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ABSTRACTS DUE OCTOBER 7

CALL FOR ABSTRACTS: ABSTRACTS DUE OCTOBER 7, 2021

Abstract Submission

Abstracts should be submitted electronically via the ION Abstract Management Portal, no later than October 7, 2021.

Authors will be given the option at the point of abstract submission to submit for "in-person presentation with video presentation for remote viewers" or "virtual presentation only."

To submit an abstract, sign in at ion.org/abstracts. If you have not used the Abstract Management Portal before, click "Create My Account." Once signed in, click on the appropriate meeting name and complete the form.

- Abstracts should describe objectives, anticipated or actual results, conclusions, any key innovative steps and the significance of your work.
- Authors will be provided with an electronic author's kit with presentation and publication guidelines in early November.
- All authors attending the meeting are required to pay registration fees.

Final Manuscripts

ITM Peer Reviewed Sessions: Completed manuscripts must be uploaded to the Abstract Management Portal (AMP) by December 1, 2021. Manuscripts will be peer reviewed by session co-chairs and designated as a primary paper, or as an alternate paper, in the onsite program based on peer review of the full manuscripts. Manuscripts not received by December 1, 2021 are subject to withdrawal from the conference. Manuscripts meeting established peer review standards will be designated as "peer reviewed" in the conference proceedings. Manuscripts will only be peer reviewed one time. Authors will be given the opportunity to make corrections/revisions to their manuscripts for inclusion in the proceedings through February 7, 2022. However, revised manuscripts will not be re-reviewed for peer-review designation.

To be included in the conference proceedings:

1. Manuscripts must be uploaded into AMP by December 1, 2021.
2. The submitted manuscript must be representative of the original abstract submitted.
3. An author listed on the manuscript must present at the conference and pay the conference registration fee (in-person and virtual presentations).
4. Video file, presentation file, and media/copyright release for must be uploaded into AMP by January 14.
5. The presenting author must attend the mandatory speakers' breakfast the morning of their session.

PTTI Sessions: PTTI papers will not be peer reviewed. Papers not representative of the original abstract submitted will not be included in the conference proceedings regardless of whether or not they were presented at the conference, and this may affect the acceptance of future abstracts by the author. Manuscripts will be accepted through February 7, 2022.

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1. Manuscripts must be uploaded into AMP by February 7, 2022.
2. The submitted manuscript must be representative of the original abstract submitted.
3. An author listed on the manuscript must present at the conference and pay the conference registration fee (in-person and virtual presentations).
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5. The presenting author must attend the mandatory speakers' breakfast the morning of their session.

Journal Publication

Authors of appropriate papers are encouraged to submit papers for possible publication in the ION's archival journal, *NAVIGATION* (indexed by Thomson Reuters). Papers may be submitted at http://mc.manuscriptcentral.com/navigation.

Exhibit Hall

Exhibit space is available. Booths are sold in 10' × 10' increments and include one full complimentary conference registration per booth purchased. For an exhibitor prospectus, or for more information, go to ion.org/itm/exhibits.cfm or contact Megan Andrews at the ION National Office via phone at 703-366-2776 or email at mandrews@ion.org.

Registration Information

All full-conference registrations include technical sessions, conference meal functions and events, and access to electronic proceedings. Registration for tutorials will be an additional fee. Individual registration benefits are non-transferable. Registration fees for registrants staying at the Hyatt Regency Long Beach, that are received and paid by January 4, 2022, start at:

- Member Rate: $960
- Non-member Rate: $1,040
- Student Rate: $600
- Virtual-Only Access: $699
- Exhibit Hall Only: $600

Student Conference Registration Grants

Student conference registration grants will be awarded on a "need basis." The registration grant will include a full technical meeting registration to include all conference sessions, meal functions and a copy of the conference proceedings. Full-time graduate or undergraduate students who are the lead and presenting author of worthy technical paper(s) are encouraged to apply. Grants are limited and are awarded on a first come, first served basis to those meeting the criteria. Prior grant recipients are not eligible. An application must be submitted with an abstract no later than October 7, 2021. See ion.org for details.

Accommodations

Accommodations are offered at the Hyatt Regency Long Beach. A block of rooms has been set aside for conference attendees at the discounted rate of $199 per night for single/double occupancy. These rooms will be available until January 5, 2022, or until the block fills, whichever comes first.

A limited number of government rate rooms for qualified federal agencies are also available. Reservations made after the deadline will be on a space-available basis and may not be at the special ION rate. We encourage you to make your hotel reservations early.

Save $200 on your registration fees by staying at the official conference hotel. All attendees who stay at the Hyatt Regency Long Beach and submit their hotel confirmation number at the time of conference registration will receive a $200 discount when registering for the conference. Hotel discounts cannot be applied retroactively.

Make Your Hotel Reservation Today:

- Online: ion.org/itm
- By Phone: Call 1-562-491-1234. Be sure to identify yourself as an ION ITM/PTTI attendee to receive the discounted attendee rate.

Co-located ITM and PTTI 2022: ONE Registration Fee, TWO Technical Events and a Commercial Exhibit

INTERNATIONAL TECHNICAL MEETING (ITM) SESSION TOPICS

ITM KEYNOTE ADDRESS
Prof. Alexandre Bayen, Director of the Institute for Transportation Studies, University of California Berkeley

GNSS Integrity and Augmentation
Fault monitoring, fault detection and exclusion, protection level algorithms and requirements for receiver-based integrity, ground-based, space-based and aircraft-based augmentation. Challenges in the provision of integrity in multi-frequency / multi-constellation services. Applications include navigation for civil aviation, automotive, UAVs, rail, maritime and other transportation applications.
Chairs: Dr. Ilaria Martini, Rhea, Belgium and Dr. Michael Felux, Zurich University of Applied Sciences, Switzerland

GNSS and Security: Interference, Jamming, and Spoofing
Techniques to make GNSS more robust to spoofing, jamming, and interference in general, through signal processing, complementary PNT, authentication, or other means. Applications in robust positioning and secure time transfer. Threat modeling, assessment and mitigation. Integrity and continuity implications of security measures. Analysis of GNSS disruption events.
Chairs: Fabian Rothmaier, Stanford University and Barbara Clark, Federal Aviation Administration

Navigation in GNSS Challenged Environments
Navigation in GNSS-denied/challenged environments. Sensing, perception, and map building in ground vehicle operations. Guidance, navigation, and control (GNC) systems for autonomous or semi-autonomous vehicles. Sensing for visual interfaces of driver-assistance systems. Requirements for ground vehicle GNC systems. Validation and verification of ground vehicle GNC systems. Algorithms and tools for global path planning and local obstacle avoidance.
Chairs: Dr. Cagatay Tanil, Amazon Prime Air and Dr. Victoria Kropp, BMW, Germany

Navigation of Unmanned Aerial Vehicles and Other Autonomous Systems
Advanced positioning and navigation algorithms for novel sensors, sensor fusion, and signals of opportunity. Algorithms and methods for high-performance applications using low-cost sensors. Derivation of multi-sensor system navigation performance requirements. New approaches for dealing with delayed and out-of-sequence measurements. Sensor fault detection and exclusion.
Chairs: Dr. Jiwon Seo, Yonsei University, South Korea and Dr. Akshay Shetty, Stanford University

Precise GNSS Positioning
New algorithms and methods for improving Precise Point Positioning (PPP), Real-Time Kinematic (RTK) and other precise positioning techniques (e.g., PPP-RTK, network-RTK). Multi-constellation solutions using single-/multi-frequency high-cost and low-cost receivers/antennas, including smartphones. PPP with Integer Ambiguity Resolution (IAR). Methods and algorithms for reliable outlier detection. Estimation of corrections relevant for PPP-RTK (or PPP-IAR), such as fractional phase biases, satellite orbits and clocks, atmospheric delays and differential code biases. Interoperability of correction services with different user equipment.
Chairs: Dr. Sandra Verhagen, Delft University of Technology, The Netherlands and Dr. Safoora Zaminpardaz, RMIT University, Australia

Radionavigation Beyond Medium Earth Orbit GNSS
Going beyond signals from Medium Earth Orbit (MEO) GNSS, this session examines alternate and novel radionavigation signals and techniques to support the demands of modern navigation systems. Signals of opportunity include cellular (e.g., LTE and 5G) and communications satellite signals (e.g., low Earth orbit (LEO) Mega Constellations). Navigational aids include terrestrial ultra-wideband (UWB) technologies, modern Wi-Fi protocols, near-field communication (NFC) devices, and emerging LEO-based satellite time and location services. Combining these sources to demonstrate PNT accuracy, integrity, and robustness, particularly for mission and safety-critical applications including automated vehicles (AVs) and intelligent transportation systems (ITS). Space Navigation.
Chairs: Dr. Zak Kassas, University of California Irvine and Dr. Tyler Reid, Xona Space Systems

Receiver Design, Signal Processing, and Antennas
GNSS receiver signal processing techniques, especially for operations in challenging environments like indoor, urban canyons, foliage, scintillation or high-dynamics. Improved acquisition and tracking sensitivity, robustness and accuracy. Mitigation of multipath and NLOS signals. Use of multiple GNSS signals including new GNSS signals. Antenna design and evaluation.
Chairs: Dr. Sabrina Ugazio, Ohio University and Ajay Vemuru, Spirent Communications, UK

Remote Sensing, Atmospheric Effects, and Space Weather
Modeling of ionospheric and tropospheric effects on navigation. Use of GNSS in atmospheric and space weather science. Scientific applications of GNSS. Forecasting, now-casting.
Chairs: Dr. Ningchao Wang, Hampton University and Dr. Larry Sparks, Jet Propulsion Laboratory

Safety-critical Applications of GNSS and Other Sensors
Navigation system design and analysis for safety-critical applications of GNSS and other sensors. Topics include: integrity monitoring for filtered solutions, antenna and receiver hardware, data collection and analysis techniques including sorting and clustering, and development of statistical models for measurement and process noise for use in safety-critical navigation algorithms.
Chairs: Dr. Mihaela-Simona Circiu, ESA/ESTEC, The Netherlands and Dr. Steven Langel, The MITRE Corporation

Sensor Fusion
Fusion of measurements from multiple sensors, data, and information sources. Estimation theories, algorithms, data processing techniques, test methods, and results of new implementations integrating diverse sensors such as GNSS, inertial sensors, odometers, magnetometers, radar, LiDAR, cameras, barometers, maps, signals of opportunity, infrared, ultrasound sensors, etc. Topics of interest include context-awareness based integration, collaborative approaches such as methods enabled by connected vehicle and infrastructure aided methods, etc.
Chairs: Dr. Melania Susi, European Commission JRC, Italy and Dr. Li-Ta Hsu, Hong Kong Polytechnic University, China

PRECISE TIME AND TIME INTERVAL (PTTI) SESSION TOPICS

PTTI PRE-CONFERENCE TUTORIALS
- Clocks in GNSS receivers
- CSAC in small satellites
- Global space-based time dissemination
- Next-generation atomic clocks
- Optical time transfer

PTTI KEYNOTE ADDRESS
"The Future of Industrial Atomic Clocks"
Dr. David R. Scherer, The MITRE Corporation

Advances in ps and Sub-ps Timing Measurements
Precise timing capability with ps and sub-ps resolution is increasingly important for applications across many different scientific fields. Ps and sub-ps timing are now a critical requirement for development of next generation particle detectors on high energy colliders, next generation medical imaging including time-of-flight and CT scanners, optical two-way time transfer systems (ground–ground, ground–space, space–space), optical clock comparisons, autonomous vehicle navigation systems and high-speed communication networks. This session will present talks on advances in ps and sub-ps timing measurements and techniques.
Chairs: Dr. Franklin Ascarrunz, SpectraDynamics and Bryan Owings, Microchip

Detection and Countering Jamming and Spoofing of Timing Services
Possible solutions to the jamming and spoofing threat to critical infrastructure include: 1) Making GNSS receivers more resilient and robust by improved hardware and more robust software algorithms with the aim of improving the resiliency of timing products against all forms of intentional and unintentional tampering. 2) Services to counter spoofing of GNSS signals are being introduced by GNSS operators (Navigation Message Authentication for the Open Service, Chips-Message Robust Authentication, CHIMERA, and the Commercial Authentication Service). 3) The possibility of using a large number of satellites in low-Earth orbits to transmit time information. The signals from these satellites will be much stronger than the signals from GNSS satellites so that jamming and spoofing is more difficult. This session will focus on stand-alone techniques and algorithms to counter spoofing and jamming of satellite-based time distribution thereby, increasing the reliability and robustness of time dissemination.
Chairs: Dr. Judah Levine, NIST and Dr. Edoardo Detoma, Italy

Microwave Atomic Clocks
New advances and plans for microwave atomic clocks and/or related measurement techniques with PTTI applications. The primary focus is atomic clock design and performance in the areas of stability, operability, and robustness to environmental disturbances.
Chairs: Dr. Daphna Enzer, Jet Propulsion Laboratory and Dr. Robert Lutwak, Microchip

Network Synchronization Technologies for Science and Infrastructure – Authentication and Certification of Time Services
Network synchronization technologies such as NTP, PTP and White Rabbit are increasingly being deployed by national laboratories to provide accurate, UTC traceable time signals to critical infrastructure systems, as well as supporting metrological and scientific applications. The accurate, secure, and resilient time signals provided by PTP/White Rabbit can complement time services from GNSS. They can also help meet increasing industrial requirements for authenticated time stamps and certified time services. This session will cover these technologies, focusing on new developments and their applications.
Chairs: Dr. Elizabeth Laier English, National Physical Laboratory, UK and Michael Lombardi, NIST

Optical- Clocks, -Combs and Fundamental Physics
The future of precision timekeeping will include a redefinition of the second based on optical atomic clocks, and this is contingent of the development of new clocks based on a variety of atoms or ions. It includes detailed studies of physical properties on atomic scale, cooling mechanisms of the particles and frequency conversion from optical to microwave frequencies using optical frequency combs. This session will present talks that highlight recent results on the details that will enable future clocks, all the way to full scale implementations.
Chairs: Dr. David Leibrandt, NIST and Dr. Per Olof Hedekvist, RISE Research Institutes of Sweden, Sweden

Present and Emerging Applications and Techniques for Time and Frequency using GNSS/RNSS
The landscape of GNSS and RNSS are evolving with an increasing number of systems, which have expanded the opportunities for innovations in time and frequency transfer and also changed the complexity of the analysis. Submissions in the areas of time and frequency transfer that utilize any of the GNSS/RNSS systems, or a combination thereof, as well as pioneering advances in timing are encouraged. This session will present talks discussing the current and evolving state of space-based time & frequency transfer encompassing GNSS, RNSS enhanced by LEO systems or systems considering even higher orbits.
Chairs: Dr. Joerg Hahn, ESA/ESTEC, Netherlands and Dr. Per Olof Hedekvist, RISE Research Institutes of Sweden, Sweden

ITM/PTTI Exhibit Hall
Bringing together international leaders in the timing, and related positioning and navigation community in a commercial exhibit.
See ion.org/itm/exhibits.cfm for more information

Present and Future Clocks for Space and Terrestrial Applications
The heart of any timekeeping system, whether for navigation or communication or some other application, is the clock. Today, we fly atomic clocks on navigation and communication satellites; we control those onboard devices with more precise clocks at the ground-control stations, and system users will often employ chip-scale clocks to better interface with a timekeeping system. Clearly, tomorrow's space and terrestrial systems will require ever more precise clocks with lower size/weight/power (SWaP) characteristics. In this session, we consider all forms of clock (e.g., atomic, MEMS, crystal oscillator) in their advanced present form, and their potential future form, for applications in space and on the Earth.
Chairs: Dr. James Camparo, The Aerospace Corporation and Ryan Dupuis, Excelitas

Reports from Laboratories that Contribute to the Community need of Time and Frequency
The opportunity for time and frequency laboratories, including those operated by National Metrology Institutes (NMIs), military, scientific and academic organizations, to highlight their current and future PTTI activities. Topics to include UTC(k) generation, and performance, time dissemination, time services, calibration and specific PTTI measurements supporting a wide range of scientific activities. The effects of the global pandemic on laboratories and their operations would also be of interest to this session.
Chairs: Dr. Michael Coleman, Naval Research Laboratory and Angela McKinley, US Naval Observatory

Space-based Time and Frequency Transfer – Established and Emerging
One-way time and frequency transfer from GNSS is the dominant global method for military, civilian, and critical national infrastructure. However, because of the increasing potential for adverse action to deny or deceive GNSS signals, an emerging range of complementary and alternative space-based systems, both two-way and one-way, are under development. Several of these emerging time and frequency systems take advantage of the new thrust in massively proliferated low-earth orbit space architectures, while some look to still utilize higher orbits. This session will present talks discussing this evolving state of space-based time and frequency transfer.
Chairs: Travis Driskell, L3Harris Technologies and Greg Weaver, JHU/APL

Terrestrial and Space Based Optical Links and Sensors
Without the benefit of radio space-borne assets like GNSS for common-view observations or geo-stationary satellites for signal relay, time and frequency transfer requires a terrestrial exchange of physical signals. We focus on high-performance techniques involving optical networks, optical signals over free-space or fiber optics, optic sensors and space-based optical links.
Chairs: Dr. Fabrizio Giorgetta, NIST and Dr. Jeff Sherman, NIST

Timescales and Algorithms
Analysis, description and implementation of old and new timescale and frequency scale algorithms involving primary/secondary frequency standards, optical frequency standards, optical cavities, low-cost clocks, and/or low-SWAP clocks such as CSACs. The generation and steering of UTC, UTC(k), and GNSS timescales. The optimization of time and frequency scales for specific purposes. Algorithms and methods that advance the state of the art in clock data analysis and their applications, such as use of Kalman filters. The applicability and use of new or old statistical measures, and novel processing of measurement data to reduce the measurement noise in timescales.
Chairs: Dr. Jian Yao, NIST and Dr. Demetrios Matsakis, Masterclock

Towards 6G: Frequency Sources and Related Components in the Submm-wave Range (100 GHz to 1.5 THz)
Today's modern society is based on access to information, which entails a continuously increasing need for higher data rates. One access point to information is the 5th Generation (5G) cellular networks that is using spectrum from sub-6 to mm-wave which provide up to G bits/s speed. There is a continuous development and the next generation access points are developed before the previous generation is fully operational. The work with the 6th Generation (6G) networks entails higher carrier frequency, submm-wave (Teraherz, THz). Another emerging technology to transmit data is UWB, or Ultra-Wide Band. UWB provides for high bandwidth communication between multiple users as an alternative to legacy systems. This session is focusing on the potential frequency sources of submm-wave such as solid state, laser, optical comb, frequency synthesis, injection locked, etc., also including their calibration methods and related components.
Chairs: Shinn-Yan (Calvin) Lin, Chunghwa Telecom, Taiwan and Peter Cash, Microchip