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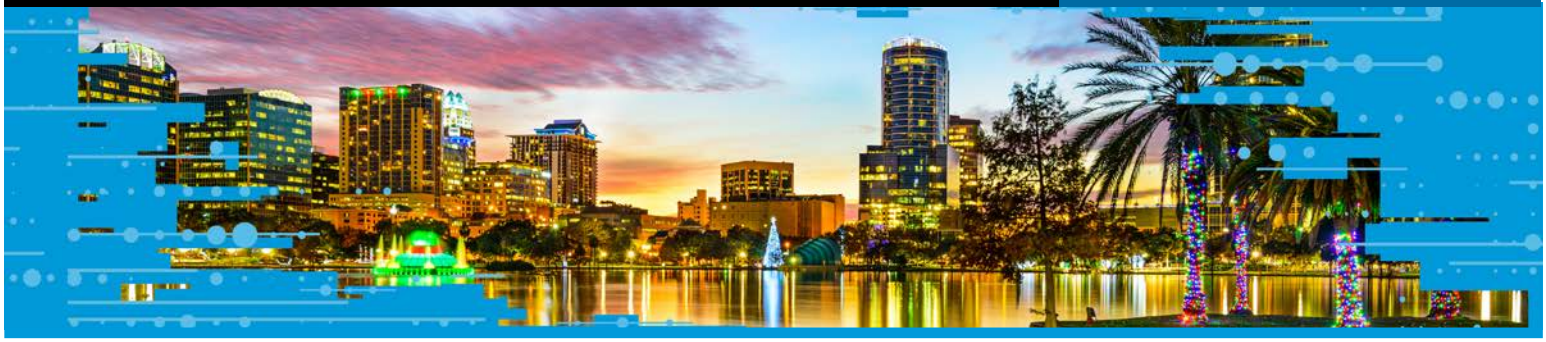

Virtual, Augmented, and Mixed Reality (XR) Technology for Multi-Domain Operations III (SI223)

Conference Chairs: **Mark S. Dennison Jr.,** U.S. Army Research Lab. (United States); **David M. Krum,** California State Univ., Los Angeles (United States); **John (Jack) N. Sanders-Reed,** Image & Video Exploitation Technologies, LLC (United States)

Conference Co-Chair: **Jarvis (Trey) J. Arthur III,** NASA Langley Research Ctr. (United States)

Program Committee: **Brendan W. Blanton,** Northrop Grumman Corp. (United States); **Michael P. Browne,** SA Photonics, Inc. (United States); **Damon M. Conover,** U.S. Army Research Lab. (United States); **Michael D'Zmura,** Univ. of California, Irvine (United States); **Venkateswara R. Dasari,** U.S. Army Research Lab. (United States); **Celso de Melo,** U.S. Army Research Lab. (United States); **Daniel D. Desjardins,** Western Carolina Univ. (United States); **Gary W. Jones,** NanoQuantum Sciences, Inc. (United States); **Michael N. Geuss,** U.S. Army Research Lab. (United States); **Glenn Hodges,** MOVES Institute at the Naval Postgraduate School (United States); **Shanalyn A. Kemme,** Sandia National Labs. (United States); **Peter Khooshabeh,** U.S. Army Research Lab. (United States); **Joshua Kvavle,** Naval Information Warfare Ctr. Pacific (United States); **James E. Melzer,** Thales Visionix, Inc. (United States); **Niklas Peinecke,** Deutsches Zentrum für Luft- und Raumfahrt e.V. (Germany); **Kim Pollard,** U.S. Army Research Lab. (United States); **Tiffany Raber,** CCDC Data & Analysis Ctr. (United States); **Adrienne J. Raglin,** U.S. Army Research Lab. (United States); **Chris Reardon,** Univ. of Denver (United States); **Simon M. Su,** U.S. Army Research Lab. (United States); **Evan Suma Rosenberg,** Univ. of Minnesota, Twin Cities (United States); **Theron T. Trout,** Stormfish Scientific Corp. (United States); **Suya You,** U.S. Army Research Lab. (United States)

Papers are sought on all aspects of situation awareness using augmented, virtual, and mixed reality (XR) for multi-Domain operations (MDO) in complex and degraded environments. Applications include both civilian and military use cases involving dismounted operators, surface vehicles, air vehicles and can include a priori databases as well as live local / remote sensors.

Degraded Visual Environments (DVE) are described as obscurants which reduce operator visibility such as smoke, haze, fog, dust, rain, snow, or reduced illumination (night). Vehicle structure which reduces direct external viewing (e.g. embedded cockpits or armored vehicles) represents another form of DVE. Degraded Environments also include Electro-Magnetic Effects (EME) such as GPS jamming or denial and degraded radio frequency environments (loss of communications). Optical degradation includes the effects of dazzlers or laser illumination. Papers discussing Phenomenology of Degraded Environments and Sensing for pilotage, targeting, Intelligence, Surveillance, and Reconnaissance (ISR), threat detection, and other functions are sought.

Technologies that allow the perception of virtual, augmented, or mixed reality (collectively XR) will provide operators with novel ways of accessing, consuming, and interacting with heterogeneous information and accelerate and augment their decision-making and situation awareness. Factors which support situation awareness include sensing (both on-board and off-board sensors), databases (e.g. terrain and cultural features), sensor processing (fusion, stitching, feature extraction and threat detection), data integration, display, and human factors. The intersection of data integration, display, and human factors is of interest to support human situation awareness and decision making in high tempo operations with many near simultaneous events which could lead to high operator workload. Papers are invited which explore concepts for collaboration of manned-unmanned teaming to extend sensor range and provide improved situation awareness. It also includes system concepts which couple sensor processing directly to vehicle or body-worn control systems.

XR has recently experienced explosive technological growth in both hardware and software solutions, making the bleeding edge a moving target. Despite this, a significant divide exists between industry goals, foundational academic research, and understanding of military requirements. As the literature on immersive analytics is in its infancy, it necessitates XR experts to collectively pave the roadmap for future essential research topics.

The primary goal of this conference is to (1) spark discussion of current and future challenges for integrating XR systems into combat operations in degraded and complex environments and (2) highlight collaborative R&D activities in technologies that support Multi-Domain Operations applications.

The topics for this conference include, but are not limited to:

OPERATIONS IN DEGRADED VISUAL AND COMPLEX MULTI-DOMAIN OPERATIONS

- operational surveys, studies, and trials
- flight qualification and certification issues
- operations through DVE weather, smoke, and other obscurants
- windowless cockpits
- runway and taxiway following
- runway incursions, collision avoidance
- automated landing systems
- development of DVE system requirements: methodology and results
- techniques for cross-domain information transfer and visualization
- human-agent teaming: embodied agents, virtual humans, asset control
- training and simulation: realistic virtual environments, user studies, teleoperations, mission rehearsal and debriefing.

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DVE-PENETRATING SENSORS AND SYSTEMS

- enhanced, low-light CCD
- long-wave, mid-wave, and short-wave infrared
- active millimeter-wave radar
- passive millimeter-wave imaging
- terahertz imaging for obscurant penetration
- obscurant penetrating 3D lidar
- night vision, color night vision
- weather radar exploitation
- sensor operation and control
- multi-band/multi-phenomenology approaches
- dual- or multi-use sensors
- sensor, weather, and environmental effect simulation
- airport surface characterization at low-grazing angles (MMW effects)
- phenomenology.

SENSOR PROCESSING ALGORITHMS, ARCHITECTURES, AND CAPABILITIES

- image enhancement, registration, exploitation
- multispectral image fusion, feature extraction, obstacle and wire detection
- coupling sensor processing to vehicle control systems
- dangerous weather identification (microburst, wind shear, etc.)
- airport, runway, and taxiway feature matching
- world-conformal display alignment methods
- system latencies, refresh rates
- architectures for sensor and information management and distribution
- terrain and obstacle database management, including sensor driven real-time updating
- database acquisition, generation, verification, certification, formats
- efficient rendering techniques for terrain and high volume ladar/lidar data
- embedded graphics systems, multicore GPU algorithm acceleration
- system inputs and interaction: virtual locomotion and haptics, input and interface techniques for AR, VR, MR
- cross-reality networking and interoperability: distributed and local systems, multi-user synchronization, sensor and data I/O, constrained and ad-hoc mobile networks, edge computing

DISPLAY SYSTEMS AND PRESENTATION FORMATS

- head-up, head-down, head-worn display formats
- heads up/eyes out flight information and formats
- 360° viewing, picture-in-picture windows
- photo-realistic display, 3D stereo display formats
- value and limitations of color information display
- dynamic perspective flight guidance, 4D pathway, highway in the sky
- flight-management and planning systems integration
- electronic Flight Bag integration
- information management, integration, and presentation
- user studies examining human perception capabilities
- user experience and multi-sensory integration: perception and cognition, physiological responses, motion sickness, telepresence, multi-user interaction.

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ABSTRACT SUBMISSION GUIDELINES

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/SI223call
- 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.
- Follow the steps in the submission wizard until the submission process is completed.

Submission agreement

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

- Register and pay the author registration fee.
- Oral Presenters: Submit a presentation video by the advertised due date, or agree to the presentation capture of your presentation on site, for online conference viewing during the event and publication in the Proceedings of SPIE on the SPIE Digital Library.
- Poster Presenters: Submit a Poster PDF and optional preview video by the advertised due date, for online conference viewing during the event and publication in the Proceedings of SPIE on the SPIE Digital Library.
- Submit a 4-page-minimum manuscript by the advertised due date, for online conference viewing during the event and publication in the Proceedings of SPIE on the SPIE Digital Library.
- Obtain funding for registration fees, travel, and accommodations, independent of SPIE, through their sponsoring organizations.
- 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.

Review and program placement

- To ensure a high-quality conference, all submissions will be assessed by the Conference Chair/Editor for technical merit and suitability of content.
- Conference Chairs/Editors reserve the right to reject for presentation any paper that does not meet content or presentation expectations.
- Final placement in an oral or poster session is subject to chair discretion.

Publication of Proceedings in the SPIE Digital Library

- SPIE will publish all presentations for viewing during the conference, as well as permanently archive all presentations in the conference proceedings on the SPIE Digital Library.
- SPIE retains rights to distribute and market the official SPIE recording of the presentation, presentation video, and/or poster.
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- More publication information available on the SPIE Digital Library.

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