

CALL FOR ABSTRACTS

JOINT NAVIGATION CONFERENCE 2020



June 1-4, 2020

Northern Kentucky Convention Center
Covington, KY/ Cincinnati, OH

Classified Session hosted at
Air Force Institute of Technology
Dayton, Ohio



**Abstracts Due
February 3, 2020**

Enhancing Dominance and
Resilience for Warfighting and
Homeland Security PNT



ion.org/jnc



Abstract Submission: Due February 3, 2020



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ABSTRACT SUBMISSION GUIDELINES

Abstracts Due: February 3, 2020

All abstracts must be written for public release with intent to present in a FOUO U.S. ONLY environment. Abstracts not approved for public release will not be accepted. Note that you must be a citizen of the USA to submit an abstract for FOUO U.S. ONLY sessions (June 1-3) and a citizen of the USA, with SECRET CLEARANCE, to submit an abstract for the classified sessions (June 4).

Abstracts should be submitted electronically via the ION Abstract Management Portal (AMP), no later than February 3, 2020. To submit an abstract, sign in at www.ion.org/abstracts.

- If you have not used AMP before, click "Create My Account."
- Once signed in, click on JNC and complete the form.
- Abstracts should include a presentation summary; describe objectives, anticipated or actual results, conclusions, any key innovative steps and the significance of your work; and limited to one page.
- Authors will be notified of acceptance in March and sent an electronic author's kit with presentation and publication guidelines.

Abstracts submitted for classified sessions should be written for public release and submitted according to the submission guidelines described above.

PRESENTATION REQUIREMENTS

Sessions will consist of presentations. Unless otherwise noted, all presentations must be approved for public release (Distribution A) or FOUO U.S. only. (Distribution C). An electronic copy of your final presentation (typically a PowerPoint file) with a signed release form must be received by the ION National Office by June 12 to be included in the FOUO proceedings. Presenters will receive a speaker's kit with presentation guidelines and additional meeting information. You must be a citizen of the USA to present at the conference and also provide verification of SECRET CLEARANCE to present in the classified session (June 4). Speakers presenting as part of the classified session must provide their classified presentation in advance to the Joint Navigation Warfare Center (JNWC) no later than May 1. All presenters must pay conference registration fees.

CONFERENCE PROCEEDINGS

Submitted presentations, approved for public release (Distribution A) and/or FOUO (Distribution C) distribution, will be released to U.S. citizens who were approved to attend the conference by the JNWC in an electronic FOUO proceedings 4-6 weeks following the conference.

CONFERENCE ATTENDANCE INFORMATION

The JNC's DTS conference ID is N20150610734

The conference will be hosted in a FOUO U.S. ONLY environment June 1-3 at the Northern Kentucky Convention Center, Covington Kentucky and a U.S. only classified environment on June 4 at the Air Force Institute of Technology, Dayton, Ohio. Advance visit requests and approvals are required for all attendees. June 1-3 participation will be restricted to U.S. government and U.S. government contractors. June 4 classified session participation will be restricted to U.S. government, and U.S. government contractors with SECRET CLEARANCE.

- **Full-Conference Registration** rates for ION member registrants staying in an official conference hotel, received/paid by May 1, \$930; after May 1, \$1130. Full Conference Registration includes all technical sessions, exhibit hall access, conference refreshments and electronic proceedings.
- **Single-Day Registration** for registrants staying in one of the official conference hotels is \$530. Single-day registration rates include sessions only, no events or proceedings.
- **Accommodations** are available at four official conference hotels, at the prevailing government rate until May 1 or until the hotel block fills, whichever occurs first. Reserve a hotel room at www.ion.org/jnc
- Additional information and updates regarding the conference may be found online: www.ion.org/jnc.

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ABOUT THE JNC

The Military Division of the Institute of Navigation will host the 2020 Joint Navigation Conference (JNC 2020) for the Department of Defense and Department of Homeland Security. The theme of this year's conference will be:

Enhancing Dominance and Resilience for Warfighting and Homeland Security PNT

JNC is the largest U.S. military Positioning, Navigation and Timing (PNT) conference of the year with joint service and government participation. The event will focus on technical advances in PNT with emphasis on joint development, testing and support of affordable PNT systems, logistics and integration. From an operational perspective, the conference will focus on advances in battlefield applications of GPS; critical strengths and weaknesses of field navigation devices; warfighter PNT requirements and solutions; and navigation warfare.

FOUO U.S. only conference attendance (June 1-3) will be screened by the Joint Navigation Warfare Center and will be restricted to U.S. only. The classified session will have U.S. only Secret Clearance access (June 4). The exhibit hall (June 2-3) will be open to all conference participants, exhibiting organizations, their employees and related organizations. All materials displayed in the exhibit hall shall be publically releasable (Distribution A).

TECHNICAL PROGRAM COMMITTEE

Military Division Chair: John Langer, The Aerospace Corporation

Military Division Vice Chair: Jan Anszperger, Draper

Program Chair: Joseph Schneckner, NIWC Pacific

Program Vice-Chair: John Del Colliano, Army CCDC C5ISR

Tutorials Chair: Paul Olson, Army CCDC C5ISR

Plenary Chair: Dr. Thomas Powell, The Aerospace Corporation

Track Chairs:

- Jan Anszperger, Draper
- Dr. David Chapman, AFRL Space Vehicles Directorate
- Dr. Greg Reynolds, Army CCDC AvMC
- David Wolfe, USCG C3CEN

Other Members:

- Eddy Emile, SMC/Production Corps
- Elliott Kaplan, The MITRE Corporation
- Neeraj Pujara, AFRL Sensors Directorate
- Fay Spellerberg, Joint Navigation Warfare Center (JNWC)
- Ben Wash, Joint Navigation Warfare Center (JNWC)

JOURNAL PUBLICATION

JNC presenters are encouraged to write publically releasable (Distribution A) technical papers based on their JNC presentations to submit for possible publication in the ION's archival journal, *NAVIGATION* (indexed by Thomson Reuters). Papers may be submitted for publication online at <http://mc.manuscriptcentral.com/navigation>.

EXHIBITS

Over 50 companies exhibit annually at JNC, showcasing their products and services. This forum also provides valuable networking opportunities. For more information, visit the Exhibitor Resource Center at ion.org/jnc or email Ken Esthus at kesthus@ion.org.

FOUO SESSION TOPICS

Application/Impact of PNT Technologies in the Homeland Critical Infrastructure

This session will focus on the use of PNT technologies in the critical infrastructure with emphasis on discussing usage, vulnerabilities, and providing mitigating solutions to safeguards against threats to the critical infrastructure. PNT based technologies, such as GPS, are now an integral part of the national critical infrastructure. Many sectors rely on some aspect of PNT ranging from timing for communication systems to clock synchronization for power transmission in the electrical grid. The growing use of PNT along with potential threats and vulnerabilities to the critical infrastructure such as the electrical grid, communication, transportation, finance, and emerging infrastructure for domestic employment of UAV systems creates a challenge for safeguarding national assets and maintaining homeland security.

Topic Leads: David Wolfe, USCG C3CEN and Lt. Col. Nathan Terry, OSD R-E

Antenna Technologies & Interference Mitigation for Robust PNT

Novel approaches to multi-signal solutions for robust PNT, including novel antenna designs, interference mitigation technologies/techniques, incorporation of signals of opportunity to augment GNSS. While algorithms may be a component of this topic, they must be related to novel antenna approaches. This topic is seeking revolutionary approaches to robust PNT enabled by robust signal detection.

Topic Leads: Dr. Manorama "Rama" Gollakota, The Aerospace Corporation; Dr. Dontae Ryan, DLR Technologies

Autonomous Systems and PNT

Autonomous systems are especially reliant on PNT. Topics in this session include autonomous systems, leveraging of AI and machine learning for autonomy and PNT, challenges of using autonomous systems in military environments, use of GPS and non-GPS PNT for autonomous systems. These systems will be operating either independently or in collaborative groups performing tasks, where the PNT systems will need to adapt to the surroundings and make use of the sensors and signals that are functional in the area. Safety, resiliency and OPTEMPO are vital in the definition of the requirements for the PNT system for military autonomous systems.

Topic Leads: Dr. Robert Leishman, AFIT and Dr. J.P. Laine, Draper

Collaborative Navigation Techniques

This topic addresses techniques for the exploitation of network connectivity and ranging information between nodes to assist and improve navigation. The ability to exchange information among partners in a network can provide synergistic improvements in terms of rapid system initialization, navigation accuracy and resiliency. This includes efforts for supplying accurate up-to-date information to navigation processors; sharing of data for both absolute and relative navigation solutions within a defined group; and determining situational awareness for the warfighter and providing pertinent navigation-related information for missions such as search and rescue, targeting, joint operations and other applications requiring complex coordination. May also include the sharing of geo-registered imagery to support collaborative position/orientation updating, collaborative path planning to optimize joint navigation accuracy, and the use of network connected devices for navigation such as smartphones, navigation apps and GPS based personal navigation systems with on-line maps.

Topic Leads: Dr. Victor O. Sivaneri, AFRL Sensors Directorate and Dr. Mikel Miller, IS4S

Complementary PNT

Subjects of this session are navigation technologies and techniques that replace, or supplement, traditional GPS/INS solutions for overcoming application related challenges including degraded or denied GPS. This includes vision-aided navigation, RF-aided navigation, exploitation of naturally occurring signals that would be immune to denial of service by an adversary, and high precision quantum-enhanced inertial sensors. Examples include but are not limited to celestial, bathymetric, gravimetric, and quantum-based or other emergent navigation sensor technologies. This session covers both tactical and strategic applications.

I: Naturally Occurring Measurement Sources – Including gravity, magnetic fields, lightning

Topic Leads: Dr. Benjamin Lane, Draper and Dr. Gregory Hennessy, USNO

II: RF Aided (Non-GPS)

Topic Leads: Chad Nash, PM PNT and Dr. Keith McDonald, MITRE

III: Vision Aided

Topic Lead: Mark Smearcheck, AFRL Sensors Directorate and Ann Adams Witt, Honeywell

GPS in Military Applications/NAVPAR

This session will involve integration of GPS into new and existing military systems; precision weapon delivery and military applications in land, sea, air, and space using GPS; and development of new military GPS and auxiliary sensor hardware. Includes PNT Situation Awareness sensing and information distribution, as well as interference and jamming aspects of GNSS from an unclassified perspective.

Topic Leads: Amelia Fortmayer, Army CCDC C5ISR; Amanda Humphrey, JNWC; and Kevin Martin, MITRE

GPS Modernization

New military capabilities and performance, including integrity and accuracy improvement concepts; modernized space segment, constellation performance, and control segment; new GPS research and development status; and impact on future applications.

Topic Leads: Brian Louie, SMC/PCU and Renee A. Yazdi, MITRE

Inertial Measurement Unit (IMU)

A review of the latest developments, materials processing, manufacturing technologies, component integrations and applications of IMUs having performance improvements and the potential to yield Size, Weight, Power and Cost (SWAP-C) benefits for our warfighters. This includes development and electronics minimization, new interface standards and algorithms that will enable accuracy improvement. A review of theoretical physical principles and describe new sensing devices that measure and model such phenomena. Advancements leading to extremely precise inertial navigation devices such as cold atom physics.

Topic Leads: Clint Blankenship, Army CCDC AvMC and Dr. Kari Moran, NIWC Pacific

NEW! Integrity and Assurance

Positioning, Navigation and Timing (PNT) systems play a critical role in virtually all military systems. Integrity/Assurance is becoming a principal requirement in all systems to ensure the mission is completed successfully and reducing the risks to our warfighters. Their design must include the capability to assess sensor inputs, detect anomalous/threat conditions, and mitigate properly to retain resiliency. This session will cover the requirements for PNT Integrity/Assurance in various military systems, system functional allocation, algorithm development, design approaches, and review performance results from demonstrations.

Topic Leads: Michael Caporellie, Army CCDC C5ISR and Dr. Samer Khanafseh, ITT/TruNav

Military GPS User Equipment

This session will provide the latest information on Military GPS User Equipment (MGUE), the SMC/GPU program developing M-Code based receiver technology for military applications. Topics will include status of receiver development, test, and integration efforts from both contractor and government representatives.

Topic Leads: Col. Clifford Sulham, SMC PCU and Michael Stanitis, The Aerospace Corporation

Modeling and Simulation

Includes GNSS, INS and complementary sensor models capable of assessing advanced algorithms/integrated systems and battlefield operations. Presentation of hardware-in-the-loop simulation capabilities that use software-defined receiver technology or other active/passive techniques for laboratory evaluation. Interfacing of PNT and mission/campaign modeling and simulation capabilities for the assessment of impacts to the warfighter and his commander.

Topic Leads: Anni Woolley, Army CCDC C5ISR and Matt Oliver, LinQuest

Multi-GNSS Receivers for Military Applications

Recent technology developments have explored the combination of military GPS signals with foreign GNSS and commercial GPS signals. The complementary benefits of multi-GNSS include improved accuracy, integrity, availability, frequency diversity, and continued operations in GPS degraded environments. Military applications require considerations for signal assurance and security. Efforts entail concept development, analyses, modeling and simulation, and/or demonstrations. The future of military multi-GNSS receivers includes those, which track and use military signals from multiple GNSSs as well as those, which combine both military and civil signals from multiple GNSSs. This session is also interested in exploring the use and integration of additional terrestrial or space-based cooperative signals for timing, ranging, or augmentation with military multi-GNSS receivers.

Topic Leads: Jason Pontious, AFRL Sensors Directorate and Alinn Herrera, The Aerospace Corporation

Navigating in Challenged Environments (e.g., Urban, Indoor and Sub-Surface Navigation)

Systems and solutions to challenges to navigation systems due to low Size, Weight, And Power (SWAP) requirements such as in UAVs, UUVs, UGVs, Autonomous UGVs (i.e., robots), missiles, dismounted soldiers, etc., are all of interest. Other environmental challenges of interest are navigating in GPS denied conditions, high multipath locations, underground/cavernous environments, poor terrain (mountainous/canyons), or urban/indoor environments.

Topic Leads: Roger Fuller, USCG HQ Office of CSIT Capability and Connor Brashar, Sandia National Laboratories

Novel Clock Technologies and Timing Applications

Warfighter systems are reliant upon Precise Time and Frequency (PT&F) synchronization/synchronization for communicating, networking, positioning, and etc. These needs are supported by GPS timing capabilities or alternative time-keeping systems that consist of high-precision clocks synchronized by time dissemination. Development efforts to employ current and novel atomic clock architectures based on optical transitions, laser cooling, and ion trapping, for example, are underway. These efforts seek to produce rugged high-precision clocks for handheld, infrastructure, aerospace, and space-based applications. This session addresses timing device and system approaches, including advanced clocks, time dissemination techniques, and timing applications for military systems.

Topic Leads: Dr. John Elgin, AFRL Space Vehicle Directorate and Francine Vannicola, NRL

Operational System Demonstrations

Demonstration of platforms to support PNT for the warfighter, with particular focus on open architecture solutions which allow incorporation of alternate or (r)evolutionary technologies. Demonstrations may include real time component demonstration, video of demonstration, and demonstration of SWiL/HWiL. Demonstrations may include, but are not limited to, human-in-the-loop, PNT sensors & algorithms, or novel approaches to deal with known limitations of current solutions, such as simplified keying solutions, user friendly interfaces, context aware energy conservation, etc. Encouraging demonstrations of technologies at varying stages of technology readiness levels (TRLs 4-6).

Topic Leads: Paul Olson, Army CCDC C5ISR and William Deike, AFRL Sensors Directorate

PNT Open Systems Architecture

Threats to PNT systems are evolving at increasingly faster rates, driving the need for PNT systems to be adaptable to stay ahead of this evolving threat. Open System Architectures (OSA) for PNT can be structured to provide frameworks for affordable adaptable PNT systems. Adaptable PNT systems provide the ability to insert capability, countering threats and providing a resilient solutions. This session covers research, development, procurement, integration and sustainment of OSA PNT concepts and systems (software, hardware, backplanes, interfaces, etc.), including applications of VICTORY, PNTA, FACE, OMS, SOSA and more.

Topic Leads: Major Tyler Hardy, AFLCMC/WNY and Dr. Adam Schofield, Army CCDC C5ISR

Precision Guided Munitions/Weapon Applications

The use of navigation technologies in the unique and challenging field of Precision Guided Munitions (PGMs) and weapon systems applications. This includes innovative design concepts, challenging performance and environmental requirements, laboratory and flight test results, compensation methods, alignment/initialization techniques, and size constraints/miniaturization as well as other issues related to the integration of navigation technologies in current and emerging PGM/Weapon systems.

Topic Leads: Marvin Fisher, AFLCMC/EBDT and Tim DeLoache, Booz Allen Hamilton

NEW! Software Defined Radios (SDRs) for PNT

This session will focus on the use of software defined radios (SDRs) for military PNT applications. Topics may include SDR architectures, SDR design considerations, operations concepts for SDR maintenance and upgrades, specific hardware/software instantiations, and updates from on-going developmental activities.

Topic Leads: Dr. Jeff Hebert, AFRL Sensors Directorate and Dr. Alessandro (Alex) Cerruti, MITRE

Space and Satellite Applications

New concepts for satellite navigation, developments in PNT payload technologies, and advanced signals. Applications of PNT systems on space-based platforms; use of navigation sensors to aid primary objectives of orbit determination, attitude determination, and navigation, and application objectives such as mapping from space; and advances in space-based user equipment. This also includes next-generation flexible satellite navigation signals as well as PNT signals from satellites in GEO or LEO orbits.

Topic Leads: Michael Orr, USAF HQ AFSPC/ASM; Lt. Col. Steven Lewis, USAF AFSPC; and Dr. Kiana Ross, The Aerospace Corporation

Surface and Sub-Surface Maritime PNT

This session seeks presentations on advanced PNT technologies as they apply to the maritime domain surface/subsurface platforms. Future PNT solutions for surface/subsurface applications include alternate and complementary technologies/sensors with enhanced open architecture host system. This includes maritime-focused alternate sources of PNT, complementary PNT technologies, and technologies that can provide enhanced sensor fusion algorithms.

Topic Leads: CDR Ben Goff, USCG C3CEN and Jei Chen, NIWC Pacific

Warfighter Requirement and Solutions

Warfighter requirements, needs and possible solutions involving operational PNT. Logistical concerns (applied maintenance concepts; spares/replacement availability; interchangeability within host platforms; interoperability with form, fit, and function of host platforms) and international restrictions/concerns, as well as requirements for future technologies. PNT for pointing and stabilization; tri-service programs and commonality considerations; user comments and feedback; NDI/COTS; Homeland Security; and other critical issues such as target location errors.

Topic Leads: Joe Page, JNWC and Amanda Rohrbach, SAF/AQR

NEW! PANEL DISCUSSIONS (FOUO U.S. ONLY)

PANEL: MGUE Integration

This panel will feature representatives from weapon systems conducting some of the initial integration of MGUE receivers. Panelists will share experience and lessons learned working with the first generation of M-Code receivers.

Moderator: Dr. Thomas Powell, The Aerospace Corporation

PANEL: National Critical Infrastructure Threat

This FOUO panel will focus on PNT threats to the national critical infrastructure. Discussion topics may include threats to the electrical grid, communication, transportation, finance, and domestic DoD support infrastructure as well as emerging infrastructure for domestic employment of UAV systems that create a challenge for safeguarding national assets and maintaining homeland security.

Moderator: Karen Van Dyke, US DOT/ OST-R

PANEL: Rapid Agile Development and Manufacturing

Representatives from all three services will address their plans to respond to urgent PNT requirements from the field in a rapid manner. Panelists will present current plans to quickly allocate requirements to an open system architecture (OSA), cooperate with industry to demonstrate prototypes, where OSA promotes the ability to plug and play new sensors with flexible interfaces from a diverse set of providers, adaptive software development to support the fusion of PNT sensor information, iterative prototyping in a cooperative manner with industry conducting demonstrations/test in government laboratories, and move forward to conduct operational tests to ensure all requirements have been satisfied. Using this methodology manufacturing can begin in a very quick turnaround in comparison to current DoD acquisition.

Moderator: Dr. Adam Schofield, Army CCDC C5ISR

CLASSIFIED PROGRAM (Secret-U.S. ONLY)

This includes topics where classified material is key to conveying the intent of the presentation. Abstracts submitted for consideration must be written/approved for public release. Sessions will include operational PNT developments related to Joint Urgent Operational Needs and Joint Emergent Operational Needs support and provide venues for the presentation for additional topics at the SECRET-U.S. Only level to discuss topics and information that cannot be shared in the FOUO sessions.

Topic Leads: Benjamin Wash and Fay Spellerberg, Joint Navigation Warfare Center

This session will include a keynote from a ranking general officer, the Warfighter panel and a Warfighter Requirement and Solutions panel.

PANEL: Warfighters (Secret-U.S. Only)

An interactive discussion between the audience and a panel of warfighters who have had recent operational experience that informs the community on how to better formulate military PNT systems.

Warfighters who have had operational "in theater" experience in the past year are being solicited from all services; Electronic Warfare specialists are of particular interest. All those who can contribute to the panel please contact Kevin Coggins, E-mail: kevin.m.coggins.civ@mail.mil. Hotel accommodations and conference registration provided at no cost to panel members.

Moderators: Kevin Coggins, Booz Allen Hamilton and CAPT Andrew Gibbons, PEO C4I PMW/A 170

NEW! PANEL: Combatant Command Joint Urgent Operational Need (JUON): Warfighter Requirement and Solutions (Secret-U.S. Only)

This panel will present highlights of a current JUON to include requirements/funding, mission analysis, fielding, and effectiveness assessment. Discussion will also include use of modular capabilities to accommodate future expansion and modifications to address other combatant command needs and evolving threats.

Moderator: Fay Spellerberg, Joint Navigation Warfare Center