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2019

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REMOTE SENSING

Palais de la Musique et des Congrès Strasbourg, France

Conferences
9-12 September 2019

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Focused on optical science technologies for advanced security and defence systems

Present your work at the event for engineers, scientists, programme managers and policy makers for the latest developments in sensing, data and signal analysis, optronics, quantum science, optical technologies, and funding programmes.

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The Organising Committee of the 16th 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 26th 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.

New challenges continue to emerge. While artificial intelligence has seen many papers in the past at this symposium, for 2019 we launch a new conference: Artificial Intelligence and Machine Learning in Defence Applications. For this conference we will arrange for joint sessions with the other conferences dealing with applications of artificial intelligence.

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 2019 where opportunities abound for combining cutting-edge science and technology with the beauty of the city of Strasbourg.

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In addition to providing membership services, SPIE Europe Ltd. organises and manages internationally recognised conferences, education programmes, and technical exhibitions featuring emerging technologies in optics and photonics.

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COOPERATING ORGANISATIONS

EOS

Cranfield University
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); Stacy E. Howington, U.S. Army Engineer Research and Development Ctr. (USA); Katrin Idla, Tallinn Univ. of Technology (Estonia); Hans M. Karlis, Swedish Defence Research Agency (Sweden); Luc Labarre, ONERA (France); Alexander Schwarz, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); Peter Wellig, Armasuisse (Switzerland)

This conference deals with algorithmic and experimental approaches for distinguishing the weak signals of targets from a cluttered background, form sensors 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 and signature monitoring
- signature reduction methods and materials
- 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
- human observer performance.
- application of big data in target-background discrimination.

Save the date

**ABSTRACTS DUE:** 13 March 2019

**AUTHOR NOTIFICATION:** 24 May 2019

The contact author will be notified of acceptance by email.

**MANUSCRIPT DUE DATE:** 14 August 2019

PLEASE NOTE: Submissions imply the intent of at least one author to register, attend the conference, present the paper as scheduled, and submit a full-length manuscript for publication in the conference proceedings.

Submit your abstract today: spie.org/SD19call
Electro-Optical and Infrared Systems: Technology and Applications (SD102)

Conference Chairs: Duncan L. Hickman, Tektonex Ltd. (United Kingdom); Helge Bürsing, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

Programme Committee: Christopher C. Alexay, StingRay Optics, LLC (USA); Gisele Bennett, Georgia Institute of Technology (USA); 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); 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-optical (EO) and infrared (IR) systems are key to providing the enhanced capability needed by military forces to meet the current and emerging challenges created through an increasingly difficult and complex range of operational conditions. Such enhanced operational capability must often be delivered against commercial demands for lower costs and reduced timescales together with operational requirements for size weight, and power (SWaP) reductions. This conference will address current and emergent sensor technology and system developments which will deliver the required future capability of EO/IR systems. It will consider a wide-range of applications across the maritime, land, and air domains together with a diverse range of platforms such as dismounted soldier sensors, UAVs and drones, robotic platforms, and multi-sensor systems.

The performance challenges faced by future military systems will continue to evolve and grow. To address these challenges, EO/IR system designers will need to draw upon the ongoing developments in underpinning technologies such as new materials, focal plane arrays, image processing, data fusion, and emergent sensor concepts such as spectral processing, computational imaging, and polarimetry. Modelling and simulation is increasingly becoming an enabler for maximizing performance and optimizing operational adaptability and its interaction with trials and validation is a subject of topical concern.

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.

Processing of sensor information has become a vital component of EO/IR sensor systems for display-driven, semi-autonomous, and autonomous applications. The timely extraction and presentation of pertinent information in a usable format is the ultimate goal in most developments, although the design flexibility to support hardware upgrades and meet emergent operational needs must be considered. Dual and multi-sensor system designs provide additional information, and offer increased performance under a wider variety of conditions. The combination of such sensor information to provide both increased performance
and robustness continues to present many design challenges despite the ongoing research into data fusion technology.

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.

The innovation required to meet these future challenges will be drawn from a broad spectrum of organisations ranging from government laboratories, through international companies to SMEs. This conference will provide a technology and applications forum for EO/IR research and development teams, academia, and business and government stakeholders. Contributions from a diverse range of disciplines such as systems engineering, optical design, sensor manufacture, material science, algorithms and software, modelling and simulation are also sought. Presentations are encouraged on dual-use applications, and for active and passive technologies systems 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
• imaging through the atmosphere
• signal and image processing
• autonomous processing including detection, tracking and classification
• data fusion technology including image fusion and sensor fusion concepts
• modelling and analysis of EO/IR systems and sub-systems
• test, verification, and validation techniques
• 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
• sensor demonstrators and prototypes
• sensor trials and performance evaluation
• system engineering approaches.
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 counterterrorism 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
- 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, unmanned 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)
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- 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.

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.

See website for SPIE Remote Sensing 2018 Best Student Paper Award Winners.
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, Joint Directed Energy Transition Office (USA); Willy L. Bohn, BohnLaser Consult (Germany); David H. Titterton, UK Defence Academy (United Kingdom)

Programme Committee: Pierre Bourdon, ONERA (France); Martin C. Richardson, CREOL, The College of Optics and Photonics, Univ. of Central Florida (USA); Jasbinder S. Sanghera, U.S. Naval Research Lab. (USA)

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**
  - advanced gas lasers (including DPAL, rare gas)
  - solid state lasers, slabs, disks, fibers
  - 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.
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)

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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 communications techniques for point-to-point links and networks. Subjects covered include research and technology advances in components and sub systems, wave propagation, requirements and analysis of present and future systems, reviews of government and commercial programs, standardization activities, and tutorial talks. 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:

- terrestrial, airborne and space links
- through water optical communications
- short range optical interconnects
- modulation techniques and formats
- pointing, acquisition, and tracking
- atmospheric effects and compensation techniques
- transmitters, receivers, and subsystems
- modulated retroreflective communications
- sensor network communications
- laboratory demonstration hardware
- cyber security implications of free space optical systems
- quantum enhanced free-space optical communications
- free space optical links to drones/UAVs
- present and future systems.
Emerging Technologies (SD107)

Conference Chairs: Gerald S. Buller, Heriot-Watt Univ. (United Kingdom); Richard C. Hollins, Defence Science and Technology Lab. (United Kingdom); Robert A. Lamb, SELEX Galileo Ltd. (United Kingdom); Martin Laureznis, Institut Franco-Allemand de Recherches de Saint-Louis (France)

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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 microscale and nanoscale 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 the 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.

(SD107 continued next page)
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
- additive manufacturing techniques
- 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
- nanophotonics including plasmonic filters, optical antennae, moth eye coatings and ultra-thin lenses
- 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.

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CALL FOR PAPERS

Millimetre Wave and Terahertz Sensors and Technology (SD108)

Conference Chairs: Neil A. Salmon, MMW Sensors Ltd. (United Kingdom); Frank Gumbmann, Rohde & Schwarz GmbH & Co. KG (Germany)

Programme Committee: Amir Abramovich, Ariel Univ. (Israel); Sherif Sayed Ahmed, Rohde & Schwarz GmbH & Co. KG (Germany); Hakan Altan, Middle East Technical Univ. (Turkey); Nicholas J. Bowring, Univ. of Huddersfield (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 a raised 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 and 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. Lower specification screening systems are demanded from governments for the screening of people entering, public and private buildings, arenas, transport networks and schools.

THE MILLIMETRE WAVE BAND (10 GHZ TO 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. Efficient architectures for high-speed digital cross-correlators are now evolving to carry aperture synthesis passive millimetre wave imagers through to the next generation of all-seeing, surround imaging, coplanar technology screening portals. 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

(SD108 continued next page)
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 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.

**Save the date**

**ABSTRACTS DUE:** 13 March 2019

**AUTHOR NOTIFICATION:** 24 May 2019

The contact author will be notified of acceptance by email.

**MANUSCRIPT DUE DATE:** 14 August 2019

**PLEASE NOTE:** Submissions imply the intent of at least one author to register, attend the conference, present the paper as scheduled, and submit a full-length manuscript for publication in the conference proceedings.
CALL FOR PAPERS

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. (USA)

Programme Committee: Chantal Andraud, Ecole Normale Supérieure de Lyon (France); André-Jean Attias, Univ. Pierre et Marie Curie (France); Carrie M. Bartsch, Air Force Research Lab. (USA); Werner J. Blau, Trinity College Dublin (Ireland); Fabrice Charra, Commissariat à l’Énergie Atomique (France); Beata J. Derkowska, Torun Univ. (Poland); James G. Grote, Air Force Research Lab. (USA); Emily M. Heckman, Air Force Research Lab. (USA); Loïc Mager, Institut de physique et chimie des matériaux de Strasbourg (France); Ana-Maria Manea-Saghin, Univ. Politehnica of Bucharest (Romania); Antoni C. Mitus, Wroclaw Univ. of Technology (Poland); Jaroslaw Mysiwiec, Wroclaw Univ. of Technology (Poland); Jacek Niziol, AGH Univ. of Science and Technology (Poland); Yoshiko Okada-Shudo, The Univ. of Electro-Communications (Japan); Fahima Ouchen, Air Force Research Lab. (USA); Agnieszka Pawlicka, Instituto de Química de São Carlos (Brazil); Luana Persano, Istituto Nanoscienze (Italy); Ullrich Pietsch, Univ. Siegen (Germany); Ileana Rau, Univ. Politehnica of Bucharest (Romania); Ifor D. W. Samuel, Univ. of St. Andrews (United Kingdom); Niyazi Serdar Sariciftci, Johannes Kepler Univ. Linz (Austria); Kenneth D. Singer, Case Western Reserve Univ. (USA)

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 and inorganic-based photodetectors
- organic and inorganic-based displays
- nanophotonic and nano-optoelectronics structures
- photonic bandgap materials
- biomolecular recognition materials
- biopolymer-based photonics
- bionanotechnology
- 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
- 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
- electrospinning
- organic field effect transistors.
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 CBRNE materials
- spectroscopy, Raman/LIBS and multi-spectral imaging
- computer vision and image/video content analysis
- person and object detection and tracking
- big data analysis and deep learning
- autonomous sensors and mobile robots
- action recognition and behavior analysis in video imagery
- forensic and surveillance sensors and systems
- biometrics, security screening and systems for border security
- techniques for long-range and wide-area sensing and surveillance.

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CALL FOR PAPERS

Quantum Technologies and Quantum Information Science (SD111)

Conference Chairs: Mark T. Gruneisen, Air Force Research Lab. (USA); Miloslav Dusek, Palacký Univ. Olomouc (Czech Republic); Paul M. Alsing, Air Force Research Lab. (USA); John G. Rarity, Univ. of Bristol (United Kingdom)

Programme Committee: Konrad Banaszek, Univ. of Warsaw (Poland); Jan Bouda, Masaryk Univ. (Czech Republic); Robert W. Boyd, Univ. of Ottawa (Canada); Michael Brodsky, U.S. Army Research Lab. (USA); Gerald S. Buller, Heriot-Watt Univ. (United Kingdom); Ryan M. Camacho, Sandia National Labs. (USA); Marcos Curty, Univ. de Vigo (Spain); Michael L. Fanto, Air Force Research Lab. (USA); John D. Gonglewski, European Office of Aerospace Research and Development (United Kingdom); Gregory S. Kanter, NuCrypt LLC (USA); Prem Kumar, Northwestern Univ. (USA); Norbert Lütkenhaus, Univ. of Waterloo (Canada); Vadim V. Makarov, Univ. of Waterloo (Canada); Ronald E. Meyers, U.S. Army Research Lab. (USA); Momtchil Peev, Austrian Research Ctrs. GmbH - ARC (Austria); Renato Renner, ETH Zürich (Switzerland); Andrew J. Shields, Toshiba Research Europe Ltd. (United Kingdom); Kathy-Anne Soderberg, Air Force Research Lab. (USA); 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.

(SD111 continued next page)
## QUANTUM SENSORS AND CLOCKS: OVERCOMING CLASSICAL LIMITS
- quantum accelerometers, gravimeters, and gyroscopes
- quantum magnetometers
- advanced interferometric sensors using squeezed light
- quantum technologies for precise timing
- quantum imaging.

## QUANTUM SIMULATORS
- quantum simulators of complex systems
- applications in solid state physics and chemistry
- technologies for quantum simulators.

## ALGORITHMS AND QUANTUM COMPUTATION
- quantum computation theory and implementations
- topological quantum computation
- fault-tolerant quantum computation
- quantum algorithms
- quantum software and quantum programming languages
- quantum randomness extractors
- quantum error correction.

## CONTRIBUTING TECHNOLOGIES
- cold atom technologies
- single-photon sources, detectors, and filters
- entanglement sources and detection
- space-qualified quantum sources and detectors
- 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
- quantum causal structures.

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CALL FOR PAPERS

Unmanned Sensors and Systems and Countermeasures (SD112)

Conference Chair: Markus Mueller, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

Programme Committee: Marc Châteauneuf, Defence Research and Development Canada, Valcartier (Canada); Frank Christnacher, Institut Franco-Allemand de Recherches de Saint-Louis (France); Michael Teutsch, HENSOLDT Optronics GmbH (Germany); Susanne Winderl, IABG mbH (Germany)

This conference will offer an opportunity to explore and promote advances in aspects of unmanned and unattended sensors and systems, their potential uses and countermeasures to defend against small unmanned systems (with a high level of avoidance of collateral damage). The scenarios are both military (peacetime and wartime) and civilian (law enforcement, crime fighting, counter terrorism and first responder tasks, protection of critical infrastructure and mass events, etc.) The objectives of this conference are to foster interest by the potential customer community, and partnerships, and technology sharing by the research, development, and acquisition communities.

Papers are solicited related to countermeasures in the following topic areas:

• (multi-) sensors (radio, visual-optical, infrared, laser, RADAR, acoustic, etc.) for detection, recognition and tracking of small UAVs, UGVs, and UUVs
• algorithms and machine learning approaches for sensor fusion, detection, recognition, tracking of unmanned systems
• defense against small unmanned systems in very sensitive scenarios - how to avoid collateral damage
• intelligent collaboration of Counter-UAV/UGV/UUV systems
• possible countermeasures (e.g. capturing, spoofing, jamming, blinding, nets, water cannons, firearms, etc. – no high power lasers, missiles, anti-aircraft systems)

Papers are solicited related to unmanned ground, air and ocean sensor systems, vehicles and associated sensor networks in the following topic areas:

• intelligent vehicle systems including embedded world and vehicle realtime control models and architectures
• machine perception, path planning and navigation
• intelligent vehicle collaboration and coordination with other vehicles and fixed sensor systems
• vehicle mobility, motion control, and novel mobility platforms
• sensor deployment and recovery technologies for unmanned vehicle operations
• vehicle payloads and mission execution
• biologically inspired air, ground and undersea robotic and sensor systems
• vehicle sensor configurations for enhanced mobility, collaboration, and perception
• sensor and vehicle communication systems (e.g. underwater acoustic comms, RF, laser, etc.)
• commercial and civilian UAVs, UGVs, and UUVs.

Papers are solicited related to unattended ground and ocean sensors in the following areas:

• application concepts for unattended sensors (e.g. force protection, treaty verification, cooperative monitoring, drug/law enforcement, counter-terrorism, border protection, etc.)
• unattended ground sensor technologies for both ground (built up and open terrain) and ocean/littoral environments including imaging, seismic, acoustic, magnetic, turbulence, chemical and biological sensors and related sensor systems
• smart sensor, computationally efficient signal and data processing algorithms (e.g. detection, classification, ID, tracking, data fusion, data compression, and power management)
• ground and ocean sensor platform developments and system-level technologies and concepts (e.g. modularity, concealment, power management and storage, platform management, emplacement)
• biologically inspired sensors
• novel power and energy conversion systems for sensors (e.g. solar, wind, ocean, microbial, motion parasitic).
Advanced Manufacturing Technologies for Micro- and Nanosystems in Security and Defence (SD113)

Conference Chairs: Andrea Camposeo, Istituto Nanoscienze, CNR (Italy); Yuris Dzenis, Univ. of Nebraska-Lincoln (USA); Maria Farsari, Foundation for Research and Technology-Hellas (Greece); Luana Persano, Istituto Nanoscienze-CNR (Italy)

Programme Committee: Tommaso Baldacchini, Newport Corp. (USA); Lynda E. Busse, U.S. Naval Research Lab. (USA); John T. Fourkas, Univ. of Maryland, College Park (USA); Jesper Glückstad, Technical Univ. of Denmark (Denmark); Andreas Heinrich, Hochschule Aalen - Technik und Wirtschaft (Germany); Natalia Vladimirovna Kamanina, S.I. Vavilov State Optical Institute (Russian Federation); Eunkyoung Kim, Yonsei Univ. (Korea, Republic of); Norihisa Kobayashi, Chiba Univ. (Japan); Beata Luszczyńska, Lodz Univ. of Technology (Poland); Andreas Ostendorf, Ruhr-Univ. Bochum (Germany); Alberto Piqué, U.S. Naval Research Lab. (USA); Dario Pisignano, Univ. of Pisa (Italy); Bastian E. Rapp, Karlsruher Institut für Technologie (Germany); Haizheng Zhong, Beijing Institute of Technology (China)

Advanced systems based on micro- and nanostructures are essential to the development of next generation imaging, sensing, light amplification and energy harvesting devices for security and defence applications. These systems are expected to be portable, wearable, self-powering and self-healing, while featuring high sensitivity and selectivity, intrinsic signal amplification and fast characteristic response times. Current micro- and nanotechnologies have enabled a novel range of structured and architectured materials, which possess enhanced properties compared to their bulk equivalent. Such structures can be realized by optical and electron beam lithographies, advanced chemical synthesis and deposition processes, soft lithographies, electrospinning, biomimetic fabrication approaches, among the others. In addition, the availability of technologies allowing for precise manipulation and assembly of micro- and nanostructures, combined with the emerging additive manufacturing technologies, will enable the fabrication of high-performance functional integrated systems, which can be produced by remotely-controlled and autonomous equipment even in harsh and dangerous environments.

This conference aims at establishing an interdisciplinary platform for researchers and engineers both from academy and industry to exchange knowledge in new and cutting-edge manufacturing technologies for micro- and nanostructured devices, with potential application in security and defence. The conference will emphasize those approaches allowing multi-material processing, the realization of multifunctional components and fully functional 3-dimensional (3D) systems. Original technical and scientific papers are solicited on, but are not limited to, the following topics:

- laser micro- and nanomachining for security and defence
- additive manufacturing of metals, alloys and multi-materials
- bio-inspired fabrication technologies
- 3D printing of functional devices for security and defence
- synthesis of nanostructured and 2D materials
- production of polymer and hybrid nanofibers for sensing and energy harvesting systems
- soft lithographies pushed to sub-micron scale, or applied to unconventional materials
- technologies for assembly and manipulation of nanostructured components
- microscale devices for manipulation and analysis of fluids
- advanced fabrication approaches for wearable sensors and electronics
- methods for gas and energy storage
- autonomous micro- and nanofabrication systems
- real-time monitoring and quality control of advanced fabrication systems
- technologies for miniaturized imaging devices for security applications
- systems for amplification of low-intensity optical signals.
CALL FOR PAPERS

Artificial Intelligence and Machine Learning in Defense Applications (SD114)

Conference Chair: Judith Dijk, TNO Defence, Security and Safety (Netherlands)

Programme committee: Fabrizio Berizzi, European Defence Agency (Belgium); Michel Honlet, Airbus Defence and Space (France); Christopher R. Bell, Defence Science and Technology Lab. (United Kingdom); David K. J. Gustafsson, FOI-Swedish Defence Research Agency (Sweden); Sidonie Lefebvre, ONERA (France)

The main application of military imaging systems is situational awareness: knowing who and what is in the vicinity and what their behavior is. Image analysis techniques support in the key tasks that enable situational awareness: detection, tracking (follow), classification, identification and behavior recognition of targets or objects, while avoiding too many false alarms or missed detections. Artificial Intelligence and Machine Learning are increasingly used to assist in these tasks, as the amount of sensor data increases while there are fewer operators and camera operators available.

This conference will focus on technology development on artificial intelligence and machine learning techniques for automatic and machine assisted EO/IR image analysis for defense applications, including image enhancement, target detection, classification, identification, tracking and threat assessment. Both model based approaches and data driven methods such as neural nets are considered.

As for civil applications the algorithms must be able to deal with noisy data and varying conditions.

One of the additional challenges encountered, compared to civilian/commercial applications, is the fact that for defense applications often not much operational data is available for training, testing and evaluation. This is especially the case for event detection, where the interesting events often occur very seldom. For defense applications, the technology should also be robust to inputs that are adversarial examples, i.e. inputs that are intentionally designed to cause the model to make a mistake. The processing should also be able to detect, classify and identify camouflaged objects.

Evaluation and performance prediction of these algorithms for varying circumstances is also part of this conference.

Original papers are solicited in, but not limited to, the following topical areas:

**IMAGE ANALYSIS TECHNIQUES**
- automatic target classification, recognition and identification, automatic target detection
- automatic tracking
- computational imaging
- image enhancement (denoising, superresolution, filtering etc)
- inverse problems
- colorization.

**ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**
- using synthetic data for training
- machine learning for EO/IR imaging systems
- transfer learning
- different learning strategies such as semi-supervised learning, transfer learning and generative adversarial learning.

**ROBUSTNESS, EVALUATION AND PERFORMANCE PREDICTION**
- robustness of algorithms to different conditions
- robustness of algorithms against adversarial examples
- transparency and explainability of algorithms.

**DEFENCE APPLICATIONS FOR THESE TYPES OF TECHNIQUES**
- maritime situational awareness
- compound security
- route clearance
- reconnaissance and surveillance
- vehicle situation awareness
- route planning
- improved visualization.
GENERAL INFORMATION

EVENT DATES: 9–12 September 2019
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TECHNICAL PROGRAMME

Both the online conference content, as well as the programme pdf, will be available in spring 2019.

CONFERENCE REGISTRATION

Registration information and online registration will be available spring 2019. All participants, including invited speakers, contributed speakers, session chairs, co-chairs, and committee members must pay a registration fee.

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Review travel, transportation, and hotel information online. Hotel information will be available in spring 2019.

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

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