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16-19 September 2024

Edinburgh International Conference Centre
(EICC)
Edinburgh, United Kingdom

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SPIE Sensors + Imaging combines two of Europe's best photonics conferences—SPIE Remote Sensing and SPIE Security + Defence

Plan to participate in the premier yearly European event that showcases the latest sensor and photonic technologies for imaging and monitoring the Earth's atmosphere and environment, as well as sensor technologies that address homeland security, defence, and counterterrorism.

Review the topic areas and see where your research fits best—submit an abstract and plan to join your colleagues in Edinburgh in April.



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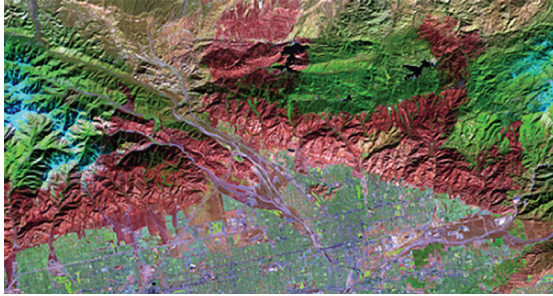
Join colleagues to learn and discuss the latest research

As we work to build yet another outstanding programme, we invite you to participate and consider submitting an abstract in 2024. We remain grateful for the enthusiastic participation of academics, researchers, engineers, and scientists who were able to connect in person in 2023. Amazing research was shared, products were demonstrated, and networking discussions had - all thanks to your continued commitment to advancing science. We now ask you to again share your work as we look forward to gathering in Edinburgh in the United Kingdom.

We appreciate the continued support of our volunteers and our event leadership. These two long standing events: Remote Sensing and Security + Defence continue to be held as individual symposia with their unique contributions, appearing under the single event name of Sensors + Imaging. The Organising Committees invite you to participate in this exciting meeting and to take the opportunity to learn about the latest scientific results within both symposia.

These two unique meetings will offer 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, both within the conference experience as well as at the exhibition. SPIE Remote Sensing and Security + Defence will consider all aspects of the evolving fields of optronics and photonics.

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SPIE Remote Sensing

The leading European conference for researchers and scientists involved in emerging sensor and photonic technologies that enable satellite-based atmospheric monitoring and observation of the earth's ecosystems.

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Remote Sensing for Agriculture, Ecosystems, and Hydrology XXVI

Chairs: Christopher M. U. Neale; Antonino Maltese

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Remote Sensing of the Ocean, Sea Ice, Coastal Waters, and Large Water Regions 2024

Chairs: Charles R. Bostater Jr.; Xavier Neyt; Caroline Nichol

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Sensors, Systems, and Next-Generation Satellites XXVIII

Chairs: Sachidananda R. Babu; Arnaud Hélière; Toshiyoshi Kimura

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Remote Sensing of Clouds and the Atmosphere XXIX

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Environmental Effects on Light Propagation and Adaptive Systems VII

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Chairs: Fabio Bovenga; Claudia Notarnicola; Nazzareno Pierdicca; Emanuele Santi

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Artificial Intelligence and Image and Signal Processing for Remote Sensing XXX

Chairs: Lorenzo Bruzzone; Francesca Bovolo

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Earth Resources and Environmental Remote Sensing/GIS Applications XV

Chairs: Karsten Schulz; Ulrich Michel; Konstantinos G. Nikolakopoulos

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Remote Sensing Technologies and Applications in Urban Environments IX

Chairs: Thilo Erbertseder; Nektarios Chrysoulakis; Ying Zhang



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The leading leading European conference for researchers and scientists involved in emerging sensor and photonic technologies that enable satellite-based atmospheric monitoring and observation of the earth's ecosystems.

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Target and Background Signatures: Traditional Methods and Artificial Intelligence X

Chairs: Karin Stein; Ric Schleijsen

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Electro-optical and Infrared Systems: Technology and Applications XXI

Chairs: Duncan L. Hickman; Helge Bürsing

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Chairs: Ove Steinvall; Philip J. Soan

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High Power Lasers and Technologies for Optical Countermeasures II

Chairs: Willy L. Bohn; Marc Eichhorn; Gareth D. Lewis

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Quantum Technologies for Defence and Security

Chairs: Giacomo Sorelli; Sara Ducci; Sylvain Schwartz

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Sensors and Communication Technologies in the 1 GHz to 10 THz Band

Chairs: Neil A. Salmon

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Emerging Imaging and Sensing Technologies for Security and Defence IX

Chairs: Gerald S. Buller; Robert A. Lamb; Martin Laurenzis

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Advanced Materials, Biomaterials, and Manufacturing Technologies for Security and Defence II

Chairs: Chantal Andraud; Roberto Zamboni; Andrea Camposeo; Luana Persano

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Artificial Intelligence for Security and Defence Applications II

Chairs: Henri Bouma; Radhakrishna Prabhu; Yitzhak Yitzhaky

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Autonomous Systems for Security and Defence

Chairs: Judith Dijk; Jose Luis Sanchez-Lopez

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Remote Sensing for Agriculture, Ecosystems, and Hydrology XXVI (RS101)

Conference Chairs: **Christopher M. U. Neale**, Univ. of Nebraska Lincoln (United States); **Antonino Maltese**, Univ. degli Studi di Palermo (Italy)

Programme Committee: **Alessandra Capolupo**, Politecnico di Bari (Italy); **José L. Chávez**, Colorado State Univ. (United States); **Monica Garcia**, Consejo Superior de Investigaciones Científicas (Spain); **María Patrocinio González-Dugo**, Instituto de Investigación y Formación Agraria y Pesquera (Spain); **Enrico B. Mondino**, Univ. degli Studi di Torino (Italy); **Saleh Taghvaeian**, Utah State Univ. (United States)

Remote sensing technology plays a significant role in the understanding of our environment. It has evolved into an integral research tool for the natural sciences. Disciplines such as agriculture, hydrology, and ecosystems have all developed a strong remote sensing component, facilitating our understanding of the environment and its processes over a broad range of spatial and temporal scales. This is highly important in the management of land and water resources and for the detection of environmental change. However, despite significant progress in recent years, there are still many areas where the potential of remote sensing has not been fully realized, and these are areas of active research.

Remote sensing has recently been employed to enhance our comprehension of the climate system and its alterations. It provides the ability to observe the Earth's surface, oceans, and atmosphere across various spatiotemporal scales, thereby facilitating the study of the climate system, climate-related processes, and both long-term and short-term phenomena such as deforestation or teleconnections patterns. Moreover, remote sensing is instrumental in bolstering alert systems and readiness, making it a valuable tool in disaster risk management. It aids in the development of early warning and forecasting systems to mitigate and manage climate-related disaster risks, such as improving predictions of cyclone and flood paths, drought events, and fire incidents, and preparing for necessary actions. Post-disaster damage assessment can also benefit from remote sensing technology through the comparative analysis of pre and post-disaster images. Furthermore, remote sensing data and information prove to be beneficial for emergency responders."

Of unique importance are those efforts that are focused on gaining a better understanding of what sensors are measuring as well as new applications and inverse modelling techniques. For this Conference, contributions using visible, near- and thermal infrared, microwave and other wavebands are so-

lited, as well as applications using LiDAR or hyperspectral imaging. The conference is especially interested in papers, which emphasize the use of data from relatively new satellites, including Sentinel, hyperspectral satellites such as PRISMA, nanosatellites, airborne and Unmanned Aerial Systems (UAS) platforms.

Documents concerning the application and the validation of products and services provided by the Copernicus program are welcome too. Indeed, although the Copernicus program supplies satellite-borne earth observation and in-situ data, and a services component that integrates these useful to address precision agriculture purposes, the assessment of their contribution and reliability is at its early stage and more attention should be deserved.

Invited keynote speakers will present overviews of problems, progress and prospects in key areas. Supporting papers are requested that review the latest contributions of Earth Observations (EO) to the water cycle and soil-vegetation-atmosphere sciences from global to basin to field. Also assessing the advances and identifying the needs in physical modelling, including uncertainties and consistency quantification and data assimilation of EO-based observations to improve our knowledge of water, vegetation and ecosystems processes and our ability to assess future changes in the water cycle, extreme events and hydrological hazards.

In recent years, opportunities for big data analysis in food and agricultural production are arising. Technological advancements in remote sensing coupled with advances in IT, mobile/cloud computing, widespread adoption of GNSS, internet of things and all advanced digital technologies have created a unique opportunity for implementing smarter solutions for large and smallholder farmers globally, leading to increased productivity, reduced resource consumption, and improved food security. In addition, the application of this technology to support policy instruments for the monitoring of the environment and agriculture is rapidly growing.

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Moreover, geomatic engineering is a rapidly developing discipline that focuses on principles of spatial information and incorporates land surveying for hydrological and agricultural remote sensing. These techniques allow for the delivery of high-tech agricultural services and precision agriculture based on remote sensing. Indeed, the combination of the new RS sensors with advanced geomatic techniques may be a powerful tool to detect changes over time and predict future scenarios. That information may provide the essential substrate to develop proper management and control strategies and, thus, to design and implement specific institutional services.

In addition, distributed networks provide the opportunity for setting up integrated processing for near real-time regional or global monitoring products for hydrology; agriculture; and ecosystems: e.g., HF radar networks, ground stations, GNSS networks, flux towers, etc.

Modern techniques for image processing and data analysis, with promising results and large potential, include deep learning and machine learning. These classes of algorithms have been successfully applied in various ecosystems.

Papers related to the above-mentioned and the following topics are solicited:

HYDROLOGICAL SCIENCES

- hydro-geomatics (surveying work carried out above the surface areas of water and for hydrological applications)
- hydrological modelling
- sensors for monitoring water resources in hydrology
- data scaling and assimilation in hydrology
- energy and water balance applications
- soil water content estimation and modeling
- satellite-based rainfall estimation and modelling (e.g., meteorological RADAR)
- water resources, precipitation, snow and ice hydrology
- GNSS reflectometry, gravimetry and magnetometry
- drought monitoring, analysis and prediction
- sedimentation and erosion
- radar applications in hydrology (interferometry for landslide detection; canopy, soil moisture and soil roughness characterization; flooding)
- lidar applications in hydrology
- remote sensing for groundwater detection (passive and active microwaves, thermal infrared, ground penetrating radar)
- remote sensing in surface water topography
- water quality

- estuarine and coastal applications
- flood mapping and modelling
- dams and hydraulic infrastructures monitoring via interferometry
- snow hydrology, glaciology.

AGRICULTURAL BIOSPHERE

- agro-geomatics (geomatics techniques application for precise management of agriculture)
- smarter solutions for farmers based on IT, cloud computing, mobile technology, GNSS
- institutional services for agriculture based on RS and IoT
- reliability and robustness of the products provided by Copernicus land monitoring service
- spectroradiometry for Earth remote sensing
- fluorescence applications in agriculture
- crop yield modelling, food production, energy and water nexus
- water securing for food
- agriculture disease detection
- vegetation indices, canopy and leaf optical models
- biomass monitoring
- evapotranspiration and energy balance (EB), eddy covariance, surface renewal, Bowen ratio systems, scintillometry etc.
- irrigation water management
- support of environmental and agricultural policies
- open data, crowd sensing, artificial intelligence and data analytics for agriculture.

ECOSYSTEMS AND CLIMATE CHANGE

- climate modelling, prediction and environmental change
- long-term shifts in temperatures
- weather patterns
- global or regional climate pattern
- extreme weather events: heatwaves, wildfires, cyclones, droughts, and floods
- large eddy simulations, turbulence and micrometeorology
- forestry dynamics and carbon cycle
- ecosystem and ecological management
- forecasting techniques
- long-term data records for water cycle and climate
- big data for sustainable development
- new trends in geospatial data analysis for change detection
- unmanned aerial systems (UAS) applications in hydrology, agriculture and ecosystems.

Remote Sensing of the Ocean, Sea Ice, Coastal Waters, and Large Water Regions 2024 (RS102)

Conference Chairs: **Charles R. Bostater Jr.**, Florida Institute of Technology (United States); **Xavier Neyt**, Royal Military Academy (Belgium); **Caroline Nichol**, Univ. of Edinburgh (United Kingdom)

Programme Committee: **Samir Ahmed**, The City College of New York (United States); **Pierre-Yves Foucher**, ONERA (France); **Alexander Gilerson**, The City College of New York (United States); **Rand Ismaeel**, Optoelectronics Research Ctr. (United Kingdom)

Remote sensing science is one of the most modern approaches for studying oceans, littoral regions, seas and large lakes, as well as sea ice covered regions. An important aspect of remote sensing science is the ability to monitor complex environmental media (air, land, water) and their interfaces (water surface wave, air-sea interaction, water-sediment, and internal interfaces). Understanding complex environmental system phenomena is key to scientific understanding of oceans, littoral zones, estuaries, coastal areas, large lakes, ports and waterways as well as sea ice dynamics since remote sensing data provides valuable monitoring information. This information often serves as input to complex numerical models of environmental systems, such as climate change models, coupled oceanic-atmosphere models at the global (planetary) scale as well as at the mesoscale space and time scales. Remote sensing techniques also provide the most valuable tool set and techniques for monitoring and mapping different bottom features in aquatic systems, such as coral reefs, submerged aquatic vegetation and other “targets” of interest to the oceanographic and aquatic community. Also of interest are robotic and mechatronic platforms for in-situ sensing of interfaces and unique sensing systems & platforms for coastal and ocean monitoring and associated data assimilation into predictive models.

There is a need to improve the accuracy and precision of retrieved geophysical parameters from remote sensing data. In this context, it is often necessary to integrate data from different sensors as well as to include the knowledge of different disciplines. This is especially important in remote sensing of water quality, submerged aquatic vegetation and coupled ocean-atmosphere models. From a remote sensing point of view, these data are mainly extracted from active or passive sensor systems, and models of complex phenomena are important

With reference to the above, this conference calls

for papers in topics such as:

- ocean, coastal, and large water region remote sensing to support sustainability of aquatic life & marine diversity
- using fiber optics in conjunction with sensing systems for sustaining safe aquatic environments
- detection of coastal & ocean currents, oceanic frontal feature detection and hazardous noxious spills in the ocean
- subsurface sensing using acoustics, optical, laser and magnetic systems, hyperspectral sensors
- ocean sensing techniques, image and signal analysis related to AI enhanced coastal benthic feature detection
- ocean, coastal and aquatic wave measurement systems & analysis
- use of remote sensing data in global and regional ocean observing platforms
- image analysis to support water quality sustainability & coastal lagoon benthic diversity
- coastal ocean, estuarine and large lake water-quality monitoring (suspended sediments, dissolved organic matter, phytoplankton pigments and biomass, submerged aquatic vegetation) using earth sensing systems
- oceanic photochemistry and hyperspectral remote sensing
- coupled oceanic and mesoscale air-sea boundary remote sensing products for model data assimilation
- modeling of spectral signatures
- studies of glaciers, shore-fast ice; polar regions, sea ice prediction monitoring and modeling
- cube sats, international space station (ISS) and multi-satellite sensor configurations
- image reregistration and sensor integration from various platforms aboard low earth orbit platforms

- data fusion, image fusion, deep learning and artificial intelligence used in earth sustainability studies
- sensor calibration and related data analysis to support disaster management assessments
- active-passive (Raman) sensing theory, applications, systems and techniques for cultural heritage applications
- novel use of GNSS signals in large water regions, lakes & coastal regions sensing using deep learning
- operational glacier, sea ice, ice sheets monitoring and system applications (Cryosat, ICESat, IceBridge, GRACE)
- active and passive remote sensing and techniques for improving underwater imaging of waterways and harbours
- airborne (manned, UAV's, drones) remote sensing missions for observation of oceanic, coastal, sea ice and large water regions, and nearby urban environments; natural disasters; sensor design and calibrations.

SPECIAL SESSIONS AND SESSION CHAIR CALL:

- a. hyperspectral sensing, modeling and applications related to breaking waves, foam, whitecaps, bubbles, air-sea gas exchange phenomena.
- b. use of AI and automatic feature extraction for detecting climate change and marine environmental quality
- c. AI and deep-learning techniques for multispectral satellite missions
- d. CubeSats and unmanned aerial vehicles for sustaining safe marine environments
- e. Future funding plans for earth remote sensing and UN sustainability goals

Those interested in developing a special session or joint sessions may contact the session chairs, members of the technical committee or contact Charles Bostater at Florida Institute of Technology: bostater@fit.edu.

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Sensors, Systems, and Next-Generation Satellites XXVIII (RS103)

Conference Chairs: **Sachidananda R. Babu**, NASA Earth Science Technology Office (United States); **Arnau Hélière**, European Space Research and Technology Ctr. (Netherlands); **Toshiyoshi Kimura**, Japan Aerospace Exploration Agency (Japan)

Programme Committee: **Jerome F. Caron**, TNO (Belgium); **Philippe Martimort**, European Space Research and Technology Ctr. (Netherlands); **Kyriaki Minoglou**, European Space Agency (Netherlands); **Asal Naseri**, NASA Headquarters (United States); **Josep Rosello**, European Space Research and Technology Ctr. (Netherlands); **Olivier Saint-Pé**, Airbus Defence and Space (France); **Hiroshi Suto**, Japan Aerospace Exploration Agency (Japan); **Xiaoxiong J. Xiong**, NASA Goddard Space Flight Ctr. (United States)

Many new remote sensing programs are under way throughout the world, in the U.S., Europe, Japan, and elsewhere. NASA's Earth Science Division is developing and implementing a broad range of Earth spaceborne remote sensing missions to answer fundamental scientific questions requiring the view from space and to meet societal needs. These include missions and new program elements from the National Research Council's Earth Science Decadal Survey, missions and selected instruments to assure continuity of long-term key data sets, missions to ensure sustained land imaging provided by the Landsat system, and small-sized competitively-selected small satellite and constellation missions and instruments belonging to the Earth Venture Program.

The Japan Aerospace Exploration Agency (JAXA) is developing and operating the ALOS series, GOSAT series, GCOM series, GPM/DPR, EarthCARE/CPR and ISS/MOLI series of programmes.

The European Space Agency (ESA) is developing and implementing a wide range of Earth Observation missions, encompassing the Earth Explorer missions addressing key scientific issues, as well as operational missions including the Copernicus Sentinels in partnership with the European Union (EU), and the meteorological missions in partnership with the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). A number of new remote sensing programmes are also under development by other organisations and nations for research and operational use. Many of the above are contributing to the Global Earth Observation System of Systems (GEOSS) as envisioned by the intergovernmental Group on Earth Observations (GEO). Each of these programs comprises a set of remote sensing systems to address their science and applications objectives.

Papers are solicited on the following and related topics:

- sensors being developed
- satellites being developed
- enabling technologies for sensors and satellites
- new design concepts for sensors, systems and satellites
- hyperspectral sensors
- sensor calibration techniques
- in-situ sensor measurement assimilation
- modeling and simulation techniques for sensor concept development
- focal plane assemblies including detectors and spectral filters
- future LIDAR missions
- system precursors including test beds and airborne simulators
- data systems being developed
- new data processing techniques (applications to Big Data and remote sensing, sensor and data interoperability).
- quantum technologies for applications in earth remote sensing from space
- innovative optical technologies for Earth remote sensing payloads from space.

Sessions on the following topics are being planned:

- Japanese missions and technologies
- European missions and technologies
- US missions and technologies
- small satellites (nano/cubesats, microsats) and constellations for Earth observation
- NASA Decadal Survey Designated Observable (DO), Venture Continuity, and Incubation studies
- commercial Earth observing constellations
- UAV systems for Earth observation
- sensor calibration
- focal plane technologies.

Remote Sensing of Clouds and the Atmosphere XXIX (RS104)

Conference Chairs: **Evgueni I. Kassianov**, Pacific Northwest National Lab. (United States); **Simone Lolli**, CNR-IMAA (Italy)

Programme Committee: **Lucas Alados-Arboledas**, Univ. de Granada (Spain); **Romain Ceolato**, ONERA (France); **Adolfo Comerón**, Univ. Politècnica de Catalunya (Spain); **Erica Dolinar**, U.S. Naval Research Lab. (United States); **Connor Flynn**, The Univ. of Oklahoma (United States); **Klaus Schäfer**, Atmospheric Physics Consulting (Germany); **Carmino Serio**, Univ. degli Studi della Basilicata (Italy); **Bastiaan van Diedenoven**, SRON Netherlands Institute for Space Research (Netherlands); **Gemine Vivone**, CNR-NBFC (Italy); **Konradin Weber**, Fachhochschule Düsseldorf (Germany)

This conference focuses on methods, underlying technologies, and applications of remote sensing of clouds and Earth and planetary atmospheres, including the following topics:

REMOTE SENSING, INCLUDING PROFILING, OF CLOUDS, ATMOSPHERIC AEROSOLS, TRACE GASES AND METEOROLOGICAL PARAMETERS:

- cloud detection, profiling and characterization
- cloud modelling
- cloud screening
- gas measurements and retrieval from ground, air and space
- aerosol detection, measurements and retrieval from ground, air and space
- assimilation of remote sensing data of clouds, aerosols and trace gases into meteorological, transport, and air-quality models
- remote sensing of constituents, dynamical and electrical structure, and wave motions of the upper atmosphere
- studies of middle and upper atmosphere variability and climatology
- hyperspectral data processing
- deep learning, machine learning, handling and processing big data as well as integration of monitoring methodologies.

RADIATIVE TRANSFER:

- Earth radiation budget
- 3D radiative transfer and approximation methods
- retrieval methods, profiling, and data assimilation
- atmospheric correction
- non-LTE radiative effects and radiative transfer codes
- non-LTE retrieval methods.

LIDAR, RADAR, AND OTHER ACTIVE AND PASSIVE (MICROWAVE, INFRARED, VISIBLE AND ULTRAVIOLET) ATMOSPHERIC MEASUREMENT TECHNIQUES AND TECHNOLOGIES:

- lidar (elastic backscatter, Raman, DIAL, etc.) methods for aerosol, cloud and gas measurements

- advances in laser sources for lidar sensing of clouds, aerosols and gases from ground, airborne and space-borne platform
- radar profiling of cloud parameters
- remote sensing by FTIR, DOAS and other spectroscopic techniques
- satellite retrievals (infrared, microwave) targeting the upper troposphere and lower stratosphere (MIPAS, ACE-FTS, MLS, OMPS, etc.)
- advances in detectors for remote sensing systems of clouds and the atmosphere
- advances in retrieval methods
- synergy between different types of instruments
- calibration/validation of satellite retrievals of atmospheric variables
- low-cost sensor networking and interplay with mobile devices (including unmanned aerial vehicles), trace compound retrieval and remote sensing from ground, air and space, food and water security, predicting and monitoring natural disasters(wildfire, landslides, floods, etc.), search and rescue.

APPLICATIONS AND SUSTAINABILITY

- weather forecast and climate trends
- air pollution monitoring, forecast and modelling, including data and information fusion
- measurement of industrial, agricultural, biomass, and volcanic emissions and transport, including determination of emission source strengths
- environmental, disaster, and fire monitoring
- improvement of agri-food production systems
- applications of small satellites (microsats, nanosats, cubesats) to remote sensing of the atmosphere.
- studies of ice sheets (Cryosat, ICESat, IceBridge, GRACE, IceCube, etc.) and snow cover dynamics.

Environmental Effects on Light Propagation and Adaptive Systems VII (RS105)

Conference Chairs: **Karin Stein**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Szymon Gladysz**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

Programme Committee: **Eyal Agassi**, Israel Institute for Biological Research (Israel); **Kasia Balakier**, European Space Agency (United Kingdom); **Ivo Buske**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Christian Eisele**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Ariadna I. Huerta Viso**, TNO (Netherlands); **Gaël Kermarrec**, Leibniz Univ. Hannover (Germany); **Andrew J. Lambert**, UNSW Canberra (Australia); **Vladimir P. Lukin**, V.E. Zuev Institute of Atmospheric Optics (Russian Federation); **Florian Moll**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Andreas Muschinski**, NorthWest Research Associates (United States); **Pietro Paglierani**, NATO STO-CMRE (Italy); **Darío G. Pérez**, Pontificia Univ. Católica de Valparaíso (Chile); **Andrew P. Reeves**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Italo Toselli**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany); **Alexander M. J. van Eijk**, TNO Defence, Security and Safety (Netherlands); **Vladimir Yurievich Venediktov**, Saint Petersburg Electrotechnical Univ. "LETI" (Russian Federation), St.-Petersburg State Univ. {Russian Federation); **Oskar F. von der Lüche**, Leibniz-Institut für Sonnenphysik (KIS) (Germany); **Henry White**, BAE Systems (United Kingdom)

The use of sensors for active and passive remote sensing of the Earth, its atmosphere and the oceans, for free-space laser communications, and for high-resolution imaging of ground-based, immersed and airborne objects are fields of growing interest for both civilian and military applications.

Such high-resolution optical sensing systems use spectral regions varying from UV to Radar. However, they all must deal with detrimental environmental influences, be it over km-long ranges in the atmosphere or even over only several meters when light propagates through very turbid media such as ocean water. Instrument and measurement analysis therefore depends crucially on a thorough understanding of all optical effects, which limit the sensor performance operating in an absorbing, scattering, and radiating random medium. Increasingly important in this area are modern methods used to ameliorate these effects through compensative hardware, algorithms, and measurements of environmental parameters performed at various locations around the World. Contributions are invited on the following topics and those related to them:

CHARACTERIZATION OF THE PROPAGATION ENVIRONMENT

- measurements of the meteorological parameters relevant to the propagation of light, such as temperature, humidity, extinction, etc.
- updates on software for transmission and radiance computations
- measurements and modelling of size distributions and optical properties of aerosols
- modelling and measurement of backgrounds in the visible and infrared spectral ranges
- prediction and measurement of scattering, absorption and turbulence in water
- instances of non-Kolmogorov turbulence.

PROPAGATION AND IMAGING THROUGH OPTICAL AND ANTHROPOGENIC TURBULENCE

- effects of atmospheric and underwater turbulence on laser beam propagation
- aero-optical and plume effects in airborne laser applications
- scintillation and surface speckle propagation
- anisoplanatism in imaging through turbulence.

LASER-BASED SENSING IN THE ATMOSPHERE AND UNDERWATER

- active imaging and gated viewing
- LIDAR and its applications
- standoff vibrometry
- supercontinuum spectroscopy.

**FREE-SPACE OPTICAL (FSO) COMMUNICATION
TECHNIQUES AND APPLICATIONS**

- space-based, terrestrial and airborne FSO systems
- through-water and underwater optical communications
- modulation techniques and formats
- pointing, acquisition, and tracking
- transmitters, receivers, and subsystems
- quantum communications
- cyber security implications of FSO systems.

**TECHNIQUES FOR MITIGATION OF
ATMOSPHERIC EFFECTS**

- adaptive optics
- image sharpening/de-blurring
- global and local image stabilization, de-warping, optical flow methods
- tracking through turbulence
- image fusion
- applications of machine learning to wavefront sensing and image processing.

**NEW DEVICES FOR ATMOSPHERIC
MEASUREMENT OR COMPENSATION**

- novel optical components such as liquid-crystal-, and MEMS-based devices
- novel wavefront sensors
- high-frame rate and low-noise visible and infrared detectors.

Microwave Remote Sensing: Data Processing and Applications III (RS106)

Conference Chairs: **Fabio Bovenga**, Istituto per il Rilevamento Elettromagnetico dell'Ambiente (Italy); **Claudia Notarnicola**, EURAC (Italy); **Nazzareno Pierdicca**, Sapienza Univ. di Roma (Italy); **Emanuele Santi**, Istituto di Fisica Applicata "Nello Carrara" (Italy)

Programme Committee: **Rajat Bindlish**, NASA Goddard Space Flight Ctr. (United States); **Maria-Paola Clarizia**, ESA-ESTEC (Netherlands); **Katarzyna Dabrowska-Zielinska**, Institute of Geodesy and Cartography (Poland); **Fabio Del Frate**, Univ. degli Studi di Roma "Tor Vergata" (Italy); **Christine Gommenginger**, National Oceanography Ctr. (United Kingdom); **Carlos Lopez-Martinez**, Univ. Politècnica de Catalunya (Spain); **Simonetta Paloscia**, Istituto di Fisica Applicata "Nello Carrara" (Italy); **Simone Pettinato**, Istituto di Fisica Applicata "Nello Carrara" (Italy); **Luca Pulvirenti**, CIMA Research Foundation (Italy); **Ronny Schomacker**, Technische Univ. Berlin (Germany); **Susan Steele-Dunne**, Technische Univ. Delft (Netherlands); **Hong Zhao**, Univ. Twente (Netherlands)

The main objective of the conference is to present an updated view of the state-of-the-art in active and passive microwave remote sensing techniques and to provide a playground for scientists coming from different microwave sectors and final application domains. In this context, the conference will offer a platform to exchange ideas and foster applications, which may take advantage from the use of microwave sensors (SAR, scatterometers, radiometers, altimeters, GNSS-R) alone, as well as their joint exploitation and combination with other sensors (optical, multispectral) to take advantage from complementarity of the different techniques.

Particular attention will be given to applications and algorithms, including model based and machine learning algorithms and time series analysis, for exploiting data from currently operating sensors, such as Sentinel 1, Sentinel 3, ALOS2, TerraSAR-X, COSMO-SkyMed, RADARSAT-2, SAOCOM, AMSR-E/AMSR2, SSMI / SSMIS, SMOS, Metop ASCAT, and SMAP and incoming missions such as Metop SG SCA, HydroGNSS, CyGNSS, Nisar, ROSE-L, COSMO SG, ALOS3, AMSR3 and CIMR. Cubesat and nanosat missions will be also considered, as well as airborne and ground-based experiments. In fact, the incoming growing capabilities of the most recent sensors, in terms of temporal revisiting and electromagnetic spectrum sampling (in active and passive mode), offer a potential tool for new environmental applications especially related to sustainable development goals including the monitoring of natural disasters (such as earthquake, flood, drought, landslides, avalanches), environmental issues, and to the food and energy challenges, which can particularly benefit from multi-temporal image analysis.

Contributions are solicited on the following and related topics for both applications and processing techniques:

- application of microwave sensing to natural hazard, risk prevention and disaster management
- application of microwave sensing to food security, energy, and biodiversity
- microwave (active and passive) electromagnetic modelling and simulation in different scenarios (land and ocean, atmosphere)
- inversion algorithms for the retrieval of biogeophysical parameters from microwave data
- microwave data (radar and radiometer) processing techniques
- active and passive data merging, disaggregation approaches
- artificial intelligence algorithms for classification and retrieval applications
- polarimetric methods, techniques and applications
- SAR interferometry techniques and applications
- bistatic radar, including GNSS reflectometry
- radar altimeter and scatterometer techniques and applications
- active and passive reflectors for calibration and validation activities
- microwave remote sensing from UAVs.

Two joint sessions will be organized with the conferences "Artificial Intelligence and Image and Signal Processing" and "Remote Sensing for Agriculture, Ecosystem and Hydrology". In the latter, contributions are solicited for the topic **monitoring of soil moisture and vegetation biomass by using optical and microwave data**.

Artificial Intelligence and Image and Signal Processing for Remote Sensing XXX (RS107)

Conference Chairs: **Lorenzo Bruzzone**, Univ. degli Studi di Trento (Italy); **Francesca Bovolo**, Fondazione Bruno Kessler (Italy)

Programme Committee: **Abdourrahmane M. Atto**, Univ. Savoie Mont Blanc (France); **Jocelyn Chanussot**, Lab. des Images et des Signaux (France); **Mathieu Fauvel**, Univ. of Iceland (Iceland); **B. S. Daya Sagar**, Indian Statistical Institute, Bangalore (India); **Begüm Demir**, Technische Univ. Berlin (Germany); **Andrea Garzelli**, Univ. degli Studi di Siena (Italy); **Manolis Koubarakis**, National and Kapodistrian Univ. of Athens (Greece); **Sicong Liu**, Tongji Univ. (China); **José M. P. Nascimento**, Instituto de Telecomunicações (Portugal); **Claudia Paris**, Univ. Twente (Netherlands); **Charlotte Pelletier**, Univ. de Bretagne Sud (France); **Benoit Vozel**, Univ. de Rennes 1 (France); **Josiane B. Zerubia**, INRIA Sophia Antipolis - Méditerranée (France)

The main goal of this conference is to address advanced topics related to signal processing, image analysis, pattern recognition, machine learning and data fusion methodologies in the field of remote sensing.

Papers describing recent and original work in the following and related research topics are welcome:

- calibration and registration
- image enhancement and restoration
- semantic segmentation and classification
- target detection and object recognition
- estimation of geo- bio-physical parameters
- artificial intelligence
- machine learning and deep learning
- supervised, semi-supervised and unsupervised paradigms to data analysis
- analysis of big data
- change detection and analysis of image time series
- analysis of multispectral and hyperspectral images
- analysis of SAR and LIDAR signals
- multisensor and multisource data fusion
- data mining techniques
- image coding and data compression
- quantum computing for remote sensing
- onboard intelligence for Earth observation
- cybersecurity in remote sensing image processing
- remote sensing applications (climate change, disaster monitoring, forest, agriculture, water quality, etc.)
- multiplatform (satellite, cubesat, nanosat, airborne and UAV) remote sensing.

Note: To assure a high quality conference, all abstracts will be reviewed by the conference scientific committee and co-chairs for technical merit and content.

Earth Resources and Environmental Remote Sensing/GIS Applications XV (RS108)

Conference Chairs: **Karsten Schulz**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Ulrich Michel**, ROSEN Creation Ctr. GmbH (Germany); **Konstantinos G. Nikolakopoulos**, Univ. of Patras (Greece)

Programme Committee: **Maria Libera Battagliere**, Agenzia Spaziale Italiana (Italy); **Markus Boldt**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Dimitri Bulatov**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Joana Maria Cardoso-Fernandes**, Univ. do Porto (Portugal); **Valerio Gagliardi**, Univ. degli Studi di Roma Tre (Italy); **Pierre Karrasch**, TU Dresden (Germany); **Aggeliki Kyriou**, Univ. of Patras (Greece); **Maria Niebla**, Hydrock Consultants (United Kingdom); **Pablo H. Rosso**, Leibniz-Zentrum für Agrarlandschaftsforschung (ZALF) e.V. (Germany); **Ana Claudia Moreira Teodoro**, Univ. do Porto (Portugal); **Kyriacos Themistocleous**, Cyprus Univ. of Technology (Cyprus); **Christine Wessollek**, TU Dresden (Germany)

Satellite remote sensing has become a common tool to investigate the different fields of Earth and environmental sciences. The progress of the performance capabilities of the optoelectronic and radar devices mounted on-board remote sensing platforms have further improved the capability of instruments to acquire information about the Earth and its resources for global, regional and local assessments.

With the advent of new high-spatial and spectral resolution satellite and aircraft imagery new applications for large-scale mapping and monitoring have become possible. The integration with Geographic Information Systems (GIS) allows a synergistic processing of multi-source spatial data. The present conference will be an occasion to outline how scientists involved in the Earth and environmental studies can take advantage of new remote sensing techniques and the advances in spatial technology. Particular subjects are:

SENSORS AND PLATFORMS

- new sensor developments
- radiometric calibration studies
- geometric correction approaches
- mobile solutions
- simulation studies.

PROCESSING METHODOLOGIES

- fusion of multi-source and multi-scale data
- multitemporal remote sensing
- machine learning methods for remote sensing
- integration of remote sensing and GIS
- analysis of optical and thermal data
- hyperspectral analytical approaches
- 3D techniques: LIDAR and Stereo.

ENVIRONMENTAL MONITORING CONCEPTS

- land degradation studies
- natural hazards (floods, landslides)
- landscape modeling
- sustainability and planning
- coastal zone management
- interaction sea-land
- resource management
- global climate change.

HAZARD MITIGATION GEOLOGIC APPLICATIONS

- geological hazards, mine waste
- earthquakes and volcanoes
- lithological and mineral mapping
- mineral and petroleum exploration
- structural geology, tectonics
- hydrogeology.

INFRASTRUCTURES AND URBAN AREAS

- 3D urban modeling
- change detection
- remote sensing for urban information systems
- virtual city models
- urban feature extraction with high resolution SAR-sensors.

REMOTE SENSING FOR ARCHAEOLOGY, PRESERVATION OF CULTURAL AND NATURAL HERITAGE

- discovering hidden archaeologic sites with remotes sensing techniques
- generating digital twins of archaeologic monuments and sites
- ground penetrating sensing
- detection and monitoring of wildfires and illegal deforestation.

NEW: EARTH OBSERVATION USING GEE AND AUTOMATED METHODOLOGIES

- GEE applications generating digital twins of archaeological monuments and sites
- development of automated methodologies
- InSAR processing of big time-series
- WebGIS applications

Earth observation using Google Earth Engine (GEE) and automated methodologies (scientific programming) has emerged as a powerful tool for remote sensing, environmental monitoring, and geospatial analysis. This special session aims to bring together experts and researchers to discuss the latest advancements in the field. We invite abstract submissions on the following topics:

- showcase innovative applications of GEE and highlight the integration of machine learning techniques for image analysis, feature extraction, and classification in remote sensing applications.
- development of automated algorithms and workflows for processing large-scale Earth observation data, and possible contributes to environmental monitoring, climate change assessment, and mitigation efforts, among others.
- analyzing big time-series of InSAR data (among others) using GEE or other automated methodologies and discussing their applications.
- development of WebGIS platforms for geospatial visualization, data sharing, and interactive mapping.

This year's conference will feature a special session on:

THEORIES AND APPLICATIONS OF SATELLITE REMOTE SENSING AND GROUND-BASED NONDESTRUCTIVE TECHNOLOGIES IN CIVIL

Session Chairs: **Valerio Gagliardi**, Roma Tre Univ. (Italy); **Luigi D'Amato**, Italian Space Agency (ASI) (Italy)

Session Committee: **Maria Libera Battagliere**, Italian Space Agency (ASI), (Italy); **Luca Bianchini Ciampoli**, Roma Tre Univ. (Italy); **Francesco Soldovieri**, Institute for Electromagnetic Sensing of the Environment (IREA)-CNR (Italy); **Fabio Tosti**, Univ. of West London, (United Kingdom)

Satellite remote sensing is becoming popular for the assessment and the routine monitoring of civil engineering structures and infrastructures, such as buildings, railways, airports and highways and the surrounding environment. The tremendous prog-

ress made recently by this technology allows to control their conditions at the network level with a very high inspection frequency and resolution as well as to identify critical sections for an early-stage detection of decays. Parallel to this, ground-based non-destructive testing (NDT) methods have become established in structure, infrastructure, and environmental management systems due to their non-invasiveness, the rapidity of data collection and the provision of reliable information. Within this context, an integration between satellite remote sensing and ground-based NDT technologies (e.g. – but not limited to – GPR, GB-SAR, UAVs, Lidar, FWD and Profilometers) can stand as a step forward in the development of new theoretical, numerical and experimental approaches towards the provision of smarter management systems in civil and environmental engineering.

Submissions related to the above mentioned, describing work in the following and related research topics are invited:

- remote sensing theories and applications in civil and environmental engineering
- medium- and high-resolution SAR sensors in civil and environmental engineering
- advanced assessment, monitoring and interpretation methods for transport infrastructures (roadways, railways, airfields), bridges, tunnels, and buildings
- design and development of new surveying protocols, equipment, and prototypes
- advances in ground-based nondestructive testing (NDT) methods, numerical developments and applications (stand-alone use of existing and state-of-the-art NDTs)
- data fusion, integration and correlation of multi-source, multi-scale, and multi-temporal data outputs for civil and environmental engineering applications.

Remote Sensing Technologies and Applications in Urban Environments IX (RS109)

Conference Chairs: **Thilo Erbetseder**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Nektarios Chrysoulakis**, Foundation for Research and Technology-Hellas (Greece); **Ying Zhang**, Natural Resources Canada (Canada)

Programme Committee: **Costas Armenakis**, York Univ. (Canada); **Ingunn Burud**, Norwegian Univ. of Life Sciences (Norway); **Thomas Esch**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Lorenza Gilardi**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Sheila Izquieta Rojano**, Univ. de Navarra (Spain); **Monika Kuffer**, Univ. Twente (Netherlands); **Giannis Lantzanakis**, Foundation for Research and Technology-Hellas (Greece); **Zina Mitraka**, Foundation for Research and Technology-Hellas (Greece); **William Morrison**, Univ. of Freiburg (Germany); **Tobias Reinicke**, Satellite vu (United Kingdom); **Dimitris Tsirantonakis**, Foundation for Research and Technology-Hellas (Greece)

The global urbanization constitutes an epochal transformation of the Earth. According to the United Nations in 2050, around 75% of the world population will be living in cities. This development poses unprecedented challenges regarding environmental problems and energy demand, population density, transportation, infrastructure and new forms of mobility and sharing, migration and demographic change linked to aspects of vulnerability and environmental justice, and finally climate change, sustainability and resilience. In any case, the urban environment plays a major role in the development of humanity and the quality of life of the individual citizen needs to be strengthened.

Remote Sensing Technologies and Applications offer a wealth of possibilities and opportunities to monitor the urban environment, to support planning processes, to enhance the availability of relevant information, to shape the resilient and sustainable city and to improve the quality of life of citizens. To achieve these objectives a combination of remote sensing and imaging with Big Data science, citizen science, numerical and statistical modelling as well as AI and machine learning is highly welcome.

The conference aims further at highlighting the role of the remote sensing and imaging community to implement the Sustainable Development Goals of the United Nations in particular, but not limited to, Sustainable Cities and Communities (11), Climate Action (13), Good Health and Well-being (3), and Build Resilient Infrastructure and Foster Innovation (9).

We invite papers related to advanced remote sensing technologies, applications and information systems focusing on the urban environment that push beyond the state-of-the-art. These include:

REMOTE SENSING OF URBAN AIR QUALITY AND CLIMATE

- air pollution and greenhouse gas monitoring using satellites, aerial planes, UAV and mobile platforms
- urban atmosphere and local climate zones
- urban climate under global climate change
- CO₂ emissions, capture and sequestration
- urban energy budget and heat fluxes
- integrated urban climate services
- urban heat island.

REMOTE SENSING FOR URBAN RESILIENCE AND URBAN PLANNING

- urban land surface information extraction
- urban morphology, infrastructure and traffic
- urban land cover and biodiversity
- urban planning indicators
- sustainable urbanization and adapting and transforming towards sustainability
- strategies with respect to natural disasters
- urban metabolism
- nature-based solutions.

SMART CITIES

- AI methods and machine learning for mapping and monitoring
- Big Data science and applications
- Digital Twins
- crowd sourcing and microsensors
- data assimilation (combining measurements and models)
- information services and mobile applications
- quality of life services and support to people at risk.

Target and Background Signatures: Traditional Methods and Artificial Intelligence X (SD101)

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

Programme Committee: **Jean Dumas**, Defence Research and Development Canada, Valcartier (Canada); **Maarten A. Hogervorst**, TNO (Netherlands); **Hans M. Kariis**, Swedish Defence Research Agency (Sweden); **Louisa Laing**, QinetiQ Ltd. (United Kingdom); **Daniel W. O'Hagan**, Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR (Germany); **Eveline Örtenberg**, FOI-

Swedish Defence Research Agency (Sweden); **Alexander Schwarz**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Gorm K. Selj**, Norwegian Defence Research Establishment (Norway); **Henny E. T. Veerman**, TNO (Netherlands); **Peter Wellig**, Armasuisse (Switzerland)

This conference deals with algorithmic and experimental approaches for distinguishing the weak signals of targets from a cluttered background, for sensors covering the spectral region from the visible up to the thermal infrared. Making this distinction requires either detailed characterization of the target properties and characterization of the backgrounds /and could use Artificial Intelligence techniques to distinguish based on training data. Knowledge of target and background signatures is essential for various applications such as systems engineering and evaluation (e.g. electro-optical sensors or camouflage design), operational planning and development of ATR algorithms. The conference also covers methods for signature reduction and signature management as well as techniques for assessing the influence of signature management at different levels such as platform signature, tactical application and operational capabilities. These signature reduction design and assessment techniques may include Artificial Intelligence.

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

- signature modeling and validation
- artificial intelligence in signature reduction

- 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
- methods and materials for signature reduction
- advances in algorithms for sensor signal and data processing
- simulation and performance evaluation including human observer performance
- sensor data fusion, multiple source integration
- artificial intelligence techniques for target - background discrimination
- signature management against artificial intelligence
- processing multi-/hyperspectral data
- multisensor signature prediction model
- camouflage effectiveness
- signature features in relation to sensor capabilities and sensor processing.

Electro-optical and Infrared Systems: Technology and Applications XXI (SD102)

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

Programme Committee: **Gianni Barani**, Leonardo (Italy); **Piet Bijl**, TNO Defence, Security and Safety (Netherlands); **Rainer Breiter**, AIM INFRAROT-MODULE GmbH (Germany); **Lounis Chermak**, Cranfield Univ., Defence Academy (United Kingdom); **Bernd Eberle**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Linda Höglund**, IRnova AB (Sweden); **Natan S. Kopeika**, Ben-Gurion Univ. of the Negev (Israel); **Malgorzata Kopytko**, Wojskowa Akademia Techniczna im. Jaroslawa Dabrowskiego (Poland); **Daniel A. Lavigne**, Defence Research and Development Canada, Valcartier (Canada); **Gino Putrino**, The Univ. of Western Australia (Australia); **Stanley R. Rotman**, Ben-Gurion Univ. of the Negev (Israel); **Frank Rutz**, Fraunhofer-Institut für Angewandte Festkörperphysik IAF (Germany); **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 on size weight, and power (SWaP) and sustainability criteria.

This conference will address current and emergent sensor technology and system developments which will deliver the required future capability of all military applications and platform types covering the maritime, land, air and space domains. Current military operations have highlighted the growing importance of UAVs and drones for data gathering, combat operations, and damage assessment, and contributions on these topics are encouraged.

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, MOEMS-MEMS, focal plane arrays, image processing, ML and AI technology, data fusion, and emergent sensor concepts such as multi-spectral and hyperspectral 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. VR/AR designs and systems are seen as an evolving technology with benefits across the military spectrum including integration with battlefield and training systems.

EO and IR systems are likely to benefit from recent advances in material research, for example new carbon-based materials (including graphene), 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. The potential benefits of MOEMS-MEMS technology, combined with new materials and device designs, are now being realized.

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 usable 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 signal 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 must 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 performance and required characteristics of sensor systems are critically dependent on the platform and the application. Many sensor payloads are now being fitted to autonomous vehicles and drones which present new challenges in design and integration. Applications areas that are currently receiving interest include target detection and tracking, area monitoring, mine and IED detection, environmental monitoring, and border security. There is also growing interest in wearable imaging devices which have their own unique challenges at the sensor design level, the exploitation of the sensor data, and the interconnection of multiple sensors.

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 and research centres. 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 covering areas such as sensor components and supporting technology, EO/IR systems engineering, optical materials and design, sensor manufacture and test, materials science, image processing algorithms design and associated software methodologies, and 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 specific areas:

- advanced materials for EO/IR, e.g. metamaterials, nanomaterials, carbon based materials and their application
- focal plane array detector technologies, covering wavebands UV to LWIR including multi-band FPAs
- detector packaging, fabrication, temperature stabilization and integration technologies
- MOEMS-MEMS architectures, designs, micro-fabrication, performance, and applications
- passive imaging: technology, modelling, system design and hardware
- active imaging: technology, modelling, system design and hardware
- novel sensor technologies and their applications
- integrated and miniaturized sensors – reduced SWaP+C for applications such as autonomous and remote-control vehicles, and the dismounted soldier
- computational imaging: techniques, components, designs, and algorithms
- optical domain processing methods
- broadband, multiband, and hyperspectral sensors
- polarisation sensitive sensors and polarimetry applications
- imaging through the atmosphere
- signal and image processing
- autonomous processing including detection, tracking and classification
- the design of ML and AI technology for military system applications
- data fusion technology including image fusion and sensor fusion concepts
- modelling and analysis of EO/IR systems and sub-systems
- AR/VR designs and applications
- 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 sensor technology
- sensor payloads for autonomous vehicles and drones
- design and applications of wearable sensor systems
- remote sensing and surveillance for military applications
- dual use of military EO/IR sensor technology for environmental imaging and analysis (including ocean monitor)
- border and area security including air-to-ground detection and tracking for applications such as drug trafficking
- system integration design and development issues
- sensor demonstrators and prototypes
- sensor trials and performance evaluation
- system engineering approaches.

Electro-Optical Remote Sensing XV (SD103)

Conference Chairs: **Ove Steinvall**, Swedish Defence Research Agency (Sweden); **Philip J. Soan**, Defence Science and Technology Lab. (United Kingdom)

Programme Committee: **Benjamin Göhler**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany); **Robert J. Grasso**, NASA Goddard Space Flight Ctr. (United States); **Per Jonsson**, FOI-Swedish Defence Research Agency (Sweden); **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); **Vasyi Molebny**, Academy of Technological Sciences of Ukraine (Ukraine); **Gunnar Rustad**, Norwegian Defence Research Establishment (Norway); **Yong Zhang**, Harbin Institute of Technology (China)

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. One important area is the use of laser sensors for autonomous cars.

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)
- 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
- lidar for CBRNE Sensing and atmospheric monitoring
- laser sensing and target tracking for high energy laser applications.
- free-space laser communication systems and applications
- multifunctional EO and laser systems.

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.

High Power Lasers and Technologies for Optical Countermeasures II (SD104)

Conference Chairs: **Willy L. Bohn**, BohnLaser Consult (Germany); **Marc Eichhorn**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany); **Gareth D. Lewis**, Royal Military Academy (Belgium)

Programme Committee: **Frances Bodrucki**, The Univ. of North Carolina at Charlotte (United States); **Pierre Bourdon**, ONERA (France); **Christopher D. Burgess**, Defence Science and Technology Lab. (United Kingdom); **M. J. Daniel Esser**, Heriot-Watt Univ. (United Kingdom); **Robert J. Grasso**, NASA Goddard Space Flight Ctr. (United States); **Markus Henriksson**, FOI-Swedish Defence Research Agency (Sweden); **James P. Hitscherich**, U.S. Army Combat Capabilities Development Command (United States); **Igor James**, Defence Science and Technology Lab. (United Kingdom); **Arkadiy A. Lyakh**, Univ. of Central Florida (United States); **William Ted Masselink**, Humboldt-Univ. zu Berlin (Germany); **Richard Maulini**, Alpes Lasers SA (Switzerland); **Curtis R. Menyuk**, Univ. of Maryland, Baltimore County (United States); **Eric D. Park**, Q-Peak, Inc. (United States); **Jasbinder S. Sanghera**, U.S. Naval Research Lab. (United States); **Ric H. M. A. Schleijsen**, TNO Defence, Security and Safety (Netherlands); **Bastian Schwarz**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany); **Ove Steinvall**, Swedish Defence Research Agency (Sweden); **Alexander M. J. van Eijk**, TNO Defence, Security and Safety (Netherlands); **Hans-Dieter Tholl**, Diehl BGT Defence GmbH & Co. KG (Germany); **Marijke Vandewal**, Royal Military Academy (Belgium)

The upcoming conference aims to explore the latest research and development concerning high-power lasers and optical countermeasures for defense and security applications. This event will cover the most recent advancements and emerging trends in these fields, which are of utmost importance to the defense and industrial research communities. It will combine research from diverse laser technology fields to share insights and engage in productive discussions. Attending this conference will allow you to exchange and broaden your knowledge about the latest technologies and methods implemented to improve the capabilities of high-power lasers and optical countermeasures for potential applications in the defense and security sectors. Developing effective laser weapon systems for operational use poses challenges despite their ability to destroy military targets with precision and minimal collateral damage while remaining covert. These include power scaling, energy conversion efficiency, wavelength control, beam quality, thermal and power management, optical issues, packaging, ruggedization, platform considerations, and special laser effects. The ultimate goal is to develop efficient and effective systems for neutralizing targets. Furthermore, optical countermeasures are advancing rapidly to counter new threats and emerging technologies. This event will provide an excellent platform for experts to collaborate and innovate on high-power laser and advanced countermeasure systems.

Papers are sought in broad laser technology and development areas:

LASER MATERIALS

- fibers, crystals, ceramics,
- new manufacturing techniques and methods.

LASER COMPONENTS

- pump diodes (efficiency, wavelength, linewidth, stability, cost)
- optics, coatings, couplers, combiners, isolators, novel devices
- beam directors and adaptive optics.

LASERS TYPES AND LASER ARCHITECTURES SUITABLE FOR POWER SCALING

- advanced gas lasers (including DPAL, rare gas)
- solid state lasers, slabs, disks and diode arrays
- mid-IR lasers sources (including, fibers, QCL and OPO)
- efficiencies and thermal control, packaging: size, weight, ruggedness.
- beam combination: coherent, spectral, other.

NOVEL DESIGN IN FIBER AND SOLID-STATE LASERS

- speciality fibers and photonic crystal fibers
- eye-safe materials (Er, other).

LASER DEMONSTRATORS AND APPLICATIONS

- DIRCM systems.
- mobile, ground based, sea- or airborne.

SPECIAL TOPIC: UAV COUNTER-SENSOR & COUNTER-PLATFORM LASERS

- countermeasures against UAV's, drones, and non-traditional platforms
- countering swarms
- lasers on UAVs.

CHARACTERIZATION OF THE THREATS

- threat detection, warning, and discrimination
- "homeland defense" and border protection
- multispectral/hyperspectral imaging seekers
- hypersonic seeker/platform threats.

LASER BEAM PROPAGATION AND EFFECTS

- long-range propagation of high-power lasers, including vortex beams and filamentation
- atmospheric attenuation mechanisms (turbulence, thermal blooming)
- influence on seekers and imaging threat systems.

OPTICAL COUNTERMEASURES

- laser dazzling and effects
- closed-loop countermeasures
- nontraditional or alternative countermeasures
- hostile fire detection, indication, and suppression
- threat detection, warning, and discrimination
- pyrotechnic, flares, and expendable countermeasures
- smokes and obscurants
- multi-mode/multi-function operation.

MODELLING & SIMULATION

- laser performance models
- atmospheric predictive models
- assessment of countermeasure effectiveness.

Quantum Technologies for Defence and Security (SD105)

Conference Chairs: **Giacomo Sorelli**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany); **Sara Ducci**, Lab. Matériaux et Phénomènes Quantiques (France); **Sylvain Schwartz**, ONERA (France)

Programme Committee: **Maria I. Amanti**, Univ. Paris Cité (France); **Thierry Debuisschert**, Thales Research & Technology (France); **Massimiliano Dispenza**, Leonardo (Italy); **Angelo Gulinatti**, Politecnico di Milano (Italy); **Benjamin Huard**, Ecole Normale Supérieure de Lyon (France); **Jonathan Leach**, Heriot-Watt Univ. (United Kingdom); **Annick Loiseau**, ONERA-CNRS (France); **Jean-Michel Melkonian**, ONERA (France); **Harold Olivier**, Institut National de Recherche en Informatique et en Automatique (France); **Pietro Paglierani**, STO-CMRE (Italy); **Reinier Tan**, TNO (Netherlands); **Dominik Walter**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany); **Kevin Weatherhill**, Durham Univ. (United Kingdom); **Thomas Wellens**, Fraunhofer-Institut für Angewandte Festkörperphysik IAF (Germany); **Lisa Wörner**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Valery Zwiller**, KTH Royal Institute of Technology (Sweden)

The use of individual quantum systems as sensors, information carriers, and processors leads to the development of novel technologies that could play a disruptive role in both civil and military applications.

Quantum technologies are developing rapidly in several areas that are crucial for defense and security, such as remote sensing, imaging, PNT (position, navigation, and timing), secure communications, simulation, and computing. This conference has been created to bring together experts from academia, industry, and defense agencies to favor the integration of quantum technologies in defense and security systems.

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

QUANTUM SENSING

- atom interferometry for gravity, gravity gradients, acceleration and rotation sensing, applications to inertial navigation
- quantum interferometry with nonclassical states of light
- NV centers for electromagnetic field sensing, gyroscopes, and other applications
- electromagnetic field sensing with Rydberg atoms, from THz to RF
- quantum and quantum-inspired imaging and spectroscopy
- quantum radar and lidar.

QUANTUM COMPUTING AND SIMULATION

- quantum hardware
- quantum algorithms and use cases for security and defense
- error correction.

QUANTUM COMMUNICATIONS

- quantum key distribution
- quantum networks and quantum memories
- post-quantum cryptography.

QUANTUM DEVICES AND MATERIALS

- 1D and 2D materials as qubits or single-photon sources
- quantum detectors of electromagnetic fields
- sources of non-classical states of light.

Sensors and Communication Technologies in the 1 GHz to 10 THz Band (SD106)

Conference Chair: **Neil A. Salmon**, MMW Sensors Ltd. (United Kingdom)

Programme Committee: **Amir Abramovich Sr.**, Ariel Univ. (Israel); **Maria Alonso-delPino**, Jet Propulsion Lab. (United States); **Hakan Altan**, Middle East Technical Univ. (Turkey); **Darren Coe**, QinetiQ Ltd. (United Kingdom); **Stephan Dill**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Charmaine Cisneros Franck**, NASA Langley Research Ctr. (United States); **Marina Gashinova**, Univ. of Birmingham (United Kingdom); **Frank Gumbmann**, Rohde & Schwarz GmbH & Co. KG (Germany); **Stuart W. Harmer**, Univ. of Suffolk (United Kingdom); **Vishal S. Jagtap**, Tyndall National Institute (Ireland); **Marcin Kowalski**, Wojskowa Akademia Techniczna im. Jaroslawa Dabrowskiego (Poland); **Chong Li**, Univ. of Glasgow (United Kingdom); **Wladislaw Michailow**, Univ. of Cambridge (United Kingdom); **Fatemeh Norouzian**, Univ. of Birmingham (United Kingdom); **Markus Peichl**, Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Ozgur Ozdemir**, Istanbul Technical Univ. (Turkey); **Douglas T. Petkie**, Worcester Polytechnic Institute (United States); **Vyacheslav A. Trofimov**, South China Univ. of Technology (China)

A community of technology experts working in the 1 GHz to 10 THz bands is brought together to present and discuss papers in those areas mentioned below, for novel system development. Device knowledge, system integration and target phenomenology are focused on market-driven problems in security, defence and many spin-out areas. Range profiling and imaging radars and radiometers are typical sensors in the band, operating on land, sea, air and satellite-based platforms.

Drivers in the lower frequency spectral regions are the low atmospheric absorption and high transmissivity of clothing and packaging materials, enabling remote sensing and security screening applications. Moving towards the higher frequency regions, the increasing interactions with media provide capabilities for material identifications via spectral information content.

The variability of atmospheric attenuation over the band means high-data rate directional communications can be offered for long-haul links through the atmospheric windows and short-range, secure, local area networks in the absorption bands. Furthermore, the variability of material reflection and transmission properties over the band highlights the wide scope for non-destructive testing. In addition, there are great opportunities for medical applications, as radiation penetration in the human body ranges from a few centimetres at the lower frequencies, to a fraction of a millimetre at the higher frequencies.

Papers are sought in the following areas:

- detectors, mixers, sources, modulators, I & Q receivers and ADCs
- materials (stealth, chiral, left-handed, plasmonics, metamaterials)
- MMICs and integrated systems, including PIC devices and subsystems
- sensors using machine learning and AI
- computational imaging (3D depth, time of flight and light-field sensing)
- simulation, modelling and target phenomenology
- quantum sensors exploiting superposition and entanglement, including quantum radar
- security screening systems for personnel (close range portal, and stand-off systems)
- systems for non-metallic & metallic knife/gun detection
- explosives & contraband detection
- vehicle screening systems for people trafficking
- shoe scanning for airport security
- handheld screening systems
- mail packages and hand baggage screening systems
- near-field scanning microscopes and imagers
- all-weather (rain, fog, cloud) imagers for (autonomous) air, sea and land vehicles
- drone detection and sensors using (swarms of) drones
- missile launch detection, tracking and seekers

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Sensors and Communication Technologies in the 1 GHz to 10 THz Band continued (SD106)

- radars: late time response (LTR), ground probing, synthetic aperture, ultra-wide band, THz
- systems exploiting polarimetry and tomography
- aperture synthesis imagers and high-speed digital cross-correlators
- novel THz spectrometers
- non-contact, under-bandage (burn) wound inspection
- diagnosing local circulatory disorders and vascularisation
- biomedical imaging (micro-Doppler & spectral breath analysis)
- resolution enhancement/super-resolution
- nondestructive testing for industry
- novel communication systems.

RECENT DEVELOPMENTS BOOSTING CAPABILITIES IN THE BAND ARE:

Detectors in the band are mainly of the radio (or electromagnetic mode) type, very different from the photon detectors used in the infrared and visible bands. A constant evolution of these radio detectors, using new materials offers ever improved performances. The detectors are inherently polarimetrically sensitive, offering capabilities for target and material characterisation using well-established techniques from the field of passive and active polarimetry.

Mixers, which shift large bandwidths of energy from one spectral region to another, are also of interest, as they can enable higher signal-to-noise ratios for detection. As with detectors, their structures and semiconductor types are constantly evolving to offer better performance. A class of mixers which can shift large bandwidths into the optical band are of particular interest, as they enable imaging systems to be developed using well-established, lower-cost optical focussing technologies.

Sources, are based on positive feedback and negative resistance, and when combined with mixers generate radiation over a wide frequency range. Of heightened interest now are the photonic integrated circuit (PIC) devices. Fabricated on a monolithic substrate, these devices can be a quantum cascade laser, an Auston switch, or a two-frequency beat device. In the Auston switch and the two-frequency beat device, optical laser radiation incident on a semiconductor generates difference frequency

radiation in the terahertz band through a nonlinear interaction. The two-frequency beat device generates particularly low phase noise coherent radiation, a great attribute for terahertz radars and communication systems. The PIC devices are enabling much smaller and lighter-weight systems for commercial exploitation.

Complementary technologies to the above are the plasmonic and metamaterial structures which confine electromagnetic modes to specific regions, to enable potentially compact and novel system architectures.

Recent innovations in structure simulator software have seen the appearance of open-source packages which compute full-wave Maxwell equation solutions. These enable efficient low-cost modelling of system components (antennas, lenses, transmission lines, couplers) and object responses for the investigation of novel applications and feasibility studies. Combined with phenomenology knowledge, a wide variety of materials, liquids, gases and plasma plumes can be modelled.

Microwave monolithic integrated circuit (MMIC) radar chips have become available over the past few years, motivated by the automotive radar industry, but now enabling a diversity of other applications. European companies are now integrating the MMICs on to a circuit board containing integral antenna(s), in-phase and quadrature (I & Q) processing and data acquisition electronics and open-source computer interface software. Having usually two or more antennas, they are available for only several hundred Euros each. With centre frequencies around 24 GHz, 60 GHz, 77 GHz and 120 GHz and several GHz of bandwidth, novel applications are enabled where ranging, polarisation and multi/in/out (MIMO) capabilities are required.

The rapid evolution of free and open-source machine learning modules over the past 10 years coupled with knowledge of target phenomenology means novel algorithms can now be written to provide unprecedented capabilities in target classification and recognition.

Contributing to the recent interest in sensors exploiting quantum superposition and entanglement, millimetre and terahertz continuous-variable systems can operate at ambient temperature, whilst discrete-variable systems can operate at cryogenic temperatures (where photon energy $hf > kT$ electromagnetic mode energy).

Emerging Imaging and Sensing Technologies for Security and Defence IX (SD107)

Conference Chairs: **Gerald S. Buller**, Heriot-Watt Univ. (United Kingdom); **Robert A. Lamb**, Leonardo MW Ltd. (United Kingdom); **Martin Laurenzis**, Institut Franco-Allemand de Recherches de Saint-Louis (France)

Programme Committee: **Giulia Acconcia**, Politecnico di Milano (Italy); **Gareth Brown**, Defence Science and Technology Lab. (United Kingdom); **Markus Henriksson**, FOI-Swedish Defence Research Agency (Sweden); **Richard C. Hollins**, Defence Science and Technology Lab. (United Kingdom); **Keith L. Lewis**, Sciovis Ltd. (United Kingdom); **Heli Lukner**, Univ. of Tartu (Estonia); **Jonathan C. Matthews**, Univ. of Bristol (United Kingdom); **Robert P. J. Nieuwenhuizen**, TNO (Netherlands)

This conference highlights advances made in electro-optical and photonics technologies for military and civilian sensor and imaging applications.

The increasing use of autonomous platforms, unmanned systems and small satellites drive the requirement for reduced size, weight, power and manufacturing cost (SWaP-C) whilst increasing the demand for increased data processing efficiency, reliability and functionality. Integrating several sensing modalities into single systems to provide a flexible mission capability is increasingly essential and further underpins the need to address performance with advanced engineering and data processing.

Continuous progress in the development of several technologies now mean that integrated engineering solutions can be realised. For example, nanoscale structured devices support the development of user-defined materials whose properties are optimised for a particular application. Additive manufactured lattice structures can be used in alloys and composites for free-form lightweight, rigid and athermal mechanical designs. Plasmonic and sub-wavelength scale metallo-dielectric structures can be made with specific refractive index profiles for ultrathin lightweight lenses, optical antennae, polarimetric detection and spectral filtration. Single photon detector arrays provide new opportunities for event-driven and neuromorphic data processing for computational sparse data processing. On-demand single photon sources provide new opportunities for quantum-based sensors, lidar, communications and imaging. Furthermore, the increasing sophistication of low-loss photonic integrated circuits (PIC) means that light can be manipulated and controlled by compact devices for complex waveform generation, signal detection and data processing.

These technologies inspire optical engineering and system-on-a-chip approaches for a new generation

of sensors with greater integrated processing capability for advanced targeting, lidar, communications, materials detection and chem/bio sensing.

This conference seeks papers on photonic technologies, data processing techniques and their integration into proof-of-concept sensors based on the following areas of research:

- novel lasers, modulators, switches, filters, detectors and components
- 2D and 3D nanomaterials materials
- additive manufacturing techniques
- low-cost sensors for unmanned systems and small satellites
- metamaterials and plasmonics including filters, optical antennae, moth eye coatings and ultrathin lenses
- techniques for exploiting heterogeneous integration eg III-Vs on silicon
- computational imaging techniques for image reconstruction from under-sampled data sets (sparse imaging), computational multispectral imaging using mosaic filters and imaging through turbid media and turbulence
- devices that support the development of quantum sensing, quantum imaging, quantum communications and navigation.

Papers that demonstrate the use of these photonic devices for operational requirements are also welcome, especially:

- sensors for target detection and tracking
- high data rate directional and secure communications links
- nondestructive testing of materials
- chem/bio detection
- detection in the cluttered environment, e.g. camouflaged or hidden threats, through turbulence or poor weather
- threat recognition / identification enabled by AI and photonic neuromorphic processing
- medical diagnostics.

Advanced Materials, Biomaterials, and Manufacturing Technologies for Security and Defence II (SD108)

Conference Chairs: **Chantal Andraud**, Ecole Normale Supérieure de Lyon (France); **Roberto Zamboni**, Istituto per la Sintesi Organica e la Fotoreattività (Italy); **Andrea Camposo**, Istituto Nanoscienze (Italy); **Luana Persano**, Istituto Nanoscienze (Italy)

Programme Committee: **Carrie M. Bartsch**, Air Force Research Lab. (United States); **Valentina Benfenati**, Istituto per la Sintesi Organica e la Fotoreattività (Italy); **Lynda E. Busse**, U.S. Naval Research Lab. (United States); **Fabrice Charra**, Commissariat à l'Énergie Atomique (France); **Przemyslaw Data**, Durham Univ. (Poland); **Beata J. Derkowska**, Torun Univ. (Poland); **Maria Farsari**, Foundation for Research and Technology-Hellas (Greece); **James G. Grote**, Air Force Research Lab. (United States); **Emily M. Heckman**, Air Force Research Lab. (United States); **Andreas Heinrich**, Hochschule Aalen - Technik und Wirtschaft (Germany); **François Kajzar**, Univ. Politehnica of Bucharest (Romania); **Loïc Mager**, Institut de physique et chimie des matériaux de Strasbourg (France); **Jaroslav Mysliwiec**, Wrocław Univ. of Technology (Poland); **Yoshiko Okada-Shudo**, The Univ. of Electro-Communications (Japan); **Dario Pisignano**, Istituto Nanoscienze (Italy); **Bastian E. Rapp**, Univ. of Freiburg (Germany); **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. (United States)

Advanced materials and systems based on micro- and nanostructures are essential for next generation imaging, sensing and energy harvesting devices addressing the need for sustainable development. These devices are expected to be portable, wearable, self-powering and self-healing, while featuring high sensitivity and selectivity, intrinsic signal amplification and fast response times. Current micro- and nanotechnologies have enabled a novel range of structured and architected materials, which possess enhanced properties compared to their bulk equivalent. In addition, the availability of technologies allowing for precise manipulation and assembly of micro- and nanostructured materials, 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 will highlight the state of the art of emerging materials, biomaterials, and related manufacturing technologies, and their role in the development of new security and defence systems. This conference aims at establishing an interdisciplinary platform for researchers and engineers both from academy and industry to exchange knowledge, to review materials and device R&D, 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.

Papers should focus on short technology reviews or recent results of new materials, processes and devices. Papers may address practical, theoretical and modeling aspects. Original technical and scientific papers are solicited on, but are not limited to, the following topics:

- organic, inorganic and hybrid materials for photonics and optoelectronics
- nanophotonic and nano-optoelectronics structures and devices
- photonic bandgap materials
- biomolecular recognition materials
- biopolymer-based photonics
- biotronics
- biomaterials
- plasmonic structures and applications
- metamaterials and metamaterials-based 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
- simulation of physical processes in molecular media
- organic materials for night vision and border control
- biopolymers for display and camouflage

- nanogenerators harvesting mechanical/ thermal energy into electricity
- methods for hydrogen storage
- environmental friendly batteries and energy storage devices
- fuel cell technology
- advanced fabrication approaches for wearable sensors and electronics
- bio-inspired fabrication technologies and biomimetic devices
- soft and smart robotic systems
- advanced sensing systems for health parameter monitoring
- 3D printing of functional devices for security and defence
- manufacturing of quantum devices for sensing and imaging
- technologies for the modification of the properties of surfaces and interfaces
- synthesis of nanostructured and 2D materials
- production of polymer and hybrid nanofibers for sensing and energy harvesting systems
- soft and nanoimprint 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
- laser micro- and nanomachining for security and defence
- additive manufacturing of metals, alloys and multimaterials
- autonomous micro- and nanofabrication systems
- artificial intelligence-enabled smart manufacturing processes
- technologies for miniaturized imaging devices for security applications
- fabrication and application of photonic integrated circuits
- advanced Materials and technologies for interfacing with living systems
- advanced Materials and technologies for optomechanical systems
- advanced materials for Terahertz sensors.

Artificial Intelligence for Security and Defence Applications II (SD109)

Conference Chairs: **Henri Bouma**, TNO (Netherlands); **Radhakrishna Prabhu**, The Robert Gordon Univ. (United Kingdom); **Yitzhak Yitzhaky**, Ben-Gurion Univ. of the Negev (Israel)

Programme Committee: **Hakan Altan**, Middle East Technical Univ. (Turkey); **Stefan Becker**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Cevahir Çigla**, ASELSAN A.S. (Turkey); **Jorge García**, Vicomtech (Spain); **Nicolas Hueber**, Institut Franco-Allemand de Recherches de Saint-Louis (France); **Hugo J. Kuijff**, TNO (Netherlands); **David Muench**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany); **Praboda Rajapaksha**, Aberystwyth Univ. (United Kingdom); **Paul A. Thomas**, Defence Science and Technology Lab. (United Kingdom); **Chris L. Willis**, BAE Systems (United States)

Artificial Intelligence (AI) has emerged as a key technology in security and defence applications. AI is used to obtain situational awareness and to extract the relevant information from a large collection of data. The need for AI is increasing, as the amount of sensor data increases while there are fewer analysts and camera operators available. This conference will focus on technology development in artificial intelligence and machine learning techniques for automatic and machine assisted image and video analysis for defence and security applications. The conference provides a forum for researchers and end users to present and discuss the latest developments in AI.

Topics include, but are not limited to:

- deep learning
- detection and tracking
- classification, recognition, identification
- action recognition and behavior analysis
- threat assessment
- privacy enhancing techniques
- synthetic data and adversarial networks
- active learning
- explainable AI
- cyber security
- maritime and space situational awareness
- intelligence, surveillance and reconnaissance
- compound security and infrastructure protection
- border control.

Autonomous Systems for Security and Defence

(SD110)

Conference Chairs: **Judith Dijk**, TNO (Netherlands); **Jose Luis Sanchez-Lopez**, Univ. du Luxembourg (Luxembourg)

Programme Committee: **Javier Civera**, Univ. de Zaragoza (Spain); **Sylvie Dijkstra-Soudarissanane**, TNO (Netherlands); **Valentina Donzella**, The Univ. of Warwick (United Kingdom); **Simos Gerasimou**, Univ. of York (United Kingdom); **Andrea Masini**, Flyby S.r.l. (Italy); **Jonas Nygård**, FOI-Swedish Defence Research Agency (Sweden); **Janko Petereit**, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung IOSB (Germany); **Holger Voos**, Univ. du Luxembourg (Luxembourg); **Ramon Suarez Fernandez**, Univ. Politécnica de Madrid (Spain)

Unmanned systems are increasingly being deployed across various defense and security applications, operating as standalone units, as a collaborative team of unmanned systems and potentially interacting with humans too. A key challenge for these deployments is to enhance the robust autonomy of these systems within real-world environments, while retaining human control. Such a requirement necessitates for technology developments and deployment of these systems within legal and ethical boundaries. Additionally, this requirement and its scope needs to be considered in the context of technologies for shared situational awareness and self-awareness within the operational context and situations where the systems are deployed.

This conference will center around advancing cutting-edge technology for imaging sensing and perception components applied autonomous systems, particularly tailored for defence and security applications. The conference will focus on various unmanned platforms, such as Unmanned Aerial Vehicles (UAVs), Unmanned Ground Vehicles (UGVs), Unmanned Surface Vehicles (USVs) and Unmanned Underwater Vehicles (UUVs). The range of perception sensors under consideration include Electro-Optical/Infrared (EO/IR) sensors, Light Detection and Ranging (LIDAR) systems, as well as multi- and hyper-spectral imaging devices.

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

PLANNING & NAVIGATION

- simultaneous localization and mapping
- simultaneous localization and mapping
- assign different tasks to specific systems
- planning within operational rules
- affordance recognition for manipulation
- control systems for actuation.
- Shared Situational Awareness
- real-time sensing

- persistent tracking
- re-identification of objects
- shared observation over multiple platforms.

HUMAN-MACHINE INTERACTION

- delegation approaches
- approaches for meaningful human control
- augmented and virtual reality
- telepresence and the combination of autonomy and telepresence.

FOUNDATION MODELS

- foundation models for situational awareness
- foundation models for planning
 - combined planning and situational awareness
 - human-machine interface with foundation models,

OTHER TOPICS

- edge processing
- perception sensor data degradation
 - sensing in harsh weather and challenging environmental conditions
 - perception sensor data filtering, enhancement, compression
 - uncertainty & risk based processing
 - open world issues
 - using foundation models.

DEFENCE & SECURITY APPLICATIONS

- maritime situational awareness
- compound security and force protection
 - border protection
 - route clearance
 - reconnaissance and surveillance
 - vehicle situation awareness
 - urban search and rescue.

Present your research at SPIE Sensors + Imaging

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Important dates

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Registration opens	17 June 2024
Author notified and programme posts online	24 June 2024
Submission system opens for manuscripts and poster PDFs*	3 July 2024
Poster PDFs due for spie.org preview and publication	21 August 2024
Manuscripts due	28 August 2024
Advance upload deadline for oral presentation slides**	13 September 2024

*Contact author or speaker must register prior to uploading

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What you will need to submit

- Title
- Author(s) information
- Speaker biography (1000-character max including spaces)
- Abstract for technical review (200-300 words; text only)
- Summary of abstract for display in the programme (50-150 words; text only)
- Keywords used in search for your paper (optional)
- Check the individual conference call for papers for additional requirements (i.e., special abstract requirements or instructions for award competitions)

Note: Only original material should be submitted. Commercial papers, papers with no new research/development content, and papers with proprietary restrictions will not be accepted for presentation.

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All presenting authors, including keynote, invited, oral, and poster presenters, agree to the following conditions by submitting an abstract

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- Attend the meeting
- Present at the scheduled time

Review and programme placement

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- Conference chairs/editors reserve the right to reject for presentation any paper that does not meet content or presentation expectations
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