

## ABOUT THE JNC

The Military Division of the Institute of Navigation will host the 2019 Joint Navigation Conference (JNC 2019) for the Department of Defense and Department of Homeland Security. The theme of this year's conference will be:

Positioning, Navigation and Timing Technologies: The Foundation for Military Ops and Homeland Security

JNC is the largest US 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 US only conference attendance (July 8-10) will be screened by the Joint Navigation Warfare Center and will be restricted to US only. The classified session will have US only Secret Clearance access (July 11). The exhibit hall (July 9-10) 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:** Sharon Donald, Draper

**Program Chair:** Eddy Emile, GPS Directorate, USAF

**Program Vice-Chair:** Joseph Schnecker, SPAWAR

**Tutorials Chair:** Paul Olson, US Army

**Plenary Chair:** Dr. Thomas Powell, The Aerospace Corporation

## Track Chairs:

- Dr. David Chapman, AFRL Space Vehicles Directorate
- Elliott Kaplan, The MITRE Corporation
- Dr. Greg Reynolds, US Army
- David Wolfe, USCG NAVCEN

## Other Members:

- Jan Anszperger, Draper
- John Del Colliano, US Army
- Greg Graham, US Army AMRDEC
- Neeraj Pujara, AFRL Sensors Directorate
- Fay Spellerberg, Joint Navigation Warfare Center
- Ben Wash, Joint Navigation Warfare Center

## 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 40 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 [www.ion.org/jnc](http://www.ion.org/jnc) or email Ken Esthus at [kesthus@ion.org](mailto:kesthus@ion.org).

## ABSTRACT SUBMISSION GUIDELINES

Abstracts Due: February 15, 2019

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 (July 8-10) and a citizen of the USA, with SECRET CLEARANCE, to submit an abstract for the classified sessions (July 11).

Abstracts should be submitted electronically via the ION Abstract Management Portal (AMP), no later than February 15. To submit an abstract, sign in at [www.ion.org/abstracts](http://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 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 July 19 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 (July 11). 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 June 7. All presenters must pay conference registration fees.

## CONFERENCE PROCEEDINGS

Submitted presentations, approved for Public Release 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 conference will be hosted in a FOUO U.S. ONLY environment July 8-10 at the Hyatt Regency Long Beach and a U.S. only classified environment on July 11 at The Aerospace Corporation. Advance visit requests and approvals are required for all attendees. July 8-10 participation will be restricted to U.S. government and U.S. government contractors. July 11 participation for the classified session 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 and paid by June 7, \$880; after June 7, \$1080. 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 \$470. Single-day registration rates include sessions only, no events or proceedings.
- **Accommodations** are available at the Hyatt Regency Long Beach at the prevailing government rate until June 7, or until the hotel block fills, whichever occurs first. Reserve a hotel room at [www.ion.org/jnc](http://www.ion.org/jnc)
- Additional information and updates regarding the conference may be found online: [www.ion.org/jnc](http://www.ion.org/jnc).

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Abstract Submission: Due February 15, 2019



July 8-11, 2019  
Hyatt Regency Long Beach  
Long Beach, California

# CALL FOR ABSTRACTS

# 2019

## JOINT NAVIGATION CONFERENCE

Positioning,  
Navigation  
and Timing  
Technologies:  
The Foundation  
for Military Ops  
and Homeland  
Security

# CALL FOR ABSTRACTS

ABSTRACTS DUE FEBRUARY 15

July 8-11, 2019  
Tutorials: July 8,  
Show Dates: July 9-10

**Hyatt Regency,  
Long Beach, California**  
Classified Session: July 11,  
The Aerospace Corporation

Sponsored by the Military Division  
of the Institute of Navigation





# 2019 JOINT NAVIGATION CONFERENCE: Positioning, Navigation and Timing Technologies: The Foundation for Military Ops and Homeland Security ABSTRACTS DUE: FEBRUARY 15, 2019



## 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.

**Co-chairs:** Roger Fuller, USCG Office of C4IT Capability and Jalal Mapar, DHS Science and Technology Directorate

## 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.

**Co-chairs:** Alinn Herrera, The Aerospace Corporation and William Joo, SPAWAR

## 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.

**Co-chairs:** Dr. Robert Leishman, AFIT and John Miranda, US Army CERDEC

## 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.

**Co-chairs:** Dr. Kevin Brink, AFRL Munitions Directorate and Dr. Jordan Britt, Leidos

## Complementary PNT

The 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 and celestial navigation such as star trackers and their applications.

**Chair:** Capt Aaron Canciani, AFIT

**II: RF Aided (Non-GPS)**

**Co-chairs:** Mark Phillips, AFRL Sensors Directorate and Dr. David Taylor, Setter Research

**III: Vision Aided**

**Co-chairs:** Dr. Donald Venable, AFRL Sensors Directorate and Gian Luca Mariottini, Draper

## Emerging Tactical and Strategic Atomic Clock Technology

Increasing demand for communications bandwidth and improved precision PNT, coupled with the threat of GPS denial, have created a need for improved performance of frequency references at all strata of the timing ecosystem. Drawing from modern atomic physics and enabled by recent advances in photonics, MEMS, and CMOS technology, efforts are underway to transition novel atomic clock architectures based on optical transitions, laser cooling and trapping, and ion trapping from laboratory environments to terrestrial and satellite deployment for mission-critical applications in challenging environments. This session addresses development efforts to produce rugged deployable atomic clocks for handheld, infrastructure, and aerospace applications as well as the latest developments in laboratory-based atomic frequency standards.

**Co-chairs:** Dr. Robert Lutwak, AFRL and Dr. John Burke, DARPA

## GPS Constellation Performance

The GPS constellation provides precision navigation to millions of civilian and military users daily. The constellation's health, availability, accuracy, and overall performance are the focus of the 2nd Space Operations Squadron with support from the GPS Directorate. Independent test organizations provide additional insights into how GPS performs to meet unique user needs. This session focuses on the GPS constellation, technologies used to manage the constellation and looks at future requirements and technologies needed to maintain current and future user needs.

**Co-chairs:** Capt Dennis Barnes, USAF SMC/GP and Heidi Graziano, The Aerospace Corporation

## GPS in Military Applications/NAVMAR

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; development of new military GPS and auxiliary sensor hardware. Includes interference and jamming aspects of GNSS from an unclassified perspective.

**Co-chairs:** Dr. Keith McDonald, The MITRE Corporation and Dr. Martin Ryba, BAE Systems

## GPS Modernization

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

**Co-chairs:** Lt Col Max Mai, USAF SMC/GP and Renee Yazdi, The MITRE Corporation

## 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 device 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.

**Co-chairs:** Dr. Ronald Polcawich, DARPA and Dr. Adam Schofield, US Army CERDEC

## 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.

**Co-chairs:** Lt Col Joseph Christensen, Col Edward J. Hospodar Jr. and Lt Col Adam Langborgh, USAF, SMC/GP

## 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.

**Chair:** Paul Olson, US Army CERDEC

## 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.

**Co-chairs:** Mark Carroll, AFRL Sensors Directorate and Dr. Jeff Dickman, Northrop Grumman

## 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.

**Co-chairs:** Mathew Nicholson, SPAWAR and Dave Hodo, IS4S

## New Signals from Space

This topic encompasses a broad range of advanced PNT signal concepts, including new waveforms, new data messages supporting PNT capabilities, and enhanced signal-based security architectures. This includes next-generation flexible GPS navigation signals as well as proposed PNT signals from satellites in GEO or LEO orbits. New signal applications may include anti-jamming, anti-spoofing, signal acquisition aids, enhanced cryptography, multipath mitigation, etc.

**Co-chairs:** Dr. Joanna Hinks, AFRL Space Vehicles Directorate and Dr. Jon Anderson, Canyon Consulting

## Next Generation Navigation – NEW

What are the next big ideas enabling accurate, resilient, robust, secure and cost-effective navigation for the future? The purpose of this session is to stimulate thought and speculative discussion about possible solutions and technologies needed to sustain our superiority in robust navigation solutions in support of our homeland and troops under current known threats, with the resilience to adapt to new threats over time. This is a white space session, intended to promote thought and discussion, which leads towards next-generation solutions.

**Chair:** Logan Scott, LS Consulting and John Langer, The Aerospace Corporation

## 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).

**Co-chairs:** Paul Olson, US Army CERDEC and Sharon Donald, Draper

## PNT Open Systems Architecture

Threats to PNT continue to evolve at faster rates, driving the need for PNT systems to be adaptable and stay ahead of the threat. The use of Open System Architectures (OSA) for PNT will provide a framework of affordable adaptable PNT systems, which counter threats and provide a resilient solution. This session covers research and procurement of OSA (software, hardware, backplanes, interfaces, etc.) which enable resilient PNT including applications of VICTORY, FACE or OMS, and the consideration needed to implement these systems and maintain affordability.

**Co-chairs:** Dr. Adam Schofield, US Army CERDEC and William Nichols, Booz Allen Hamilton

## Precise Navigation, Azimuth and Survey

The use of navigation technologies for precise navigation, azimuth and survey applications, including precise Inertial Measurement Units (IMU), Inertial Navigation Systems (INS), Global Positioning System (GPS), and integrated GPS/INS systems. Topics include innovative design concepts, challenging performance requirements, survey in challenged environs (GPS/RF denied), precise azimuth target location and test results for use with today's precision weapon's systems and platforms.

**Co-chairs:** Paul White, US Army AMRDEC and David Faulkner, EMCORE

## 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/miniaturation as well as other issues related to the integration of navigation technologies in current and emerging PGM/Weapon systems.

**Chair:** Dr. Chris Stout, US Army ARDEC

## 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.

**Co-chairs:** John Langer, The Aerospace Corporation and Dr. Madeleine Naudeau, AFRL Space Vehicles Directorate

## Surface and Sub-Surface 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.

**Co-chairs:** CAPT Andrew Gibbons, USN, PEO C4I, PMW/A 170 and CAPT Michael Nasitka, USCG C3CEN

## Timing Applications

Current warfighting systems have become increasingly reliant upon Precise Time and Frequency (PT&F) for positioning and secure communications and computer networking. These needs are supported by GPS timing capabilities and have stimulated the need for alternative and more precise time-keeping systems. This session addresses developments in timing applications for military systems and the generation of PT&F to support these applications.

**Chair:** Dr. Warren Walls, USNO and Martin Bloch, Frequency Electronics, Inc.

## Warfighter Requirements 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.

**Co-chairs:** Michael Orr, USAF Space Command and Joseph Page, Joint Navigation Warfare Center

## CLASSIFIED SESSIONS (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.

The morning general session will include a briefing on the latest adversary advances to deny or degrade Blue Force PNT, followed by a keynote speaker and the Warfighter Panel (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).

Afternoon 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.

**Co-chairs:** Benjamin Wash and Fay Spellerberg, Joint Navigation Warfare Center

## Warfighters Wanted: CLASSIFIED SESSION (Secret-U.S. Only)

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.

**Co-chairs:** BG Thomas James, US Army Joint Forces Space Component Command; Kevin Coggins and Sean Memmen, Booz Allen Hamilton