

## ABOUT THE JNC

The Military Division of the Institute of Navigation will host the 2018 Joint Navigation Conference (JNC 2018) 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 9-11) 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 12). The exhibit hall (July 10-11) 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:** Elliott Kaplan, The MITRE Corporation  
**Military Division Vice Chair:** John Langer, The Aerospace Corporation

**Program Chair:** Greg Graham, US Army  
**Program Vice-Chair:** Eddy Emile, GPS Directorate, USAF  
**Tutorials Chair:** John Del Colliano, US Army

## Track Chairs:

- Jan Anzperger, Draper
- Dr. David Chapman, AFRL Space Vehicles Directorate
- Elliott Kaplan, The MITRE Corporation
- Joseph Schnecker, USN Space and Naval Warfare Systems Center Pacific

## Other Members:

- Bill Bollwerk, Naval Observatory
- Kevin Coggins, US Army
- Sharon Donald, Draper
- Robert Greenlee, Joint Navigation Warfare Center
- CAPT Russell Holmes, USCG NAVCEN
- Jalal Mapar, DHS Science and Technology Directorate
- Paul Olson, US Army
- Dr. Thomas Powell, The Aerospace Corporation
- Neeraj Pujara, AFRL Sensors Directorate, USAF

## 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 30 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, 2018

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 9-11) and a citizen of the USA, with SECRET CLEARANCE, to submit an abstract for the classified sessions (July 12).

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 20 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 12). 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 15. 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 9-11 at the Hyatt Regency Long Beach and a U.S. only classified environment on July 12 at The Aerospace Corporation. Advance visit requests and approvals are required for all attendees. July 9-11 participation will be restricted to U.S. government and U.S. government contractors. July 12 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 15, \$880; after June 15, \$1080. Full Conference Registration includes all technical sessions, exhibit hall access, conference refreshments and events, 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 15, 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, 2018



July 9-12, 2018  
Hyatt Regency Long Beach  
Long Beach, California

# CALL FOR ABSTRACTS

# 2018

## JOINT NAVIGATION CONFERENCE

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

Sponsored by the  
Military Division  
of the Institute of  
Navigation

July 9-12, 2018  
Hyatt Regency Long Beach  
Long Beach, California

Classified Session July 12, The Aerospace Corporation





# 2018 JOINT NAVIGATION CONFERENCE: Military Navigation Technology: The Foundation for Military Ops

## ABSTRACTS DUE: February 15, 2018



### Application/Impact of GPS Technologies in the Homeland Critical Infrastructure

GPS based technologies are now an integral part of the national critical infrastructure. Many sectors rely on some aspect of GPS ranging from timing for communication systems to clock synchronization for power transmission in the electrical grid. The growing use of GPS 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. This session will focus on the use of GPS technologies in the critical infrastructure with emphasis on discussing usage, vulnerabilities, and providing mitigating solutions to safeguards against threats to the critical infrastructure. Co-chairs: CAPT Russell Holmes, USCG NAVCEN and Jalal Mapar, DHS Science and Technology Directorate

### Collaborative Navigation Techniques

The ability to exchange information among partners in a network has proven to provide synergistic improvements in terms of rapid system initialization, accuracy and resiliency. This topic addresses techniques for the exploitation of network connectivity to assist and improve navigation. 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 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: Capt Turner "TJ" Montgomery, AFRL Sensors Directorate and Dr. Mikel Miller, Integrated Solutions for Systems (IS4S)

### 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 and exploitation of naturally occurring signals, which would be immune to denial of service by an adversary. Examples include celestial, bathymetric, gravimetric, and other naturally occurring phenomenology. 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: Dr. Thao Nguyen, AFRL Sensors Directorate

II: RF Aided (Non-GPS)

Chair: Dr. Tom Wallace, Vesperix

III: Vision Aided

Co-chairs: Dr. Don Venable, AFRL Sensors Directorate and Kevin Betts, Leidos

### Emerging Tactical and Strategic Atomic Clock Technology – NEW!

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, Draper 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 Robyn Anderson, USAF and Heidi C Graziano, The Aerospace Corporation

### GPS in Military Applications/NAVWAR

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: Maj. Leon Killings, USAF SMC/GPE and Fay Spellerberg, Joint Navigation Warfare Center

### 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 Bryan Howard, USAF and Beneka Bali, 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 mini-mization, 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: Virginia Overstreet, US Army and Joe Franiak, Northrop Grumman

### MGUE Integration

Over the next decade, the Department of Defense will spend tens of billions of dollars to upgrade its various military systems so they can operate in a contested, degraded, operationally limited GPS environment. A quick look at MGUE cards integration into weapon systems from the services. Exploring the complexities of how integrated M-code avionics systems for process and disseminate navigation data into weapons. Looking at other use of MGUE into non-lead platforms. This session reviews the progress that has been made by the Air Force, Army, Navy and Marine Corps in integrating and testing these new receivers to meet the challenge. Chair: Brian Louie, USAF SMC/GPUI

### Military GPS/Antenna Technologies and Interference Mitigation

Antenna designs for GNSS with emphasis on size, gain control, multiple frequency coverage, multipath mitigation, and RF interference suppression. The combined effects of interference on military receivers, interference mitigation techniques and limits of performance.

Co-chairs: Alan Babich, SPAWAR and Dr. Jay Chuang, The MITRE Corporation

### Military GPS Receivers and Technologies - Current and Future Innovations

Military GPS receivers form the core of military PNT capability. This session explores critical design aspects of currently fielded receivers, ongoing modifications to fielded military GPS receivers and future designs and algorithms. Topics include mission constellations and other ongoing modifications; limitations of current designs; proposed modifications to current hardware designs; resiliency and software assurance measures for current and future receivers; readily-available design improvements; hardware, algorithms and techniques related to rapid acquisition; improved code and/or carrier tracking performance; high accuracy position solutions; reduced computational loads; flexible receiver architectures for GNSS receivers; receiver implementations using programmable processors or reconfigurable Field Programmable Gate Arrays (FPGAs); unique approaches to military GPS software receivers; unique advantages of software receivers; and implementation of new approaches. Co-chairs: Matt Brown, US Army PM PNT and Alinn Herrera, The Aerospace Corporation

### 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: Col Edward Hospodar, SMC/GPU USAF and Lt Col Jack Rhodes III, SMC/GPUM USAF

### 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.

Co-chairs: Ed Agunos, SPAWAR and Paul Crampton, Spirent Federal Systems

### 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 entailing concept development, analyses, modeling and simulation, and/or demonstrations. The future of military multi-GNSS receivers – from the perspective of military receivers which track and use military signals from multiple GNSSs as well as the perspective of military receivers which combine both military and civil signals from multiple GNSSs (to include GPS P(Y)-code plus GPS L5-codes or GPS P(Y)-code plus WAAS L1 C/A-codes). Co-chairs: Joseph Stevanak, US Army CERDEC and Thomas Taylor, NovAtel USA

### Multi-Sensor Solutions for Guidance, Navigation and Control

Information about navigation sensor developments, new or emerging navigation sensors and advantages to navigation from additional information available from existing sensors. Techniques for integrating multiple sensors into a single navigation systems; advantages to system performance for sensor coupling; or developments of multiple sensors in guidance, navigation, and/or control applications.

Co-chairs: Dr. Adam Schofield, CERDEC and Dr. Randall Jaffe, L3

### 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: Michael Caporelli, CERDEC and Andrew Sabater, NORTHCOM

### Open Architectures (OAs)

Threats to PNT continue to evolve at faster rates, driving the need for adaptable PNT systems that can match pace with the threat. The use of Open Architectures (OA) for PNT provides a framework of affordable adaptable PNT systems, which counter threats and provide a resilient solution. This session covers research and procurement of OA (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. Jacob Campbell, AFRL Sensors Directorate and Chad Pinkelman, SPAWAR

### Operational System Demonstrations

Demonstrate recent system developments fielded or with near term application. Demonstrations should incorporate live operation of the system and/or video of in-field use and engage the audience for active participation. Presenters should expect to receive feedback from participants including warfighters and first responders with extensive field experience. Presentations are 40-minutes with no more than a 10-minute narrative to explain the system that will be demonstrated, a 20-minute demonstration and 10-minute question and answers portion.

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

### PNT for Autonomy and Autonomy for PNT – New!

Improved PNT systems are required to support robust operations for aerial, ground and maritime unmanned platforms. Requirements for position, velocity and attitude information feeding both control systems and payload systems; absolute and relative positioning/navigation requirements and the associated performance for GNSS (positioning and attitude with a multi antenna system); GNSS/INS; and combinations of other aiding sources such as feature based navigation. Autonomous mobility and the use of unmanned systems with PNT assurance that support the warfighter.

Co-chairs: Dr. Kari Moran, SPAWAR and Greg Reynolds, AMRDEC

### 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.

Co-chairs: Amy Mulvoy, Assured Precision Weapons and Munitions Division, US Army and Paul Manz, US Army

### 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, AMRDEC and Mary McGriff, Kearfott

### 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: Dr. Madeleine Naudeau, AFRL Space Vehicles Directorate and John Langer, The Aerospace Corporation

### Surface and Sub-Surface PNT

Surface/subsurface PNT architectures involve multi-sensors including GNSS, inertial, wind, gyrocompass, and other sensors today; and emergent concepts to integrate existing and novel sensors under development for tomorrow, including the integration of the MGUE going forward. The focus of future PNT solutions for the surface and subsurface applications are complementary technologies/sensor coupling with GPS and sensors that are employed as alternatives to GPS and used together to achieve improved navigation performance. This session seeks presentations on GPS/multi-sensor fusion algorithms can be used to provide aiding methods, while also providing weighted PNT blending/filtering algorithms that work in concert with GPS-only PNT solutions, technologies to maintain GPS solutions through sensor blending and interference mitigation techniques, as well as technologies that promise to provide accurate PNT in the absence of GNSS-based solutions. Unique technologies going forward include leveraging communications/data link systems, radar technologies, celestial navigation, signals of opportunity, intelligent sovereign sensor fusion algorithms, and technologies to address precise time transfer using two way time transfer techniques and cooperative navigation.

Co-chairs: Barbara "Barbie" Fidura, SPAWAR and Lee Inslay, ARL Penn State

### 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.

Co-chairs: Tommy Willis, Office of Naval Research and Edward Byrne, Microsemi

### 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: Lt Col Thomas Niday, OASD (R&E) and Bill Bollwerk, USNO

### 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 classified sessions provide venues for the presentation of topics at the SECRET-U.S. Only level to discuss topics and information that cannot be shared in the FOUO sessions. Session chairs: Benjamin Wash, Joint Navigation Warfare Center 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: Kevin Coggins, US Army and CAPT Sean Memmen, Navy