SPIE. DEFENSE+ COMMERCIAL SENSING

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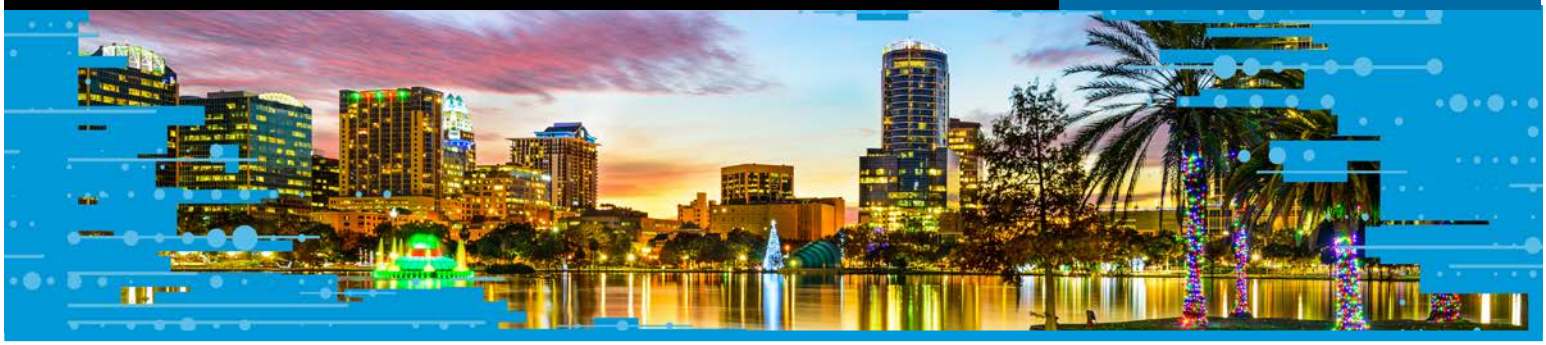

Image Sensing Technologies: Materials, Devices, Systems, and Applications IX (SI102)

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Image sensing technologies extending across broad bands of the electromagnetic spectrum from ultraviolet (UV) to long-wave infrared (LWIR) regions are advancing from novel sensing devices to camera system level implementations for commercial applications in a diverse market mix including automotive, biomedical, security and surveillance, agriculture and industrial machine vision. In the near future, embedded vision technologies will become an integral part of the emerging Internet of Things and Smart Cities. Additionally, applications of artificial intelligence and neuromorphic computing is now being applied to imaging technology giving rise to advanced smart imaging capabilities. The goal of the conference is to convene the community of researchers active in image-sensing-related research covering materials, devices (image sensor), optics, hybridized or monolithic integration of optics and electronics, camera systems, intelligent image processing and their novel applications. The conference provides a robust platform for the mutual exchange of ideas. The conference will address topics directed towards the understanding and advancement of the state-of-the-art for image sensing technologies ranging from UV to LWIR spectrum. The primary emphasis is on emerging commercial and industrial applications.

Silicon-based imaging sensors (CMOS/CCD) in large format especially for the visible (VIS) spectrum are today widely used in all types of consumer and commercial camera systems from security and surveillance, to smart phones and digital cameras, and recently making in-roads into more value-added applications such as emerging automotive, medical imaging, IoT and Smart Cities. With this progression, technology innovation in Si-based camera systems not only requires large formats extending from tens of mega pixels to several giga-pixel formats, but also extending its spectrum range into the near-infrared (NIR) region.

Initially, image sensing technologies, especially in NIR, shortwave IR (SWIR), mid-wave IR (MWIR), and long-wave IR (LWIR) spectrum regions were used exclusively by the geo-satellite and defense industries. This was in part due to restrictions on dual-use, but overwhelmingly due to the high cost of such imaging devices, systems, and applications. However, this extremely expansive and spectrally unique portion of the wavelength spectrum was of high interest for such applications as space-based imaging and communications, upper atmospheric sensing, remote sensing, security and surveillance, and high-end machine vision.

More recently, the UV to LWIR spectral bands have been identified as ideal for a wide range of imaging applications beyond scientific and defense sectors, to include the commercial industry from medical systems to bulk-cargo transit security, from automotive systems to agricultural crop monitoring systems, and from food safety to semiconductor quality control systems.

The need for low-cost small form-factor, light-weight, and low-power (SWaP-C) camera systems is pushing the technology innovation of image sensor technology to wafer level optics and/or electronics integration, either hybridized or monolithically integrated kinds. Researchers are seeking ways to embed more intelligence not only at the system software and algorithm levels that will power these image sensing applications, but also at the component and device level to include advanced and adaptive readout electronics, and image fusion processors. Moreover, the realization of various material systems especially on a wide range of substrate usage (e.g., Si, GaAs, dielectric, etc.), nanostructures, metamaterials, 2D materials and composite materials along with advances in optics and device performance may revolutionize overall image sensing technologies in all spectrum regions.

In addition to Si-CMOS/CCD sensors, low-cost and larger format infrared imagers are making in-roads. Recent developments in various detector materials systems, II-VI, III-V, and developments in room temperature IR detectors have resulted in significant material advances, signaling the possibility of higher-performance IR image sensing technologies at optimal cost to continue the trend towards broader commercial and defense industry applications.

The scope of the conference spans topics in new image sensor device-physics, new optical and sensing materials, components and subsystem level development for novel commercial and industrial applications. The scope also includes research in embedded intelligence in imaging sensors such as Artificial Intelligence and machine learning capabilities. This conference intends to bring together scientists and engineers involved in the development and transition into commercial and industrial application spaces of novel image sensing concepts from UV to LWIR, broadband or multispectral imaging including various multiband combinations VIS-SWIR, VIS-LWIR, NIR-MWIR, SWIR-LWIR, and other options. Concepts relating to new broadband antireflection (AR) coating and lens technologies are also of interest. Cutting edge topics including image processing techniques on or off the focal plane array, smart reconfigurable readout

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electronics that bring more intelligence, including but not limited to, artificial intelligence, machine / deep learnings, and neuromorphic processing, technologies to the imaging devices or systems, innovative packaging techniques, small scale compact systems, lens and optics integration at wafer scale, innovative camera encapsulation techniques with SWaP-C optimization in emerging applications are all of interest.

The sessions are organized to facilitate the exchange of ideas and promote the discussion of recent progress in image sensing device, materials, optics integration research, and trends toward application and system-level development. It is anticipated that this conference will foster cross-fertilization amidst many disciplines with participants being exposed to the entire range of scientific and engineering problems associated with the concepts-to-systems development pipeline, as well as the development roadmaps at commercial companies, research institutions, academia, and government agencies.

We are looking for papers that demonstrate state-of-the-art in novel image sensing technologies that will serve as tools for researchers in various disciplines. Papers are solicited for, but not limited to, the following topics:

MATERIAL TECHNOLOGIES FOR IMAGE SENSING

- composites material systems for image sensor and bolometer
- detector / bolometer materials (i.e., Si, Ge, InSb, HgCdTe, GaAs, ZnS, ZnSe, etc.)
- nanotechnologies (nanowires, nanopillars, plasmonic, metamaterials, etc.) -based image sensor
- colloidal technologies for low-cost image sensor
- smart sensing materials
- broadband operation with sensitive detection and conversion of below-bandgap photons
- nano-patterned structures for advanced light trapping schemes via holographic lithography
- nano-enhanced absorbers in the IR range
- advanced windows based on novel transparent conductors
- bandstructure nano-engineering for high conversion performance
- nano-engineered electron processes for suppression of thermalization and recombination losses
- advanced passivation schemes for reducing surface recombination
- epitaxial growth processes of materials on compliant and non-compliant substrates (e.g. HgCdTe, GaAs, InGaAs, etc.) for detectors, and other optoelectronic applications.

DEVICE TECHNOLOGIES FOR IMAGE SENSING

- innovative devices (e.g. PIN, MQW, APD etc.)
- innovative process and post process (e.g. 3-D integration)
- recent development of detectors and bolometers for image sensing: X-ray, UV, VIS, SWIR, MWIR, and LWIR
- advances in alternative technologies (organic, a-Si etc.)
- nano/micro bolometers
- single-photon imaging: theoretical basis, sensor design, and production
- large-format FPA, bolometer, and CMOS sensor
- advanced quantum structures for large FPAs
- on-chip (image sensor) image fusion processors
- novel uncooled FPA and bolometer technologies
- bio-inspired techniques for detectors
- development of Novel III/V II/IV/VI materials and devices
- transition efforts that raise the operating temperature and reduce the cost of “cooled” high performance infrared detectors
- transition efforts that increase performance of “uncooled” infrared detectors
- plasmonics /photonics structure to enhance detector QE
- FPA and lens/filter-integration
- single photon detector and its array for quantum sensing.

READ-OUT TECHNOLOGIES FOR IMAGE SENSING, RANGE DETECTION, AND QUANTUM SENSING

- development of advanced readout circuits including neuromorphic and bio-inspired circuit designs
- on-chip image processing for 3-D imaging
- innovative high-performance (e.g., high dynamic range and high frame rate, ultralow power, ultra low noise, large format, high speed , etc.) readout integrated circuits (ROIC)
- noise analysis and noise reduction techniques
- on-chip signal or image processing
- high throughput image sensor
- readout circuits for quantum sensing.

OPTICS AND INTEGRATION TECHNOLOGIES

- theoretical studies and modeling of materials and photonic crystal applications to lenses and windows
- hybrid and monolithic integration of optics and image sensors
- wafer-level optics and electronics integration
- on-chip and off-chip micro-lens array
- broadband AR coating and lens and their integration to image sensors
- broadband metasurface based optics and their integration to image sensors.

IMAGE SENSING SYSTEMS, ALGORITHMS, AND APPLICATIONS

- sensor system integration and performance
- multi-sensor system
- high throughput system for image sensing computer vision
- multiband image fusion systems
- FPAs for simultaneous active and passive imaging
- adaptive multimode sensing
- multimodal-sensor-in-a-pixel FPA
- time-of-flight and 3D imaging applications
- developments in broadcast image sensor technology
- multi-aperture imaging
- computer simulation and modeling of single and multicolor detectors and systems
- on-chip/off-chip vs component/algorithm trade-off strategies for system speed, efficiency, and SWaP-C maximization
- imaging systems and camera image quality benchmarking: pinpointing defects that degrade image quality and their source (optics, sensor, processing)
- machine learning and algorithm for smart imaging and sensing
- compression sensing and imaging
- ladar/lidar for 3D imaging
- computational imaging
- embedded vision for intelligent imaging
- imaging and its applications based on THz technique
- hyperspectral/multispectral imaging, system integration, and applications
- machine Learning (ML) or Deep Learning / AI Algorithms for smart vision or imaging and their applications
- multispectral system for Medical imaging
- remote sensing
- optical sensing for agriculture
- fluorescence imaging
- quantum sensing/imaging.

CONTINUED NEXT PAGE➡

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Below are abstract submission instructions, the accompanying submission agreement, conference presentation guidelines, and guidelines for publishing in the Proceedings of SPIE on the SPIE Digital Library. Submissions subject to chair approval.

Important dates

Abstract submission deadline	6 October 2021
Author notification	3 December 2021
Submission system opens for presentations and manuscripts*	31 January 2022
Manuscript due	9 March 2022
Oral presentation videos due	9 March 2022
Poster PDF and preview videos due	9 March 2022
Oral presentation slide deadline	1 April 2022

*Authors must register prior to uploading.

What you will need to submit

- Title
- Author(s) information
- 250-word abstract for technical review
- 100-word summary for the program
- Keywords used in search for your paper (optional)
- Check the individual conference Call for Papers for additional requirements (for example, some conferences require 2- to 3-page extended summary for technical review, or have 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.

How to submit your abstract

- Visit the conference page: www.spie.org/SI102call
- You may submit more than one abstract but submit each abstract only once.
- Click the "Submit An Abstract" button on the conference page.
- Sign in to your SPIE account or create an account if you do not already have one.
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Submission agreement

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

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- Ensure that all clearances, including government and company clearance, have been obtained to present and publish. If you are a DoD contractor in the USA, allow at least 60 days for clearance.
- Attend the meeting.
- Present at the scheduled time.

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