognition and identification, signal and data processing, image segmentation, machine vision and information processing

- non-contact metrology, vibrometry, dynamics, and microdynamics measurement modeling, simulation and model validation
- surveillance sensors, short and long distance ranging systems, topographic mapping and bathymetry systems, remote sensing of vegetation, surveying and image building, emergency response (disaster management) as well as component technology and novel system architectures and applications
- surveillance sensors for detection, tracking and identification of small air vehicles (e.g., UAVs, ultralights and hang gliders)
- sensors for border security, perimeter control and intrusion detection
- security issues such as remote explosive detection, general dangerous materials, person recognition at distance, weapon detection, see-through media (vegetation, water, smoke and fire) etc.
- calibration standards, testing standards and quality assurance procedures.

The objective of this conference is to bring together engineers and scientists from academia, industry and government from around the world to exchange results and ideas for future advancement of electro-optical remote sensing.

Submit your abstract by 13 March 2017

Technologies for Optical Countermeasures (SD104)

Conference Chairs: **David H. Titterton,** UK Defence Academy (United Kingdom); **Robert J. Grasso,** EOIR Technologies (United States); **Mark A. Richardson,** Cranfield Univ. (United Kingdom)

Programme Committee: **Brian Butters,** Meon Technology Limited (United Kingdom); **Marc Eichhorn,** Institut Franco-Allemand de Recherches de Saint-Louis (France); **Ian F. Elder,** SELEX Galileo Ltd. (United Kingdom); **Markus Henriksson,** FOI-Swedish Defence Research Agency (Sweden); **David B. James,** Cranfield Univ. (United Kingdom); **Helena Jelinkova,** Czech Technical Univ. in Prague (Czech Republic); **Espen Lippert,** Norwegian Defence Research Establishment (Norway); **Gerald C. Manke,** Naval Surface Warfare Ctr. Crane Div. (United States); **Eric D. Park,** Q-Peak, Inc. (United States); **Philip Perconti,** U.S. Army Research Lab. (United States); **Manijeh Razeghi,** Northwestern Univ. (United States); **Kenneth A. Sarkady,** U.S. Naval Research Lab. (United States); **Ric H. M. A. Schleijpen,** TNO Defence, Security and Safety (Netherlands); **Dirk Peter Seiffer,** Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Ove Steinvall,** Swedish Defence Research Agency (Sweden); **Alexander M. J. van Eijk,** TNO Defence, Security and Safety (Netherlands); **Dorota S. Temple,** RTI International (United States); **Hans-Dieter Tholl,** Diehl BGT Defence GmbH & Co. KG (Germany)

Optical Countermeasures continue to evolve and expand as new threats emerge and new technologies evolve to detect and defeat this ever-present threat. Additionally, new countermeasure methods continue to evolve and improve with the development of enabling component technologies, advanced systems concepts, integration with new platforms, and innovative technology employment strategies. Combined with advances in threat detection, laser and source technology, advanced pointer/tracker architectures, signal processing, data fusion, and advanced techniques, the diversity and sophistication of these capabilities continue to grow in support of a wide range of defense application. This conference presents an opportunity for experts, and those who wish to stay current on the latest advances in enabling technology, to interact, collaborate, and foster innovation in the development of these advanced countermeasure systems.

Further, while enabling technology development is an important and exciting topic in itself, development of enabling technology can be more interesting and exciting when considered within the context of application of that technology to address a specific problem. Examining enabling and emerging technology as the device level, system level, problem level, and application level can help to define future application of this technology to both general and specific problem areas for difficult defense, security, and counter terrorism application. These new applications may create additional demands upon the supporting technologies, and, as a result, this conference will focus upon not only on enabling optical countermeasures, but also upon the practical applications of those discrete enabling technologies, and, in particular, new applications of optical countermeasure technology. Papers on military, commercial, laser/source, effects, and applications are solicited.

Papers are solicited in the following areas:
- quantum cascade lasers
- solid state and fibre lasers
- mid-IR lasers and sources
- nonlinear optics
- DIRCM systems
- countermeasures for UAV's, drones, and non-traditional platforms
- advances in lasers and nonlinear optics
- pyrotechnic, flares, and expendable countermeasures
- smokes and obscurants
- beam steering, guiding, and control
- threat detection, warning, and discrimination
- hostile fire detection, indication, and suppression
- threats and threat properties
- modelling and simulation
- aberration issues and compensation methods
- laser dazzling and effects
- mid-IR transmission fibres
- platform protection
- external/platform effects
- threat properties and characteristics
- multi-mode/multi-function operation
- closed-loop countermeasures
- non-traditional countermeasures
- laser propagation and effects
- atmospheric and background effects
- military/commercial application of technology
- enabling component/system technology
- alternative countermeasures
- novel optical devices and technology
- "homeland defence" and border protection
- other civil and military applications.

High Power Lasers: Technology and Systems, Platforms, Effects (SD105)

Conference Chairs: **Harro Ackermann,** High Energy Laser Joint Technology Office (United States); **Willy L. Bohn,** BohnLaser Consult (Germany); **David H. Titterton,** UK Defence Academy (United Kingdom)

Programme Committee: **Martin C. Richardson,** CREOL, The College of Optics and Photonics, Univ. of Central Florida (United States); **Jasbinder S. Sanghera,** U.S. Naval Research Lab. (United States)

The purpose of this conference is to provide a technical forum for the exchange of information related to aspects of high power laser research and development, and for the discussion of latest demonstrations of laser systems in militarily relevant scenarios. Numerous demonstrations have shown the capability of laser weapon systems in negating targets of military interest with the standard attributes of lasers preserved, such as precision, timelines, and minimal collateral damage. Many challenges remain and are being addressed to bring laser weapon systems to the maturity required for military field applications. Among these are power scaling, energy conversion efficiency, wavelength control, beam quality, thermal and power management, a variety of optical issues, as well as packaging and ruggedization. In addition platform considerations and special laser effects will be considered.

A viable laser weapon will provide the battlefield commander with new engagement options and capabilities in defensive or offensive scenarios, and in a variety of environments. It can potentially provide improved stand-off range, cause covert effects, handle extremely short time-line engagements, and enable precise control of damage in the target area. The requirement exists to develop efficient, effective laser weapon systems capable of depositing required amounts of energy on selected stationary or mobile targets to affect their negation.

Papers are solicited in the following broad areas of laser technology and laser development:

Lasers and Laser Architectures Suitable for Power Scaling
- gas (including DPAL), slab, disk, fiber
- efficiencies and thermal control
- beam combination: coherent, spectral, other
- packaging: size, weight, ruggedness.

Laser Demonstrators
- ground based and at-Sea Tests
- airborne applications
- lasers on UAVs

Components
- diode pumps -efficiency, wavelength, linewidth, stability, cost
- optics, coatings
- couplers, combiners, isolators
- beam directors & adaptive optics.

Novel Design in Fiber and Slab Lasers
- photonic crystal fibers, other
- eye-safe fibers, Er ,other
- single, multi-mode, gain, transport
- thermal management.

Laser Materials
- optical/mechanical/thermal
- ceramics
- manufacturing.

Platforms
- mobile
- ground based
- airborne.

Effects
- laser filamentation
- interaction with advanced materials.

Submit your abstract by 13 March 2017

Advanced Free-Space Optical Communication Techniques and Applications (SD106)

Conference Chairs: **Henry J. White,** BAE Systems (United Kingdom); **Florian Moll,** Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany)

Programme Committee: **Aniceto Belmonte,** Univ. Politècnica de Catalunya (Spain); **G. Charmaine Gilbreath,** U.S. Naval Research Lab. (United States); **Andrew R. Harvey,** Univ. of Glasgow (United Kingdom); **Dominic C. O'Brien,** Univ. of Oxford (United Kingdom); **Angélique Rissons,** Institut Supérieur de l'Aéronautique et de l'Espace (France); **Andrew M. Scott,** QinetiQ Ltd. (United Kingdom); **Zoran Sodnik,** European Space Research and Technology Ctr. (Netherlands); **Ian Underwood,** The Univ. of Edinburgh (United Kingdom); **Murat Uysal,** Ozyegin Univ. (Turkey); **Andrew C. Williams,** BAE Systems (United Kingdom)

Free-space optical communication provides high-capacity data links for defence and security. This conference will provide a forum for all professionals involved with both short and long range free-space optical techniques for communications and sensing. Subjects covered include research and technology advances in components and sub systems, requirements and analysis of present and future systems, and reviews of government and commercial programmes. One area of growing interest is the use of free-space optical techniques for highly asymmetric, high bandwidth links to small mobile platforms.

The conference will provide an overview useful to laser specialists as well as communication and optical system engineers, scientists, and managers.

Original papers are encouraged on, but are not limited to, the following topics:

- space-based systems
- terrestrial and airborne links
- short range optical interconnects
- modulated retroreflective communications
- sensor network communications
- through water optical communications
- free-space optical sensing including identification of friend or foe
- modulation techniques and formats
- pointing, acquisition, and tracking
- atmospheric effects and compensation techniques
- transmitters, receivers, and subsystems
- laboratory demonstration hardware
- cyber security implications of free space optical systems
- free space optical links to drones/UAVs
- present and future systems.

IMPORTANT DATES:

Abstract Due Date:
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Emerging Imaging and Sensing Technologies (SD107)

Conference Chairs: **Keith L. Lewis,** Sciovis Ltd. (United Kingdom); **Richard C. Hollins,** Defence Science and Technology Lab. (United Kingdom); **Gerald S. Buller,** Heriot-Watt Univ. (United Kingdom); **Robert A. Lamb,** SELEX Galileo Ltd. (United Kingdom)

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Challenges posed when sensing under the difficult conditions encountered in military environments lie at the heart of many applications of photonics. This conference brings together emerging activities in sensor and optical technologies within the context of their associated defence and potential civilian application. As interests shift towards the exploitation of autonomous platforms, unmanned systems and small satellites, there are requirements to address size, weight, power and manufacturing cost issues for those components and devices.

Emerging micro-scale and nano-scale device concepts can support the realization of low-cost, power-efficient solutions, especially those required for use in hand-held systems. For example, the understanding of plasmonics and sub-wavelength scale metallo-dielectric structures is advancing, as is the realization of metamaterials at optical wavelengths. New approaches exploiting micro and nano-technologies can also provide for unprecedented advance in the ability to control the propagation of light, providing the basis for devices capable of being exploited in adaptive optical systems. In addition, techniques to understand and improve target discrimination, to enable more accurate target tracking and provide vision through turbulent atmospheres, can benefit from the application of both pre-detector and post-detector processing techniques. The relevance of embedded software is becoming increasingly important, driving the search for improved algorithms to support the management of large streaming datasets to avoid adverse impact on communication channels in networked environments.

Improved active and passive components are required, including laser sources, modulators and photo-detectors, which in some cases can be brought together in photonic integrated circuits. New materials eg graphene are emerging, as well as those exploiting quantum-scale effects (eg quantum dots) that offer the potential for disruptive advance in many areas of photonics. Spectral filters are used widely in optics for security and defence, and technologies that offer a better trade-off between bandwidth and field of view are being sought for many applications. New optical techniques and devices can enable the processing of RF signals as well as the evolution of new techniques for extraction of patterns in data streams as would be relevant to challenges in cyber security.

In the area of chemical and biological sensing, some existing capabilities already exploit photonic devices such as quantum cascade lasers, but these can also support the detection of concealed energetic materials and the remote sensing of precursor materials.

Advanced quantum detection technologies provide the basis for wide area terrain mapping as well as quantum communications, navigation, quantum sensing, quantum-enhanced imaging and other applications, especially when there are requirements for operating in covert environments. New approaches in the area of single-photon avalanche diode (SPAD) array technologies are relevant here to allow operation across wide spectral ranges, especially in the SWIR band. New approaches to the processing of sparse photon images are also highly relevant.

Emerging Imaging and Sensing Technologies (SD107) continued

This conference seeks papers ranging from the underlying physics associated with photonic device technologies through to the exploitation of those devices in defence systems, including the following areas of activity:

- lasers, modulators, switches, filters and detectors
- materials, especially emerging 2D materials and those exploiting quantum-scale effects
- low-cost sensors for unmanned systems and small satellites
- microwave photonic devices including integration and interconnect techniques
- optical sampling and A to D converters
- metamaterials and plasmonics, both for the microwave and optical regimes
- optical signal processing including spectral synthesis
- advanced focal plane detector concepts, including on-chip optics and processing
- techniques for exploiting heterogeneous integration eg III-Vs on silicon
- architectures and techniques for discriminative imaging, including active imaging and imaging through turbulence
- computational imaging techniques and compressive sensing, including image reconstruction from under-sampled data sets (sparse imaging), computational multispectral imaging using mosaic filters and SAR techniques
- devices and architectures to support the evolution of quantum sensing, imaging, communications and navigation
- exploitation of low-cost imaging techniques into civilian applications such as those relevant to healthcare
- micro-optical-electro-mechanical systems
- algorithms and software for improving sensor exploitation
- novel approaches to micro- and nanophotonics
- devices for chemical and biological sensing exploiting photonic techniques
- optical components including coatings, films, and devices for control of spectral and polarimetric characteristics
- bio-optics, bioinspiration and biometric techniques.

IMPORTANT DATES:

Abstract Due Date:
13 MARCH 2017

Manuscript Due Date:
14 AUGUST 2017

Millimetre Wave and Terahertz Sensors and Technology (SD108)

Conference Chairs: **Neil A. Salmon,** MMW Sensors Ltd. (United Kingdom); **Sherif Sayed Ahmed,** Rohde & Schwarz GmbH & Co. KG (Germany)

Programme Committee: **Amir Abramovich,** Ariel Univ. (Israel); **Hakan Altan,** Middle East Technical Univ. (Turkey); **Nicholas J. Bowring,** Manchester Metropolitan Univ. (United Kingdom); **Stephan Dill,** Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Charmaine Cisneros Franck,** NASA Langley Research Ctr. (United States); **Marcin Kowalski,** Military Univ. of Technology (Poland); **Wojciech Knap,** Univ. Montpellier 2 (France); **Steven R. Murrill,** U.S. Army Research Lab. (United States); **Markus Peichl,** Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Douglas T. Petkie,** Wright State Univ. (United States); **Christopher A. Schuetz,** Phase Sensitive Innovations, Inc. (United States); **Vyacheslav A. Trofimov,** Lomonosov Moscow State Univ. (Russian Federation); **Vincent P. Wallace,** The Univ. of Western Australia (Australia)

Objectives
The conference provides a technical forum for increased awareness of novel sensor architectures, enabling component technologies, signal and image processing, phenomenology and applications over the band from 10 GHz to 10 THz. Market awareness and user requirements understood in the forum follow the changing drivers from the world of security and defence. Unrelenting tenacity and innovation of members is establishing the unique selling propositions of sensors in this band. European Framework programs seek means to identify materials through innovative use of active, passive, spectral and spatial signatures. Increased demands for a more widespread deployment of systems to screen people together with their bags increases the potential market size. This will only be realised if innovative solutions enable screening of walking subjects for explosives and weapons, without the need to remove thicker items of clothing or divest items from pockets. Systems to monitor borders for drones, and to screen vehicles for stowaways at border crossings are in demand. Ever present is the requirement from aviation security for highly effective screening for persons entering departure lounges.

The millimetre wave band (10 GHz -300 GHz)
The millimetre wave band continues to demonstrate its capability for all-weather sensing by providing recognisable imagery in air, sea and land environments, through fog, cloud, rain and smoke. Likewise the transparency of clothing and fabric in this band is leading to demonstrators and prototypes for stand-off personnel scanning, vehicle screening and full-body portal imagers, with shoe and baggage scanning variants. Novel active techniques from lower frequency bands, such as late time response (LTR) analysis, ultra-wide band (UWB) and synthetic aperture radar (SAR), and full polarimetric sensing, are now being implemented in this band for target recognition. Systems are now becoming more compact through the use of emerging electronic imagers, which sample electric fields using sparse arrays, and generate imagery using digital signal processors (DSP), as opposed to using lens and mirror based focusing optics. These emergent architectures are enabling the classical techniques of (optical) holography and (radio astronomy) aperture synthesis to be exploited in novel active and passive systems. These more compact systems may allow sensor deployment on drones.

The terahertz band (300 GHz to 10 THz)
The terahertz band is attracting increased interest from military, security and medical fields largely due to the demonstration of spectral signatures for recognition (in the security and medical fields) and the generally far range capabilities for stand-off security screening. Spectral signatures of threats are becoming well known, but challenges exist in novel spectrometer design to exploit these for security screening purposes. Machine recognition techniques are being used increasingly to provide rapid threat recognition, be it either on spectral signatures or imagery, also helpful in privacy protection. A number of systems are also demonstrating capabilities for the screening of postal mail, exploiting the semi-transparency of packaging materials in this band. Recent developments in the efficiency and compactness of closed cycle coolers are enabling cryogenic detectors to deliver superior noise performance in imagers. This has led to the emergence of high performance imagers for stand-off and portal screening scenarios, exploiting knowhow from the astronomy community.

Biological and medical applications
Research into biological and medical applications

Millimetre Wave and Terahertz Sensors and Technology (SD108) continued

is gradually revealing how 10 GHz to 10 THz band may be exploited. There have been long standing questions about the nature of the interactions between radiation in this band and biological systems at the cellular, protein and DNA level. In biological systems there will be mode conversions between electro-magnetic, electrostatic and acoustic waves, and relaxation and resonance phenomena that lie beneath the dominating effects of water. Index matching will also be a key factor to achieving sensitivity, as human tissue, has a large complex refractive index. Whether this band is effective at determining malignancy of tissue just below the skin surface (not apparent in the visible band) or if wound inspection under bandages is possible are still open questions. This forum invites speakers from these communities to enlighten the aerospace community, in order to accelerate technology development in the terahertz and millimetre wave band.

Broad application areas

Papers are solicited in the following broad areas of sensors, component technologies and applications:

- millimetre and THz radiometric and radar imagers and sensors
- concealed weapons and contraband detection
- stand-off millimetre wave threat warning systems
- handheld, portal and stand-off screening systems
- sensors using drones
- sensors for border protection
- biomedical imaging (micro-Doppler & spectral breath analysis)
- enabling technology (mixers, detector, sources, filters, ADCs)
- novel materials (stealth, chiral, left-handed)
- image and signal processing
- novel image reconstruction techniques
- resolution enhancement/super-resolution
- sensor fusion and multiple sensor systems
- modelling, simulation and phenomenology
- nondestructive testing for industry
- postal mail and package screening
- vehicle screening of stowaways
- driving/navigation on land and sea
- aircraft landing in poor/no-visibility and ground taxiing
- adverse weather intelligence, surveillance and reconnaissance imaging
- non-imaging military applications
- (ballistic) missile (launch)/warhead detection/tracking/seeking
- civil/commercial remote sensing
- THz tomography
- THz microscopes
- THz spectroscopy and signatures
- THz secure communications.

Optical Materials and Biomaterials in Security and Defence Systems Technology (SD109)

Conference Chairs: **Roberto Zamboni,** Istituto per la Sintesi Organica e la Fotoreattività (Italy); **François Kajzar,** Univ. Politehnica of Bucharest (Romania); **Attila A. Szep,** Air Force Research Lab. (United States); **Katarzyna Matczyszyn,** Wroclaw Univ. of Technology (Poland)

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This conference will highlight state of the art and emerging nano-bio materials and devices and their role in the development of new security and defence systems. The aim is to review materials and device R&D, in progress, in both Europe and the USA, based on nano-bio materials technologies for photonic, electronic and optoelectronic applications and to promote closer collaboration and awareness of common objectives and potential advances. It will also seek to bring together researchers from different materials science, physics, chemistry, biology and engineering areas. The conference should be of interest to research scientists and engineers, project managers, senior scientific staff, materials producers and device manufacturers in Europe and the USA.

Papers should focus on short technology reviews or recent results of new materials processes and devices, with particular application to security and defence technologies. The materials and devices may be based on nano-, bio- and metamaterials-based technologies including inorganics, organics, biopolymers, and hybrids as well as devices that take advantage of these materials technologies.

Papers may address practical, theoretical and modeling aspects of the subject. Fields of study will include:

- organic, inorganic and hybrid-based photonics and optoelectronics
- organic inorganic and hybrid-based laser and amplifier materials
- smart materials, systems and devices for sensing and diagnostic
- organic and inorganic-based photodetectors
- organic and inorganic-based displays
- nanophotonic and nano-optoelectronics structures
- photonic bandgap materials
- biomolecular recognition materials
- biopolymer-based photonics
- biotronics
- biomaterials
- plasmonic structures and applications
- metamaterials and metamaterials-based devices
- nonlinear optical materials and devices
- predictive modeling of materials parameters for specific applications
- electroluminescent materials and devices
- photorefractive and photochromic materials and processes

Optical Materials and Biomaterials in Security and Defence Systems Technology (SD109) continued

- polymer optical waveguides and fibres
- multiphoton processes
- charge transport in organic materials
- simulation of physical processes in molecular media
- organic materials for night vision and border control
- biopolymers for display and camouflage
- biolasers.

IMPORTANT DATES:

Abstract Due Date:
13 MARCH 2017

Manuscript Due Date:
14 AUGUST 2017

Counterterrorism, Crime Fighting, Forensics and Surveillance (SD110)

Conference Chairs: **Henri Bouma,** TNO (Netherlands); **Felicity Carlysle-Davies,** Forensic Science SIG KTN (United Kingdom); **Robert James Stokes,** Cobalt Light Systems Ltd. (United Kingdom); **Yitzhak Yitzhaky,** Ben-Gurion Univ. of the Negev (Israel)

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This conference brings together emerging technologies for countering terrorism and crime and providing support to forensics, surveillance, security and defence forces. It addresses the big issue of maintaining security and safety by detecting and identifying dangerous, hidden and camouflaged materials and recognizing suspicious behavior from video imagery, all the while working within a legal and moral framework that respects individuals' rights.

Part 1: Detection and identification of materials
Sensors for explosives, narcotics, and chemical and biological warfare agents must provide a prompt alert with fast, wide area coverage and must cope with unexpected hiding places. If they are to be routinely deployed, such sensors must offer accurate detection and low false alarm rates, use few consumables and need little operator involvement. Optical sensing now extends from UV, through visible and infrared, into terahertz and RF wavelengths, offering novel imaging systems with increased penetration through barriers, and spectroscopic techniques that can help characterize suspicious materials.

Part 2: Computer vision and video content analysis
The threat from people's activities can be reduced by identifying suspicious behaviour and by tracking individuals across multiple TV cameras. Increased computing power and advanced algorithms are expected to help in difficult scenarios such as crowded environments (face and iris recognition or other biometrics), and longer range imagery through turbulent atmospheres. Improved handover techniques from TV imaging will reduce the burden placed on local sensors.

This conference provides a forum for researchers, product and system engineers and military and government officials to present and discuss the latest developments in optically-based sensor and diagnostic technologies and their applications. Original papers are sought on, but not restricted to, the following topics:

- detection and identification of explosives, narcotics, chemical and biological materials
- spectroscopy, LIBS and Raman, multispectral and imaging techniques
- forensic and surveillance sensors and systems
- biometrics, security screening and systems for border security
- computer vision and video content analysis for security applications
- person and object detection, tracking and re-identification in video
- suspicious and anomalous behavior and events detection in video imagery
- techniques for long-range and wide-area sensing and surveillance
- system concepts for autonomous sensor networks and multi-sensor fusion
- big data analytics and deep learning for security.

Quantum Technologies and Quantum Information Science (SD111)

Conference Chairs: **Mark T. Gruneisen,** Air Force Research Lab. (United States); **Miloslav Dusek,** Palacky Univ. Olomouc (Czech Republic); **John G. Rarity,** Univ. of Bristol (United Kingdom)

Programme Committee: **Paul M. Alsing,** Air Force Research Lab. (United States); **Jan Bouda,** Masaryk Univ. (Czech Republic); **Robert W. Boyd,** Univ. of Ottawa (Canada); **Gerald S. Buller,** Heriot-Watt Univ. (United Kingdom); **Ryan M. Camacho,** Sandia National Labs. (United States); **Marcos Curty,** Univ. de Vigo (Spain); **Michael L. Fanto,** Air Force Research Lab. (United States); **John D. Gonglewski,** Air Force Research Lab. (United States); **Gregory S. Kanter,** NuCrypt LLC (United States); **Prem Kumar,** Northwestern Univ. (United States); **Norbert Lütkenhaus,** Univ. of Waterloo (Canada); **Vadim V. Makarov,** Univ. of Waterloo (Canada); **Ronald E. Meyers,** U.S. Army Research Lab. (United States); **Momtchil Peev,** Austrian Research Ctrs. GmbH - ARC (Austria); **Renato Renner,** ETH Zürich (Switzerland); **Andrew J. Shields,** Toshiba Research Europe Ltd. (United Kingdom); **Rupert Ursin,** Austrian Academy of Sciences (Austria)

The purpose of this conference is to provide a technical forum for discussions on the latest developments in quantum technologies and quantum information science. Quantum information is a broad area of study regarding the information processing tasks that can be accomplished using quantum mechanical systems. Its applications include quantum computation, quantum communication, and quantum cryptography. Quantum technology refers more broadly to techniques and applications that are based on principles of quantum mechanics where commercial development is now realizable through recent advancements in the fields of cold atoms, matter-wave quantum interferometers, quantum entanglement, squeezed states of light, and single-photon sources and detectors. These advancements open new perspectives in the simulation of complex physical systems, precise sensing, and imaging. Applications include quantum accelerometers, gravimeters, magnetometers, and precise clocks.

Quantum technologies have important implications for security and defence. Progress in quantum computing threatens classical techniques for encryption whose security relies on computational complexity. Quantum-physics-based approaches to key sharing however are theoretically unbreakable. Quantum cryptographic systems are already commercially available. There are, however, many challenges to developing quantum technologies to a position where they can provide robust capabilities in defence applications. These include the development of quantum networks, fiber and free-space quantum channels, photon sources and detectors, integrated photonics for quantum circuits, chip-scale atomic clocks, quantum memories, quantum gates, quantum relays, quantum repeaters, quantum inertial navigation systems, etc.

Original papers are sought on, but not restricted to the following categories and topics.

Cybersecurity in Post-Quantum World
- quantum key distribution and quantum data encryption
- quantum digital signatures
- finite-key security analysis for general attacks
- device-independent security proofs
- security proofs for DV and CV QKD systems
- analysis of side-channel attacks and other loopholes
- certification of QKD devices
- quantum-cryptography primitives and protocols.

Quantum Hacking
- implementation loopholes
- quantum computing threats to cryptography.

Quantum Channels and Quantum Networks
- quantum hubs and quantum communication networks
- earth-satellite and satellite-satellite links
- multi-channel and multi-level encoding techniques
- photon orbital angular momentum
- spatial, temporal, and frequency encoding and multiplexing techniques.

Quantum Simulators
- quantum simulators of complex systems
- applications in solid state physics and chtry
- technologies for quantum simurs.

Algorithms and Quantum computation
- quantum computation theory and implementations
- quantum algorithms
- quantum randomness extractors.

Contributing Technologies
- cold atom technologies
- single-photon sources, detectors, and filters
- entanglement sources and detection
- space-qualified quantum sources and detectors
- random number generation
- random number generation
- probabilistic qubit amplifiers and their use in QKD
- quantum memories, gates, relays, and repeaters
- signals processing and computer architectures for quantum cryptographic systems
- integrated photonics for quantum circuits.

Related Fundamental Physics
- tests of quantum theory.

TECHNICAL PROGRAMME

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