

January 30–February 2, 2017 • Hyatt Regency Monterey • Monterey, California



ITM

INTERNATIONAL TECHNICAL MEETING

PTTI

PRECISE TIME AND TIME INTERVAL
SYSTEMS AND APPLICATIONS MEETING



ITM/PTTI 2017 Meeting Schedule

Monday, January 30

Tutorials 9:00 a.m.–4:45 p.m.

Tuesday, January 31

Exhibit Hall Open 8:00 a.m.–5:00 p.m.
Exhibitor Hosted Breakfast 8:00 a.m.–9:30 a.m.
ITM/PTTI Plenary Session 9:30 a.m.–10:45 p.m.
Morning Sessions 10:50 a.m.–12:30 p.m.
Lunch in Exhibit Hall 12:30 p.m.–2:00 p.m.
Afternoon Sessions 1:40 p.m.–5:45 p.m.
PTTI Poster Session 6:00 p.m.–7:00 p.m.

Wednesday, February 1

Exhibit Hall Open 8:00 a.m.–4:30 p.m.
Morning Sessions 8:30 a.m.–12:00 p.m.
Lunch in Exhibit Hall 12:00 p.m.–1:30 p.m.
Afternoon Sessions 1:40 p.m.–5:45 p.m.

Thursday, February 2

Morning Sessions 8:30 a.m.–12:00 p.m.
Awards Luncheon 12:00 p.m.–2:00 p.m.
Afternoon Sessions 2:00 p.m.–5:45 p.m.

Online Access to Technical Papers and Presentations

Qualified attendees may download copies of conference presentations and papers online for FREE by logging in to the ION website at www.ion.org/itm or www.ion.org/ptti. Only presentations and papers provided to the ION by the presenting author will be available. Presentations will only be made available once the full technical paper is submitted. If a desired document is not available, we recommend you contact the author directly. Official conference proceedings will be distributed electronically in March to all eligible conference participants.

Mobile Conference Site

Access the technical program, real-time attendee list, and other conference information from your mobile device. Point your mobile browser to m.ion.org.

Free Internet Access

Network: Hyatt-Meeting
Access Code: instofnav

Photography Policy

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ONSITE PROGRAM

PROGRAM OVERVIEW

	ITM Track A Room: Big Sur	ITM Track B Room: Windjammer	ITM Track C Room: Cypress	PTTI Sessions Room: Spyglass
Monday January 30				9:00 a.m.–12:15 p.m. • Tutorial Sessions
				12:15 p.m.–1:30 p.m. • Lunch on Your Own
				1:30 p.m.–4:45 p.m. • Tutorial Sessions
Tuesday January 31	Exhibit Hall Open 8:00 a.m.–5:00 p.m., Regency Ballroom • Exhibitor Hosted Breakfast in Exhibit Hall 8:00 a.m.–9:30 a.m.			
	9:30 a.m.–10:45 a.m. ITM/PTTI Plenary Session: Back to the Future: Forecasts for Time and Navigation, 1917 and 2017, Regency Ballroom I			
	11:00 a.m.–12:30 p.m. A1: Modernized and Emerging GNSS	11:00 a.m.–12:30 p.m. B1: Advanced RAIM and Integrity 1	11:00 a.m.–12:30 p.m. C1: Multi-Sensor Fusion 1	10:50 a.m.–12:30 p.m. PTTI Opening Session
	12:30 p.m.–2:00 p.m. Lunch in the Exhibit Hall, Regency Ballroom			
	2:00 p.m.–5:30 p.m. A2: Space-borne Applications of GNSS	2:00 p.m.–5:30 p.m. B2: Advanced RAIM and Integrity 2	2:00 p.m.–5:30 p.m. C2: Multi-Sensor Fusion 2	1:40 p.m.–3:30 p.m. P2a: Time Scales and Algorithms 4:00 p.m.–5:45 p.m. P2b: Optical Clocks and the Eventual Redefinition of the SI Second 6:00 p.m.–7:00 p.m. P2c: PTTI Poster Presentation Session
Wednesday February 1	Exhibit Hall Open 8:00 a.m.–4:30 p.m.			
	8:30 a.m.–12:00 p.m. A3: Receiver and Antenna Technology	8:30 a.m.–12:00 p.m. B3: High Precision GNSS-PPP	8:30 a.m.–12:00 p.m. C3: Augmentation Systems	8:30 a.m.–10:00 a.m. P3a: Timing Laboratory Activities and Updates 10:30 a.m.–12:00 p.m. P3b: Time is Money: The Role of PTTI in the Financial Sector
	12:00 p.m.–1:30 p.m. Lunch in Exhibit Hall, Regency Ballroom			
	2:00 p.m.–5:30 p.m. A4: Interference and Spectrum Management	2:00 p.m.–5:30 p.m. B4: High Precision GNSS-RTK	2:00 p.m.–5:30 p.m. C4: Autonomous Navigation	1:40 p.m.–3:30 p.m. P4a: Advances in GNSS Time Transfer 4:00 p.m.–5:45 p.m. P4b: The Role of PTTI in Improving GNSS Invulnerability, Reliability, and Performance
	8:30 a.m.–10:00 a.m. A5a: Alternative Sensors and Backups to GNSS 1 10:30 a.m.–12:00 p.m. A5b: Algorithms for GNSS Processing and Sensor Integration 1	8:30 a.m.–12:00 p.m. B5: Mitigation of Jamming and Spoofing	8:30 a.m.–12:00 p.m. C5: Atmospheric Effects on GNSS Signals	8:30 a.m.–10:00 a.m. P5a: Advances in Geostationary Satellite Time and Frequency Transfer 10:30 a.m.–12:00 p.m. P5b: Advances in Computer Time Transfer: NTP, PTP, and Related Systems
Thursday February 2	12:00 p.m.–2:00 p.m. Awards Luncheon, Regency Ballroom			
	2:00 p.m.–5:30 p.m. A6: Algorithms for GNSS Processing and Sensor Integration 2	2:00 p.m.–5:30 p.m. B6: Alternative Sensors and Backups to GNSS 2	2:00 p.m.–5:30 p.m. C6: GNSS in Challenging Environments	2:00 p.m.–3:45 p.m. P6a: Advances in Clock Technology and in Optical Fiber Time Transfer 4:00 p.m.–5:45 p.m. P6b: Advances in PTTI Measurement Techniques

Hyatt Floor Plan

All conference events will take place within the Conference Center.

Conference Center, First Floor
(ITM/PTTI Sessions)



Conference Center, Second Floor
(Exhibit Hall)



Pre-conference tutorials have been organized to provide in-depth learning prior to the start of the technical program. All courses will be taught in a classroom setting. Electronic notes will be made available for download by registered attendees from the meeting website; registered attendees are encouraged to download notes in advance of courses. Notes will not be provided. Power will NOT be made available to course attendees for individual laptop computers; please come prepared with adequate battery power if required. ION reserves the right to cancel a portion of the tutorial program based on availability of the instructor.

Time	Course	Presenter
9:00 a.m. - 10:00 a.m.	Reference Time Scales and Traceability Concepts	Dr. Elisa Felicitas Arias, Dr. Demetrios Matsakis
10:00 a.m. - 11:00 a.m.	Measuring Electronic and Vibration-Induced Phase Noise in Oscillators	Dr. Archita Hati
11:00 a.m.–11:15 a.m. Break		
11:15 a.m. - 12:15 p.m.	Introduction to Atomic Frequency Standards	Dr. Robert Tjoelker
12:15 p.m.–1:30 p.m. Lunch on Your Own		
1:30 p.m. - 2:30 p.m.	Global Navigation Satellite Systems (GNSS)	Dr. Pascale Defraigne
2:30 p.m. - 3:30 p.m.	Fiber Based Time and Frequency Transfer	Dr. Sven-Christian Ebnehag
3:30 p.m.–3:45 p.m. Break		
3:45 p.m. - 4:45 p.m.	Earth's Time Varying Rotation	Dr. Richard Gross

Tutorial Descriptions and Instructor Biographies

Reference Time Scales and Traceability Concepts

Reference time scales are maintained based on international cooperation coordinated by the International Bureau of Weights and Measures (BIPM). Algorithms for achieving the required frequency stability and accuracy are developed for supporting their construction. Time and frequency time transfer methods are used for the integration of the data into the algorithms.

National laboratories maintaining local representations of the reference time scale must fulfill the criteria of traceability to the reference. Similarly, the provision of time and frequency services needs to demonstrate that they are traceable to the time references.

This tutorial will present the concepts underlying the construction of a time scale in general, and in particular those for the computation of the reference time scale Coordinated Universal Time (UTC). Time services are been developed for disseminating time to users. For claiming that they provide reference time, they must prove that they are traceable to UTC. The concepts of traceability will be introduced and the different ways of obtaining traceability will be described.



Dr. Felicitas Arias was born in Argentina. She received the master's degree in astronomy from the University of La Plata (Argentina) and the PhD in astrometry, celestial mechanics and geodesy from Paris Observatory. She was director of the Buenos Aires Naval Observatory and is Professor at the University of La Plata. Since 1999 she is the Director of the Time Department at the International Bureau of Weights and Measures (BIPM), where she is responsible for the maintenance of the Coordinated Universal Time (UTC). Her fields of activity are the space and time references. She is an active member of scientific organizations and unions such as the International Astronomical Union, the International Association for Geodesy, the International Earth Rotation and Reference Systems Service. She is the BIPM representative at the International Telecommunication Union. In France, she is a corresponding member at the Bureau of Longitudes. She is author of about 130 publications in scientific journals and proceedings.



Dr. Demetrios Matsakis holds a PhD from U.C. Berkeley. Initially a radio astronomer, he is now chief scientist for Time Services at the U.S. Naval Observatory. He has published over 100 papers and for almost thirty years been active in most aspects of timekeeping, including clock development, timekeeping statistics, timescale theory, time transfer, and eighteen years managing the USNO's Time Service Department. In the course of this time he has served on many international bodies and working groups, such as serving as president of the IAU's Time Commission and vice president of the U.S. delegation of the ITU's WPA.

Measuring Electronic and Vibration-Induced Phase Noise in Oscillators

Noise, present everywhere, causes a signal source to deviate from its ideal performance. This noise introduces time dependent phase and amplitude fluctuations on the signal. The spectral purity of a frequency source can be characterized in terms of amplitude modulation (AM) and phase modulation (PM) noise. This tutorial will cover the basic theory of modulation noise, the origin of different noise types, and the effects of signal manipulation such as amplification, frequency translation, and multiplication on the spectral purity of a signal. Various phase noise measurement techniques will be discussed, in particular, the advantages and problems of the cross-spectrum technique. In addition, in this tutorial we will discuss vibration-induced phase noise. An oscillator can often provide sufficiently low intrinsic phase noise to satisfy a particular system's requirements in a quiet environment. However, field environments are often far more strenuous than a laboratory setting; the mechanical vibration and acceleration onboard a vehicle or aircraft can introduce mechanical deformations that deteriorate the oscillator's otherwise low PM noise. We will discuss various sources of vibration-induced phase noise, the vibration sensitivity of different classes of oscillator, and a few techniques to improve the vibration-sensitivity of an oscillator.



Dr. Archita Hati is an electronics engineer at the Time and Frequency Division of the National Institute of Standards and Technology. She received her MSc and PhD degrees in Physics from University of Burdwan, W.B., India, in 1992 and 2001 respectively. Her current field of research includes phase noise metrology, ultra-low noise frequency synthesis, development of low noise microwave and opto-electronic oscillators, and vibration analysis. She is the calibration service leader for the Time and Frequency Metrology Group at NIST. In 2015 she was awarded the Allen V. Astin Measurement Science Award for developing a world-leading program of research and measurement services in phase noise.

PTTI PRE-CONFERENCE TUTORIALS (Spyglass Room)

Introduction to Atomic Frequency Standards

Atomic frequency standards form the basis of the definition of the second, enable ultra-stable timekeeping and timescales, and provide frequency metrology and references for a multitude of earth and space based applications that include fundamental physics, telecommunication, navigation, and radio science. There are many types of atomic frequency standards and clocks to address a wide range of application specific performance and operability requirements. Depending on the approach, achievable frequency standard accuracy, stability, size/mass/power, and cost can vary by many orders of magnitude. This course will present the fundamentals behind atomic frequency standards and survey the range of approaches.



Dr. Robert Tjoelker received degrees in architecture, mathematics, and physics from the University of Washington and the PhD degree in physics from Harvard University for the confinement and cooling of antiprotons in an ion trap and a precision comparison of the antiproton and proton mass. He currently leads the Frequency and Timing Advanced Development Group at the NASA Jet Propulsion Laboratory with responsibility for atomic frequency standard and timing developments for ground and spaceflight applications, the NASA Deep Space Network (DSN) Frequency and Timing System, and the JPL Frequency Standards Test Laboratory. He has published more than 100 journal and conference papers in the areas of atomic physics, fundamental constants, precision trapped ion mass spectrometry, atomic frequency standards, and frequency and timing technologies and systems. Dr. Tjoelker is a member of the IEEE UFFC, the American Physical Society, the Institute of Navigation, and the International telecommunication Union USWP-7A.

Global Navigation Satellite Systems (GNSS)

GNSS and Time have a bi-directional relationship. On the one hand, GNSS also relies on time: everything is based on the measurements of the signal travel time between the satellite and the receiver. GNSS therefore needs a reference timescale maintained by the operators and broadcast by the satellites. On the other hand, the satellite navigation systems offer a wonderful tool for time and frequency metrology, as these flying atomic clocks on board the satellites can be used as a reference for the comparison of ground time and frequency standards.

The tutorial will raise both aspects of the link between GNSS and TIME. After showing concretely the need for accurate time scales for the GNSS, the "GNSS time transfer" technique will be detailed. Code and carrier phase measurements will be presented and the procedure to get a precise and accurate clock comparison will be explained, both from the instrumental point of view and in terms of data analysis. GNSS Common View (or All in View) as well as Precise Point Positioning will be detailed in the presentation. The different error sources on the measurements will be studied and hence an ideal station setup will be presented.



Dr. Pascale Defraigne obtained her PhD in Geophysics in 1995 at the Université Catholique de Louvain. Since 1997 she manages the time and frequency activities at the Royal Observatory of Belgium, where the Belgian reference UTC (ORB) is maintained. Her research activities mainly concern the use of satellite navigation systems for time and frequency transfer. Dr. Defraigne presently chairs the CCTF working group on GNSS time transfer, and contributes to the validation of Galileo timing signals.

Fiber Based Time and Frequency Transfer

The ability to utilize optical fibers for high performance time and frequency transfer has reached a high level of interest in recent years. The techniques are in discussion in a Bureau International des Poids et Mesures (BIPM) working group on Advanced Time and Frequency Transfer Techniques, and several research groups work actively on the topic, improving the performance. The fiber enables a connection between timing users that unlike GNSS signals, cannot easily be jammed or spoofed, and it has low enough uncertainties to compare the frequency of optical clocks.

Even though the techniques at a first glance may appear straightforward and simple, the fibers have imperfections and limitations. The best case is when a dedicated fiber is used, since the full flexibility of the fiber can be utilized, but there are still crucial parameters to take into account. Furthermore, when only a wavelength channel in an active communication network is available for time-transfer, an additional concern is that these networks are not designed for stable time transfer, which means that novel techniques must be implemented in the existing structure, for better accuracy and stability than common time transfer protocols such as NTP and PTP.

The tutorial will focus on the practical issues of optical telecommunication fibers, covering attenuation, scattering, propagation modes, dispersion, temperature dependence, amplification and detection, with the addition of typical network designs, and how these parameters influence the achievable quality of the time transfer. Finally, a review of the development of time transfer over fiber up to the present date will be given.



Dr. Sven-Christian Ebnehag received his PhD from Chalmers University of Technology in Sweden, with a thesis on frequency transfer techniques and applications in fiber optic communication systems. He has a past as hardware and software consultant for electronics. Since 2002 he has worked at the SP Technical Research Institute of Sweden, where he is one of the senior scientists in the implementations of time and frequency transfer over a national fiber communication network. He is also group leader for Time, Frequency, Photometry and Radiometry at SP Technical Research Institute of Sweden.

Earth's Time Varying Rotation

The Earth's rotation is highly irregular. It varies on all observable time scales, from subdaily to decadal and longer. The gravitational attraction of the Sun, Moon, and planets causes the Earth to precess and nutate in space and, by periodically deforming the solid and fluid parts of the Earth, causes periodic changes in the Earth's rate of rotation and wobble. Torques acting on the solid Earth associated with the transport of mass within the Earth's atmosphere, hydrosphere, oceans, and core also change the Earth's rotation as does mass displacement occurring within the solid Earth caused by earthquakes and other tectonic and non-tectonic motions like glacial isostatic adjustment. Measurements of the Earth's rotation can therefore be used to gain greater understanding of a wide variety of geophysical and geodynamical processes. This tutorial will review the techniques used to measure variations in the Earth's rotation and the mechanisms that are causing it to vary.



Dr. Richard Gross received a PhD degree in Geophysics from the University of Colorado at Boulder. Since 1988 he has worked at NASA's Jet Propulsion Laboratory where he is a Senior Research Scientist and Supervisor of the Geodynamics and Space Geodesy Group. His research interests include Earth rotation, time variable gravity and terrestrial reference frame determination. He is President of the International Astronomical Union's (IAU's) Commission A2 on Rotation of the Earth, Chair of the Science Panel of the International Association Geodesy's (IAG's) Global Geodetic Observing System, and Co-Chair of the IAU/IAG Joint Working Group on Theory of Earth Rotation and Validation.

MEETING ORGANIZERS



ITM General Chair
Steve Rounds
John Deere



ITM Program Chair
Dr. André Hauschild
*German Aerospace
Center (DLR), Germany*



PTTI General Chair
Ryan Dupuis
Excelitas Technologies



PTTI Program Chair
Michael Lombardi
NIST



PTTI Tutorials Chair
James Hanssen
USNO

ITM/ PTTI PLENARY SESSION

Tuesday, January 31, 2017
9:30 a.m. – 10:45 a.m.
Regency Ballroom I

Welcome and Introductions



Dr. Dorota Grejner-Brzezinska
ION President
The Ohio State University



Dr. André Hauschild
ITM Program Chair
*German Aerospace
Center (DLR), Germany*



Michael Lombardi
PTTI Program Chair
NIST

ITM/PTTI Plenary Session

Back to the Future: Forecasts for Time and Navigation, 1917 and 2017



Following the New Year's custom to look forward to the future and back to evaluate the past, this presentation will explore significant forecasts made in 1917 about time and navigation and relate them to the future as we envision it from 2017. Some of these predictions turned out to be amazingly accurate. Others turned out to be pipe dreams. Examples will come from science, science fiction and technical work.

Carlene E. Stephens
Curator, Division of Work and Industry
Smithsonian National Museum of American History

Session A1: Modernized and Emerging GNSS

11:00 AM - 12:30 PM

Room: Big Sur



Dr. Stuart Riley, Trimble



Satoshi Kogure, JAXA, Japan

11:05 A Novel Real-time Multipath Mitigation Algorithm for BeiDou GEO Satellites Based on the Spacecraft Reflection Model:

Peng Wu, Baowang Lian, Northwestern Polytechnical University, China; Haowei Xu, Northwestern Polytechnical University, China/The Ohio State University

11:35 National Spatial Reference System Access in 2022: D.R. Roman, NOAA, National Geodetic Survey

12:05 VBOC1 GMGM Waveforms and ACF PSO: Part 2--Theory and Simulations: Ilir F. Progri, Giftet Inc.

Alternate

1. "Spectral Transparent Adhesive" - A Solution to the Next Generation Satellite Navigation Signals: Zheng Yao, Mingquan Lu, Tsinghua University, China

Session B1: Advanced RAIM and Integrity 1

11:00 AM - 12:30 PM

Room: Windjammer



Dr. Okuary Osechas, German Aerospace Center (DLR), Germany



Dr. Mathieu Joeger, The University of Arizona

11:05 Evaluation and Comparison of GNSS Navigation Integrity Monitoring Algorithms for Urban Transport Applications:

Ni Zhu, Juliette Marais, University Lille Nord de France, IFSTTAR, COSYS, LEOST, France; David Bétaille, IFSTTAR, COSYS, GEOLOC, France; Marion Berbineau, University Lille Nord de France, IFSTTAR, COSYS, LEOST, France

11:35 A New Approach for Quantifying the Effect of Measurement Faults in Extended Kalman Filtering:

Steven E. Langel and Kevin S. Martin, The MITRE Corporation

12:05 New 3D-Mapping-Aided Approach for User Integrity Monitoring in Urban Environments using a Nonparametric Positioning Errors Modeling:

N. Kbayer and M. Sahmoudi, ISAE-SUPAERO / TESA, Université de Toulouse, France

Alternates

1. Advanced RAIM Fault Detection and Exclusion Algorithm for Maritime Applications: Giulio Franzese, Politecnico di Torino, Italy; Ilaria Martini, German Aerospace Center, (DLR), Germany; Letizia Lo Presti, Politecnico di Torino, Italy; Michael Meurer, DLR, Germany
2. A Reduced Monitoring Subset Method for Different Orbit Satellites ARAIM: Zhipeng Wang, Yishan Ge, Jun Zhang, Lei Zheng, Beihang University, China
3. RAIM Performance Enhancement for GNSS Receiver Aided By Low-cost SINS: SiYuan Tan and Bocheng Zhu, Peking University, China

Session C1: Multi-Sensor Fusion 1

11:00 AM - 12:30 PM

Room: Cypress



Dr. Gert Trommer, Karlsruhe Institute of Technology, Germany



Dr. Walter Lillo, The Aerospace Corporation

11:05 Smartphones Orientation Tracking Algorithm for Pedestrian Navigation:

Maan Khedr, and Naser El-Sheimy, University of Calgary, Canada

11:35 Personnel Positioning System based on Low Cost MEMS Sensors:

Jian Chen, Gang Ou, Ao Peng, Lingxiang Zheng, Xiamen University, Xiamen, People's Republic of China

12:05 A Particle Filter and a Pattern Recognition Based Robust Indoor Localization in the Weak WiFi Environment:

Beomu Shin, Bosun Yu, Jaewon Bang, Jeahun Kim, Taikjin Lee, KIST, South Korea

Lunch in Exhibit Hall, 12:30 p.m. - 2:00 p.m., Regency Ballroom

Session P1: PTTI Opening Session

10:50 AM - 12:30 PM

Room: Spyglass



Michael Lombardi,
NIST



Ryan Dupuis,
Excelitas
Technologies

10:55 Meeting Opening: Mr. Michael Lombardi, NIST

11:00 Opening Remarks: CAPT Marc C. Eckardt, Superintendent, U.S. Naval Observatory

11:20 In Memoriam: For Dr. Gernot Maria Rudolph Winkler

11:30 PTTI Exhibitor Presentations



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Lunch in Exhibit Hall, 12:30 p.m. - 2:00 p.m., Regency Ballroom

Session A2: Space-borne Applications of GNSS

2:00 PM - 5:30 PM
Room: Big Sur



Frank Bauer,
FBauer
Aerospace
Consulting
Services



Dr. Jan Weiss,
UCAR

- 2:05 Precise Orbit and Baseline Determination for the SAOCOM-CS Bistatic Radar Mission:** O. Montenbruck, G. Allende-Alba, DLR/GSOC, Germany; J. Rosello and M. Tossaint, ESA/ESTEC, The Netherlands
- 2:35 Developing a Robust, Interoperable GNSS Space Service Volume for the Global Space User Community:** F. H. Bauer, FBauer Aerospace Consulting Services; J.J K. Parker, NASA Goddard Space Flight Center; B. Welch, NASA Glenn Research Center; W. Enderle, ESA European Space Operations Center
- 3:05 G-SPHERE-S GNSS: New GNSS Receiver for Operational Orbit Restitution of MICROSCOPE Satellite :** Thomas Junique, Romain Mathieu, David Pascal, Pierre-Yves Guidotti and Yves André, CNES, France; Philippe Bataille, Syrlinks, France
- Break: 3:30 p.m. - 3:55 p.m.**
- 4:00 HiSGR: A Novel High Sensitive Spaceborne GNSS Receiver for Lunar Missions:** Xiaoliang Wang, Yansong Meng, Yanguang Wang, Bo Qu, Xingyuan Han, Longlong Li, Lin Han, Academy of Space Electronic Information Technology, China; Xiaogong Hu, Min Fan, Peijia Li, Yong Huang, Shanghai Astronomical Observatory Chinese Academy of Sciences, China; Deren Gong, Shanghai Jiaotong University, China
- 4:30 The Influence of Atmosphere on GNSS Signals for High Altitude Orbit and Lunar Mission:** Guoliang Sun and Rui Fan, Beihang University, China
- 5:00 The Introduction to GNOS Instrument for FY-3 Meteorological Satellites:** Qifei Du, Yueqiang Sun, Weihua Bai, Xianyi Wang, Dongwei Wang, Xiangguang, Meng, Yuerong Cai, Congliang Liu, Chunjun Wu, Wei Li, Junming Xia, Cheng Liu, National Space Science Center, CAS, China

Alternates

- 1. Ground and Airborne Experiments of a GNSS-R Receiver:** Jyh-Ching Juang, heng-Hsiung Ma, and Chen-Tsung Lin, National Cheng Kung University, Taiwan
- 2. Ionospheric Scintillation Monitoring using GNOS Receiver:** Yusen Tian, University of Chinese Academy of Sciences, National Space Science Center, CAS, China; Yueqiang Sun, Xianyi Wang, Qifei Du, Dongwei Wang, Yuerong Cai, Chunjun Wu, Beijing Key Laboratory of Space Environment Exploration, NSSC, CAS, China

Session B2: Advanced RAIM and Integrity 2

2:00 PM - 5:30 PM
Room: Windjammer



Dr. Okuary
Osechas,
German
Aerospace
Center (DLR),
Germany



Dr. Mathieu
Joerger,
The
University of
Arizona

- 2:05 Characterization of GLONASS Broadcast Clock and Ephemeris: Nominal Performance and Fault Trends for ARAIM:** Kazuma Gunning, Todd Walter, Per Enge, Stanford University
- 2:35 Evaluation of a Multi-Constellation ARAIM Airborne Prototype:** Juan Blanch, R. Eric Phelts, Yu-Hsuan Chen, Per Enge, Stanford University
- 3:05 Analysis of Advanced RAIM Performance Degradation That can be Caused by Imprecise Integrity Support Message:** Young C. Lee and Brian Bian, The MITRE Corporation
- Break: 3:30 p.m. - 3:55 p.m.**
- 4:00 New Advanced RAIM Residual Based Fault Detection and Exclusion Method:** Peng Zhao, Jun Zhang, Beihang University, China; Yawei Zhai, Illinois Institute of Technology, U.S.; Mathieu Joerger, The University of Arizona, U.S.; Boris Pervan, Illinois Institute of Technology, U.S.
- 4:30 RAIM and AUKF for GNSS Performance Enhancement in Multi-Constellation:** F. C. Meng, X. Meng, L. Tao, J. R. Sun, Z. Niu, B. C. Zhu, Peking University
- 5:00 GNSS Environment for BDS Based ARAIM:** Bohao Zhao, Rui Xue, Peng Zhao, and Yanbo Zhu, Beihang University, China

Alternates

- 1. Advanced RAIM Fault Detection and Exclusion Algorithm for Maritime Applications:** Giulio Franzese, Politecnico di Torino, Italy; Ilaria Martini, German Aerospace Center, (DLR), Germany; Letizia Lo Presti, Politecnico di Torino, Italy; Michael Meurer, DLR, Germany
- 2. A Reduced Monitoring Subset Method for Different Orbit Satellites ARAIM:** Zhipeng Wang, Yishan Ge, Jun Zhang, Lei Zheng, Beihang University, China
- 3. RAIM Performance Enhancement for GNSS Receiver Aided By Low-cost SINS:** SiYuan Tan and Bocheng Zhu, Peking University, China

Session C2: Multi-Sensor Fusion 2

2:00 PM - 5:30 PM
Room: Cypress



Dr. Gert
Trommer,
karlsruhe
Institute of
Technology,
Germany



Dr. Walter
Lillo,
The
Aerospace
Corporation

- 2:05 Augmenting Navigation Systems of Micro Aerial Vehicles with a Hybrid Laser-Camera Sensor:** Jamal Atman, Manuel Popp, Institute of Systems Optimization (ITE), Karlsruhe Institute of Technology (KIT), Germany; Gert F. Trommer, ITE KIT, Germany & ITMO University, Russia
- 2:35 Vanishing Point/vehicle Motion Constraints Aided Ground Vehicle Navigation:** Zhenbo Liu, Naser El-Sheimy, Chunyang Yu, University of Calgary, Canada; Yongyuan Qin, Northwestern Polytechnical University, China
- 3:05 Spacecraft Relative Navigation Using Appearance Matching and Sensor Fusion:** Christopher R. McBryde and E. Glenn Lightsey, Georgia Institute of Technology
- Break: 3:30 p.m. - 3:55 p.m.**
- 4:00 Real-Time Context Aware Dual-Mode Filter Design for Seamless Indoor and Outdoor Navigation:** Pekka Peltola, Chris Hill, Terry Moore, Nottingham University, UK
- 4:30 An Airborne LiDAR/INS Integrated Navigation Solution based on Fuzzy Controlled SIFT:** Haowei Xu, Northwestern Polytechnical University, China/The Ohio State University; Baowang Lian, Northwestern Polytechnical University, China; Charles K. Toth, Dorota Brzezinska, The Ohio State University
- 5:00 Performance of Ship's Heading Autonomous Integrity Monitoring using Multi-Compass:** Kazumichi Oi, Yuji Okutomi, Shigeyuki Okuda, Marine Technical College, JMETS, Japan; Masatoshi Shimpo, Tokai University, Japan; and Yasuo Arai, Marine Technical College, JMETS, Japan

Session P2a: Time Scales and Algorithms**1:40 PM - 3:30 PM****Room: Spyglass**Dr. Stefania Romisch,
NISTKen Senior,
Naval Research Laboratory

- 1:45 BIPM Services for the Time and Frequency Community:** Elisa Felicitas Arias, International Bureau of Weights and Measures, France
- 2:05 On Systematic Uncertainties in Coordinated Universal Time (UTC):** Demetrios Matsakis, U.S. Naval Observatory
- 2:25 Time Scale Steered by an Optical Lattice Clock:** T. Ido, H. Hachisu, F. Nakagawa, and Y. Hanado, National Institute of Information and Communications Technology, NICT, Japan
- 2:45 The Development of a New Kalman-Filter Time Scale at NIST:** Jian Yao, Thomas Parker, and Judah Levine, Time and Frequency Division, National Institute of Standards and Technology
- 3:05 Robust Ensemble Time Onboard a Satellite:** Marion Gödel and Johann Furchner, German Aerospace Center (DLR), Germany

Break: 3:35 p.m. - 3:55 p.m.**Alternates**

- 1. ITU-R Activities on the Future of the UTC Timescale:** Ronald Beard, U.S. Naval Research Laboratory
- 2. UTC(NPLI) Generation and Maintenance using Time Scale Algorithm:** M. P. Olaniya, S. Yadav, Preeti Kandpal, Pranalee P. Thorat, V.N. Ojha, CSIR-National Physical Laboratory, India
- 3. A Clock Ensemble using only Active Hydrogen Masers:** T.E. Parker and S. Romisch, Time and Frequency Division, National Institute of Standards and Technology

Session P2b: Optical Clocks and the Eventual Redefinition of the SI Second**4:00 PM - 5:45 PM****Room: Spyglass**Dr. Jeffrey Sherman,
NISTGregory Weaver,
John Hopkins Applied Physics Laboratory

- 4:05 International Comparisons Involving NPL's Optical Atomic Clocks:** Helen Margolis and Patrick Gill, National Physical Laboratory (NPL), UK
- 4:25 Estimation of the UTC Scale using an Optical Lattice Clock:** H. Hachisu, F. Nakagawa, Y. Hanado, and T. Ido, National Institute of Information and Communications Technology, NICT, Japan
- 4:45 1400 km Optical Fiber Link Tests Whether French and German Clocks Tick Alike:** G. Grosche¹, C. Lisdat, Physikalisch-Technische Bundesanstalt (PTB), Germany; N. Quintin, Université Paris 13 (UP13), France; C. Shi, LNE-SYRTE, Observatoire de Paris, France; S.M.F. Raupach, C. Grebing, PTB, Germany; D. Nicolodi, LNE-SYRTE, F. Stefani, Observatoire de Paris, France; A. Al-Masoudi, S. Doerscher, S. Haefner, PTB, Germany; J.-L. Robyr, LNE-SYRTE, F. Stefani, Observatoire de Paris, France; N. Chiodo, UP13, France; S. Bilicki, E. Bookjans, LNE-SYRTE, F. Stefani, Observatoire de Paris, France; A. Koczwara, S. Koke, A. Kuhl, PTB, Germany; F. Wiotte, UP13, France; F. Meynadier, LNE-SYRTE, Observatoire de Paris, France; E. Camisard, RENATER, France; M. Abgrall³, M. Lours³, LNE-SYRTE, Observatoire de Paris, France; T. Legero, H. Schnatz, U. Sterr, PTB, Germany; H. Denker, Leibniz Universität Hannover, Germany; C. Chardonnet, UP13, France; Y. Le Coq, LNE-SYRTE, Observatoire de Paris, France; G. Santarelli, Université de Bordeaux, France; A. Amy-Klein, UP13, France; R. Le Targat, J. Lodewyck, P.-E. Pottie, LNE-SYRTE, Observatoire de Paris, France; O. Lopez, UP13, France
- 5:05 Optical Frequency Division with More than 20 Digits (A Tool for Optical Frequency Ratio Measurement):** Yuan Yao, Yanyi Jiang, Hongfu Yu, Zhiyi Bi and Longsheng Ma, East China Normal University, China
- 5:25 Trapped-ion optical Atomic Clocks at the Quantum Limits:** David R. Leibbrandt, Samuel M. Brewer, Jwo-Sy Chen, Chin-Wen Chou, Aaron M. Hankin, David B. Hume, and David J. Wineland, NIST

Alternates

- 1. A Pilot Study on Incorporating an Optical Clock in a Time Scale:** Jian Yao and Judah Levine, Time and Frequency Division, National Institute of Standards and Technology
- 2. Development of an Optical Frequency Standard Based on a Single Trapped Ytterbium ion:** S. Panja, S. De, N. Batra, A. Roy, S. Majhi, U. Mishra, L. Sharma, S. Yadav and A. Sen Gupta, Time and Frequency Division, CSIR-National Physical Laboratory, India; K.S. Krishnan Marg, Academy of Scientific and Innovative Research (AcSIR), India

Session P2c: PTTI Poster Presentation Session**6:00 PM - 7:00 PM****Room: Spyglass Prefunction**Michael Lombardi,
NISTRyan Dupuis,
Excelitas Technologies

- 1. A Clock Ensemble Using Only Active Hydrogen Masers:** T.E. Parker, Time and Frequency Division, NIST
- 2. A Pilot Study on Incorporating an Optical Clock in a Time Scale:** J. Yao, J. Levine, NIST
- 3. Development of an Optical Frequency Standard Based on a Single Trapped Ytterbium ion:** S. Panja, Time and Frequency Division, CSIR-National Physical Laboratory, India
- 4. Russian State Time and Frequency Standard Laboratory Activities and Updates:** I. Blinov, VNIIFTRI Time and Space, Russia
- 5. Development of the Time and Frequency Laboratory of INACAL:** H. Diaz, INACAL, Peru
- 6. Study of the Consistency of P1 and P2 Calibration in GNSS Receiving Systems Dedicated to Time Transfer:** P. Defraigne, W. Huang, Royal Observatory of Belgium
- 7. Autonomous Time Synchronization for Navigation Constellation based on Inter-satellite Link:** D. Wang, Beijing Satellite Navigation Center, China
- 8. Algorithm for on Orbit GPS III Clock Correction:** J. Janis and M. Jones, Harris Corp.
- 9. Resilient Solution based on Distributed Linked GNSS Receivers:** J. Diaz, Seven Solutions / University of Granada, Spain
- 10. Testing GNSS Based Timing Systems:** L. Perdue, Spectracom
- 11. A GPS Spacecraft Atomic Clock Flight Simulation and Test Station:** H. Wang, The Aerospace Corporation
- 12. EGNOS time and UTC Disseminated by EGNOS:** P. Defraigne, Royal Observatory of Belgium
- 13. Accurate Time Transfer with Indirect TWSTFT Links:** Z. Jiang, BIPM, France;
- 14. Next Generation of Software Defined Timing (SDT) Systems:** J.L. Gutierrez, Seven Solutions
- 15. Time and Frequency Dissemination in an All-optical Coherent Fiber Communication Network:** S.-C. Ebenhag, SP Technical Research Institute of Sweden
- 16. Microsemi CSAC Updates, Applications and Technical Tradeoffs:** P. Cash, Microsemi
- 17. On the Theoretical Approximation of Radiant Grey Body Transfer in Concentric Cylindrical Clock Geometries:** K.L. Miskell, The University of Alabama
- 18. The Absolute Delay Calibration of the Specialized GNSS Time Transfer Receiver. Results and Analysis:** S. Bolginova, VNIIFTRI Time and Space, Russia
- 19. The Use and Challenges of Precise Time in Electric Power SynchroPhasor Systems:** M. Weiss, NIST
- 20. Time and Frequency from Electrical Power Lines:** J. Hardis, NIST
- 21. Time in the Connected Vehicle Ecosystem:** M. Calabro, Booz Allen Hamilton

Session A3: Receiver and Antenna Technology
8:30 AM - 12:00 PM
Room: Big Sur



Dr. Rodrigo Leandro,
Hemisphere
GNSS



Dr. Sanjeev Gunawardena,
Air Force
Institute of
Technology

- 8:35 **Code and Carrier Tracking for Spectrally Asymmetric Signals:** Thomas Pany, University FAF Munich, Germany; Chun Yang, Sigtem Technology, Inc.
- 9:05 **Pinch the Correlation Function: A Method to Improve Delay Estimation in Multipath:** Chun Yang and Andrey Soloviev, QUNav, LLC
- 9:35 **The Auto-correlation Curve Fitting Technique in GNSS Receivers:** Zhibin Luo, Jicheng Ding, Lin Zhao, Mouyan Wu, College of Automation, Harbin Engineering University, China

Break: 10:00 a.m. - 10:25 a.m.

- 10:30 **An Optimizing Combined Unambiguous Correlation Functions for BOC Signals Tracking:** Tian Li, Jiaolong Wei, Zuping Tang, Zhihui Zhou, Boyi Wang, Huazhong University of Science and Technology, China
- 11:00 **Performance Evaluation of LQG based Optimal GNSS Tracking Loop using Non-linear Measurements:** Sanghoon Jeon, Minhuck Park, Beomju Shin, Changdon Kee, Seoul National University, South Korea; Chongwon Kim, Corporate R&D Center, SK Telecom, South Korea
- 11:30 **GNSS Spread Spectrum Security Code Detection using Sequential vs. Fixed Window Approaches for Proof of Location:** John J. Hall, Logan Scott, Jade Morton, Colorado State University

Alternate

1. **Development of a Low-cost Precise RTK Receiver with the Augment of the Local Ionosphere Model:** Wenlin Yan, Wenfeng Nie, Tianhe Xu, Guochang Xu, Institute of Space Sciences, Shandong University, China

Session B3: High Precision GNSS - PPP
8:30 AM - 12:00 PM
Room: Windjammer



Dr. Javier Tegedor,
Fugro
Satellite
Positioning,
Norway



Dr. Sunil Bisnath,
York
University,
Canada

- 8:35 **Characterization of Timing and Pseudorange Biases due to GNSS Front-End Filters by Type, Signal Structure and Temperature:** Justin Guerrero, Sanjeev Gunawardena, AFIT
- 9:05 **Analysis of Multi-GNSS PPP Initialization using Dual- and Triple-frequency Data:** John Aggrey and Sunil Bisnath, York University, Canada
- 9:35 **An Improved Triple-frequency Carrier Ambiguity Resolution for BDS + GPS:** Xiaoying Gu, Lin Tao, Bocheng Zhu, Peking University, China

Break: 10:00 a.m. - 10:25 a.m.

- 10:30 **Trimble RTX: State of the Art of Multi-GNSS, Multi-Frequency PPP with Proven Trimble RTK Performance:** Herbert Landau, Markus Brandl, Xiaoming Chen, Ralf Drescher, Trimble Terrasat GmbH, Germany
- 11:00 **GPS/BDS/GLONASS Real-Time Precise Point Positioning using RCTM-SSR for Kinematic Maritime Positioning:** Fuxin Yang, Liang Li, Lin Zhao, Jin Chen, Harbin Engineering University, China
- 11:30 **Novel VPPP Algorithms with Multiple Antennas and Attitude Estimation:** Atsushi Mouri, Goshi Okuda, Yukihiro Kubo and Sueo Sugimoto, Ritsumeikan University, Japan

Alternate

1. **Single- and Dual-Frequency PPP Using GPS, BeiDou, and Galileo Observables: A Flexible Approach for Avoiding Constellation Reliance:** Ryan White, Richard B. Langley, The University of New Brunswick, Canada; Simon Banville, Natural Resources Canada

Session C3: Augmentation Systems
8:30 AM - 12:00 PM
Room: Cypress



Santiago Perea,
German
Aerospace
Center (DLR),
Germany



Dr. Todd Walter,
Stanford
University

- 8:35 **Extension of EWF Threat Model and Associated SQM:** Olivier Julien, Ikhlas Selmi, Jean-Baptiste Pagot, ENAC, France; Jaron Samson, Francisco Amarillo Fernandez, European Space Agency, The Netherlands
 - 9:05 **Catalog and Description of GPS and WAAS L1 C/A Signal Deformation Events:** Karl Shallberg and Swen Ericson, Zeta Associates Inc.; Eric Phelts and Todd Walter, Stanford University; Karl Kovach, The Aerospace Corporation
 - 9:35 **High-Fidelity Signal Deformation Analysis of the Live Sky GLONASS Constellation using ChipShape Processing:** Mark Wireman, Sanjeev Gunawardena, Mark Carroll, Air Force Institute of Technology
- Break: 10:00 a.m. - 10:25 a.m.**
- 10:30 **Geometric Approximations of Heavy-Tail Effects for Chi-Square Integrity Monitors:** Jason H. Rife and J. Scott Parker, Tufts University
 - 11:00 **Test Statistic Auto- and Cross-correlation Effects on Monitor False Alert and Missed Detection Probabilities:** Boris Pervan, Samer Khanafseh, and Jaymin Patel, Illinois Institute of Technology
 - 11:30 **Bounding GPS L1 Antenna Group Delay Variation for GNSS Landing System Integrity:** Matt Harris, Matt Miltner, Tim Murphy, Boeing Commercial Airplanes; Frank van Graas, Anurag Raghuvanshi, Ohio University

Alternates

1. **Method to Reduce the Influence of Abnormal Meteorological Conditions for MCDF GBAS:** Zhipeng Wang, Pumin Xin, Yanbo Zhu, Beihang University, TaoSheng Wang, Beijing Institute of Tracking and Telecommunication Technology, China
2. **Efficiency Improvement of the Current SBAS System by Removal of RRC and Fast Correction:** Cheolsoo Lim, Byungwoon Park, Sejong University, South Korea; Changdon Kee, Seoul National University, South Korea

Lunch in Exhibit Hall, 12:00 p.m. - 1:30 p.m., Regency Ballroom

Session P3a: Timing Laboratory Activities and Updates

8:30 AM - 10:00 AM

Room: *Spyglass*



Dr. Mauricio Lopez, Centro de Investigación y Estudios Avanzados (CINVESTAV), Mexico



Liz Catherine Hernández Forero, Instituto Nacional de Metrología (INM), Colombia

8:35 **PTB's Time and Frequency Services 2015 – 2016:** D. Piester, A. Bauch, J. Becker, J. Leute, T. Polewka, F. Riedel, D. Sibold, E. Staliuniene, S. Weyers, Physikalisch-Technische Bundesanstalt (PTB), Germany

8:55 **Time and Frequency Activities at the JHU Applied Physics Laboratory:** Mihan Miranian, Gregory L. Weaver, Jeffrey F. Garstecki, Richard A. Dragonette, JHU/ Applied Physics Laboratory

9:15 **The Evolution About Time and Frequency Metrology and the Legal Time of the Republic of Colombia:** Liz Catherine Hernández Forero, Nelson Bahamón Cortés, Alexander Martínez López, Instituto Nacional de Metrología de Colombia, (INM), Colombia

9:35 **Report on Time & Frequency Activities in Poland, and Cooperation with Lithuania:** Jerzy Nawrocki, Astrogeodynamical Observatory, Poland; Albin Czubla, Central Office of Measures, Poland; Rimantas Miskinis, Center for Physical Sciences and Technology, Lithuania

Break: 10:05 a.m. - 10:25 a.m.

Alternates

- Russian State Time and Frequency Standard Laboratory Activities and Updates:** I. Blinov, Domnin Yu, S. Donchenko, I. Ignatenko, N. Koshelyaevsky, A. Naumov, S. Slyusarev, Smirnov Yu, VNIIFTRI Time and Space, Russia
- Development of the Time and Frequency Laboratory of INACAL:** Henry Diaz, INACAL, Peru

Session P3b: Time is Money: The Role of PTTI in the Financial Sector

10:30 AM - 12:00 PM

Room: *Spyglass*



Dr. Elizabeth Laier English, National Physical Laboratory, UK



Dr. Marina Gertszov, National Research Council, Canada

10:35 **Time Traceability, a Challenge for the Financial Sector:** Elisa Felicitas Arias, International Bureau of Weights and Measures, France

10:55 **NRC Remote Clock – A Secure and Traceable Time Source:** John Bernard, Andre Charbonneau, Bill Hoger, Hai Pham and Marina Gertszov, National Research Council (NRC), Canada

11:15 **Update on the NPL Time Service and Future Developments with White Rabbit:** Elizabeth Laier English, Peter Whibberley, Conway Langham, David Hicks, Leon Lobo, National Physical Laboratory, UK

11:35 **Ultra Tight Relative Timing in Finance Trading:** E. Ros, J. Díaz, Seven Solutions / Universit of Granada, Spain; A. Rojo, Seven Solutions, Spain

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Lunch in Exhibit Hall, 12:00 p.m. - 1:30 p.m., Regency Ballroom

Session A4: Interference and Spectrum Management

2:00 PM - 5:30 PM

Room: Big Sur



Thomas Kraus,
University
FAF, Germany



Dr. Olivier
Julien,
ENAC, France

- 2:05 **DOT GPS Adjacent Band Compatibility Assessment Test Results:** Stephen Mackey, Hadi Wassaf, and Karen Van Dyke, DOT, OST-R/Volpe Center; Christopher Hegarty, The MITRE Corporation; Karl Shallberg, Zeta Associates
- 2:35 **GNSS Spoofing, Jamming, and Multipath Interference Classification using a Maximum-Likelihood Multi-Tap Multipath Estimator:** Jason N. Gross, West Virginia University; Todd Humphreys, University of Texas at Austin
- 3:05 **A More Accurate Evaluation of GPS C/A Code Self-Interference Considering Critical Satellites:** A.J. Van Dierendonck, AJ Systems; Sai Kalyanaraman, Rockwell Collins; Chris Hegarty, The MITRE Corporation, Karl Shallberg, Zeta Associates
Break: 3:30 p.m. - 3:55 p.m.
- 4:00 **Monitoring GNSS for Targeted RF Interference:** Okuary Osechas, Santiago Perea, Boubeker Belabbas, Michael Meurer, German Aerospace Center (DLR), Germany
- 4:30 **Results of an Interference Detection and Localization System Operation in an Airport:** Deok Won Lim, Sebum Chun, Korea Aerospace Research Institute (KARI), South Korea; Jin Hyuk Lee, Sang Jeong Lee, Chungnam National University, South Korea; Moon Beom Heo, KARI, South Korea
- 5:00 **Interference Testing of the 1st Adjacent-channel of the Ground-Based Augmented System (GBAS) and the Very High Frequency (VHF) Omni-Directional Radio Ranges (VOR):** E. Etienne, V. Hinton, S. Beauchamp, L. Salcedo, Federal Aviation Administration

Alternates

1. **A Multiple-Antenna Software GPS Signal Simulator for Rapid Testing of Interference Mitigation Techniques:** Russell Powell, Joshua Starling, and David Bevely, Auburn University
2. **Blind Despreading of Civil GNSS Signals for Resilient PNT Applications:** Brian G. Agee, B3 Advanced Communication Systems

Session B4: High Precision GNSS - RTK

2:00 PM - 5:30 PM

Room: Windjammer



Dr. Christian
Tiberius,
Delft
University of
Technology,
The
Netherlands



Dr. Robert
Odolinski,
University of
Otago, New
Zealand

- 2:05 **The Effect of Inter-system Biases Estimation for Mixed GPS-BeiDou on Ambiguity Resolution:** Nobuaki Kubo, Hiroko Tokura, Tokyo University of Marine Science and Technology, Japan
- 2:35 **On the Performance of a Low-cost Single-frequency GPS+BDS RTK Positioning Model:** R. Odolinski, University of Otago, New Zealand; P.J.G. Teunissen, Curtin University of Technology, Australia & Delft University of Technology, The Netherlands
- 3:05 **Long Baseline GPS+BDS RTK Positioning with Partial Ambiguity Resolution:** Andreas Brack, Technische Universität München (TUM), Germany
Break: 3:30 p.m. - 3:55 p.m.
- 4:00 **A New Approach for NRTK with Precise Ionosphere Model in Local Region:** Zhao Jiaojiao, Li Zishen, Wang Liang, Qu Jianghua, Yuan Hong, Chinese Academy of Sciences, China
- 4:30 **A Novel Geometry-free and Geometry-based Combined TCAR Algorithm: Preliminary Performance Analysis for BeiDou System:** Chun Jia, Liang Li, Lin Zhao, Zeyu Xin, Harbin Engineering University, China
- 5:00 **Evolving Quality Assurance and Quality Control in The Global Navigation Satellite System Surveying Firms - A case Study in Egypt:** M. Hamdy Elwany, H.G. El-Ghazouly, Mohamed M. Hosny, Samy M. Ayaad, Alexandria University, Egypt

Session C4: Autonomous Navigation

2:00 PM - 5:30 PM

Room: Cypress



Dr. Naser
El-Sheimy,
University
of Calgary,
Canada



Dr. Zak Kassas,
University of
California,
Riverside

- 2:05 **A Loosely Coupled Decentralized Cooperative Navigation Algorithm for Team of Mobile Agents:** Jianan Zhu and Solmaz S. Kia, University of California Irvine
- 2:35 **Collaborative Autonomous Vehicles with Signals of Opportunity Aided Inertial Navigation Systems:** Joshua Morales, Joe Khalife, and Zaher (Zak) Kassas, University of California, Riverside
- 3:05 **Factor Graphs-Based Multi-Robot Cooperative Localization: A Study of Shared Information Influence on Optimization Accuracy and Consistency:** Laith R. Sahawneh, University of Florida; Kevin M. Brink, U.S. Air Force Research Laboratory, Munitions Directorate
Break: 3:30 p.m. - 3:55 p.m.
- 4:00 **Continuity Risk of Feature Extraction for Laser-Based Navigation:** Mathieu Joerger, The University of Arizona and Boris Pervan, Illinois Institute of Technology
- 4:30 **Optical Flow Based Approach for Vision Aided Inertial Navigation Using Regression Trees:** M. Mostafa, A. Moussa, N. El-Sheimy, A. Abu Sesay, University of Calgary, Canada
- 5:00 **Nonlinear Control with Adaptive Control Allocation for a Quadrotor with Tilttable Rotors:** Georg Scholz, Institute of Systems Optimization (ITE), Karlsruhe Institute of Technology (KIT), Germany; Gert F. Trommer, ITE, KIT, Germany, ITMO University, Russia

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Session P4a: Advances in GNSS Time Transfer

1:40 PM - 3:30 PM

Room: *Spyglass*



Dr. Pascale Defraigne, Royal Observatory, Belgium



Dr. Judah Levine, NIST

- 1:45 **Examining Short-Term Noise in GPS Carrier Phase Time Transfer:** Christine Hackman, United States Naval Observatory
- 2:05 **Performances of E5 AltBOC for Time and Frequency Applications:** Pascale Defraigne, Wei Huang, Royal Observatory of Belgium; Giancarlo Cerretto, Elena Cantoni, INRIM, Italy; Franco Fiasca, aizoOn, Italy; Alexander Mudrak, ESTEC, ESA, The Netherlands
- 2:25 **A Simple and Accurate Procedure for the Absolute Calibration of GNSS Receivers:** Pierre Waller, Daniel Schultz, Roberto Prieto-Cerdeira, European Space Agency, The Netherlands
- 2:45 **Long-term Instability in UTC Time Links:** Zhiheng Jiang, BIPM, Bureau International des Poids et Mesures, France; Demetrios Matsakis, US Naval Observatory; Victor Zhang, National Institute of Standards and Technology
- 3:05 **Demonstrator of Time Services based on European GNSS Signals:** The H2020 DEMETRA Project: Pascale Defraigne, Royal Observatory of Belgium

Break: 3:35 p.m. - 3:55 p.m.

Alternates

1. **Study of the Consistency of P1 and P2 Calibration in GNSS Receiving Systems Dedicated to Time Transfer:** Pascale Defraigne and W. Huang, Royal Observatory of Belgium
2. **Autonomous Time Synchronization for Navigation Constellation based on Inter-satellite Link:** Dongxia Wang and Zhixue Zhang, Beijing Satellite Navigation Center, China; Lin Xie, Tsinghua University, China; Tingsong Tang, Na Zhao, Beijing Satellite Navigation Center, China
3. **SynchroNet Service Demonstration Results in Demetra H2020 Project:** A Scalable High Performances Synchronisation Solution: Enrico Varriale and Quirino Morante, Thales Alenia Space Italia S.p.A., Italy
4. **An Assessment of the Precise Products on Static Precise Point Positioning using Multi-Constellation GNSS:** J. Mohammed, The University of Nottingham, UK & University of Wasit, Iraq; T. Moore, C. Hill, R.M. Bingley, The University of Nottingham, UK
5. **Time Synchronization Using Common View Global Navigational Satellite Systems (CVGNSS):** M. P. Olaniya, S. Panja, S. Yadav, A. Sen Gupta, CSIR-NPL, India; S. Sudharani, DLRL, India

Session P4b: The Role of PTTI in Improving GNSS Invulnerability, Reliability, and Performance

4:00 PM - 5:45 PM

Room: *Spyglass*



James Hannsen, U.S. Naval Observatory



Dr. Jian Yao, NIST

- 4:05 **0.0000137 Seconds! The January 2016 GPS Timing Glitch:** Martin Burnicki, Heiko Gerstung, Meinberg Radio Clocks; Douglas Arnold, Meinberg-USA
- 4:25 **The Effects of the January 2016 UTC Offset Anomaly on GPS Receivers Monitored at NIST:** Jian Yao, Michael A. Lombardi, Andrew N. Novick, Bijunath Patla, and Victor Zhang, Time and Frequency Division, National Institute of Standards and Technology
- 4:45 **The Impact of the GPS UTC Anomaly Event of January 2016 on the Global Timing Community:** Charles Curry, MD Chronos Technology Ltd, UK
- 5:05 **Signals of Opportunity as an Augmentation or Alternative to GNSS for Critical Timing Applications:** Lisa Perdue, Ronald Dries, John Fischer, Spectracom
- 5:25 **MBS Indoor Timing Receiver – Concept, Implementation, and Test Results:** Wouter Pelgrum, Subbu Meiyappan, Vikram Kalkunte, Sameet Deshpande, Umadevi Sambasivam, NextNav LLC

Alternates

1. **Algorithm for on Orbit GPS III Clock Correction:** John Janis and Michael Jones, Harris Corp.
2. **Resilient Solution based on Distributed Linked GNSS Receivers:** J. Díaz, E. Ros, Seven Solutions /University of Granada, Spain; B. Rat and R. Rodríguez, Seven Solutions
3. **Testing GNSS Based Timing Systems:** Lisa Perdue, Spectracom
4. **A GPS Spacecraft Atomic Clock Flight Simulation and Test Station:** H. Wang, G.H. Iyanu, and J.C. Camparo, The Aerospace Corporation

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Session A5a: Alternative Sensors and Backups to GNSS 1

8:30 AM - 10:00 AM

Room: Big Sur



Dr. Wouter Pelgrum, NextNav LLC



Courtney Mario, Draper

- 8:35 **A Portable Tactical Field Sensor Array for an Infrasound Direction-Finding and Positioning System:** John McIntire, Duy Nguyen, Eric Vinande, and Frederick Webber, Air Force Research Laboratory
- 9:05 **Relative Position Estimates from Terahertz Observables:** John Scott Parker and Jason Rife, Tufts University
- 9:35 **Magnetic Anomaly Navigation with Sparse Map Data using Covariance Maps:** Aaron Canciani John Raquet, Air Force Institute of Technology

Break: 10:00 a.m. - 10:25 a.m.

Alternates

1. **Differential and Rubidium Disciplined Test Results from an Iridium-Based Secure PNT Solution:** H. Stewart Cobb, David Lawrence, Gregory Gutt, and Michael O'Connor, Satelles
2. **Transitioning the United States National Airspace System's (NAS) Legacy Network of Very High Frequency (VHF) Omni-Directional Radio Ranges (VOR) to a Minimum Operational Network (MON):** E. Etienne, V. Hinton, L. Salcedo, Federal Aviation Administration

Session A5b: Algorithms for GNSS Processing and Sensor Integration 1

10:30 AM - 12:00 PM

Room: Big Sur



Dr. Jean-Marie Sleewaegen, Septentrio, Belgium



Dr. Thomas Pany, IGASPIN GmbH, Austria

- 10:30 **A Partitioned Vector Tracking Loop for GNSS Carrier Phase Signals with Separate Estimation of Common and Single Channel Errors:** José M. Marçal, Fernando Nunes, Instituto de Telecomunicações University of Lisbon, Portugal; Fernando M. G. Sousa, Instituto de Telecomunicações ISEL, Portugal
- 11:00 **Improvement of Carrier Phase Tracking Based on Vector Architecture:** Shaohua Chen, Shiyu Xing, Yang Gao, University of Calgary, Canada
- 11:30 **Design and Performance Evaluation of an Adaptive Hybrid Coherent and Non-coherent GNSS Vector Tracking Loop:** Mouyan Wu, Lin Zhao, Jicheng Ding, Yingyao Kang, Zhibin Luo, College of Automation, Harbin Engineering University, China

Alternates

1. **Combined Algorithm of Acquisition and Anti-jamming based on Improved Sparse Fourier Transform(SFT) for GNSS Signals:** Zhen Liu, Jie Huang, Mingquan Lu, Yongjun Zhao, Guangyun Li, National Digital Switching System Engineering Technology Center (CNDSC), China
2. **Impact of Discriminator Spaces and Elevation Angle on GNSS SQM for New Generation Signals:** Chengyan He, Xiaochun Lu, Xue Wang and Yongnan Rao, NTSC, Chinese Academy of Sciences, China

Session B5: Mitigation of Jamming and Spoofing

8:30 AM - 12:00 PM

Room: Windjammer



Dr. Jason Gross, West Virginia University



Ivan Johnston, L-3/Interstate Electronics Corporation

- 8:35 **PCB Implementation of a Single Null-steering Antenna and its Anti-spoofing/ jamming Testing:** Yu-Hsuan Chen, Fabian Rothmaier, Stanford University; Dennis Akos, University of Colorado at Boulder; Sherman Lo and Per Enge, Stanford University
- 9:05 **GNSS Spoofing Detection based on Correlator Outputs Stationarity Monitoring:** Huiqi Tao, Hong Li, Mingquan Lu, Tsinghua University, China; Peng Liu, Space Star Technology Co., Ltd.
- 9:35 **Performance Analysis of Spoofing Signal Ratio for GNSS Receiver-Spoofers:** Zhou Meng, Liu Ying, Li Hong, Lu Mingquan and Liu Peng, Tsinghua University, China

Break: 10:00 a.m. - 10:25 a.m.

- 10:30 **GNSS Spoofing Detection Ability of a Loosely Coupled INS/GNSS Integrated Navigation System for Two Integrity Monitoring Methods:** Yang Liu, Qiangwen Fu, Zhenbo Liu, Sihai Li, Northwestern Polytechnical University, China
- 11:00 **Counteracting the Effects of GNSS Jamming in a Maritime Multi-Target Scenario by Fusing AIS with Radar Data:** Gregor Siegert, Pawel Banys, Julian Hoth, Frank Heymann, German Aerospace Center (DLR), Germany
- 11:30 **APNT for GNSS Spoof Detection:** Peter F. Swazek, University of Rhode Island; Richard J. Hartnett, U.S. Coast Guard Academy; Kelly C. Seals, U.S. Coast Guard Academy

Alternates

1. **An Anti-spoofing Method Based on Doppler Positioning:** Fengkui Chu, Hong Li, Jian Wen, Tsinghua University, China; Hailing Wu, Beijing Institute of Tracking and Telecommunications Technology, China; Mingquan Lu, Tsinghua University, China
2. **Error Analysis of Carrier Phase Positioning For Controlled Reception Pattern Array:** Joshua Starling and David M. Bevil, Auburn University

Awards Luncheon, 12:00 p.m. - 2:00 p.m., Regency Ballroom

Session C5: Atmospheric Effects on GNSS Signals

8:30 AM - 12:00 PM

Room: Cypress



Dr. Attila Komjathy, NASA JPL



Dr. Miquel Garcia-Fernandez, Rokubun, Spain

- 8:35 Ionospheric Scintillation Effects on GPS Pseudorange and Carrier Phase Measurements and An Adaptive Algorithm to Limit Position Errors During Scintillation:** Greg Myer, Yu (Jade) Morton, Colorado State University and Brian Schipper, Honeywell
- 9:05 On the Use and Performance of New Galileo Signals for Ionospheric Scintillation Monitoring over Antarctica:** Rodrigo Romero, Nicola Linty, Calogero Cristodaro, Fabio Dovis, Politecnico di Torino, Italy; Lucilla Alfonsi, Istituto Nazionale di Geofisica e Vulcanologia, Italy
- 9:35 GBAS Ionosphere Monitoring and Assessment Based on GPS Data in Beijing Area:** Zhipeng Wang, Shujing Wang, Yanbo Zhu, Beihang University, Taosheng Wang, Beijing Institute of Tracking and Telecommunication Technology, China

Break: 10:00 a.m. - 10:25 a.m.

- 10:30 Simultaneous Investigations of the Effects of Ionospheric Scintillations on GPS and EGNOS Signals over Equatorial Africa:** A.O. Akala, University of Lagos, Nigeria; O.A. Arowolo, University of Lagos & Nigerian Civil Aviation Authority, Nigeria; P.H. Doherty, Boston College
- 11:00 Towards Re-creating Real-world Ionospheric Scintillation Events in a Spirent Simulator-Based Robust PNT Test Framework:** Talini Pinto Jayawardena, University of Bath/Spirent Communications, UK; Guy Buesnel, Spirent Communications, UK; Cathryn N Mitchell, University of Bath, UK; Richard Boyles, Spirent Communications, UK; Biagio Forte, Robert J Watson University of Bath, UK
- 11:30 Tropospheric Delays for Ground-to-Air Radio Links:** Shrivathsan Narayanan, Okuary Osechas, German Aerospace Center (DLR), Germany; Christoph Günther, DLR, & Technical University of Munich, Germany

Alternate

- 1. SBAS Ionospheric Correction with Minimalization of the Ionospheric Threat:** Takeyasu Sakai, Mitsunori Kitamura, Takahiro Aso, and Kazuaki Hoshinoo, National Institute of Maritime, Port and Aviation Technology, Japan

Session P5a: Advances in Geostationary Satellite Time and Frequency Transfer

8:30 AM - 10:00 AM

Room: Spyglass



Victor Zhang, NIST



Dr. Demetrios Matsakis, U.S. Naval Observatory

- 8:35 Pilot Study on the Validation of the Software-Defined Receiver for TWSTFT:** Zhiheng Jiang and Elisa Felicitas Arias, Bureau International des Poids et Mesures, France
- 8:55 A Study on Using the SDR Receiver for the Europe-to-Europe and Transatlantic TWSTFT Links:** Victor Zhang, Tom Parker, National Institute of Standards and Technology (NIST); Yi-Jiun Huang, Shinn-Yan Lin, National Standard Time and Frequency Laboratory, Telecommunication Laboratories (TL); Dirk Piester, Physikalisch-Technische Bundesanstalt (PTB), Germany; Joseph Achkar, LNE-SYRTE, Observatoire de Paris (OP), PSL Research University, CNRS, Sorbonne Universités, UPMC University, France; Zhiheng Jiang, Bureau International des Poids et Mesures (BIPM), France
- 9:15 Domestic Time Transfer with Digital Broadcast Satellite Signals:** Tadahiro Gotoh, Toshihiro Kubo-oka, Hiroshi Takiguchi, and Jun Amagai, NICT, Japan
- 9:35 Utilizing TWSTFT in a Passive Configuration:** Carsten Rieck, Per Jarlemark, and Kenneth Jaldehag, Department of Measurement Technology, SP Technical Research Institute of Sweden, Sweden

Break: 10:05 a.m. - 10:25 a.m.

Alternates

- 1. EGNOS time and UTC Disseminated by EGNOS:** P. Defraigne, W. Huang, Royal Observatory of Belgium; N. Suard, A. Kanj, J Delporte, J Marechal, CNES, France; P. Uhrich, Ph. Tuckey, LNE-SYRTE, Observatoire de Paris, PSL Research University, CNRS, Sorbonne Universités, UPMC University, France; I. Sesia, G. Signorile, INRIM, Italy
- 2. Accurate Time Transfer with Indirect TWSTFT Links:** Zhiheng Jiang, Bureau International des Poids et Mesure, France; Victor Zhang, Tom Parker, Jian Yao, National Institute of Standards and Technology; Yi-Jiun Huang, Shinn-Yan Lin, National Standard Time and Frequency Lab., Chunghwa Telecom

Session P5b: Advances in Computer Time Transfer: NTP, PTP, and Related Systems

10:30 AM - 12:00 PM

Room: Spyglass



Lee Cosart, Microsemi



Rodney Greenstreet, National Instruments

- 10:35 Sub-nanosecond Time Distribution Through Long-haul Fiber-optic Links using White Rabbit Ethernet:** T. J. Pinkert, Nikhef, OPNT B.V., The Netherlands; E. F. Dierikx, VSL, The Netherlands; H. Z. Peek, Nikhef, The Netherlands; C. van Tour, Vrije Universiteit, The Netherlands; R. Smets, SURFnet, The Netherlands; J.C.J. Koelemeij, OPNT B.V., Vrije Universiteit, The Netherlands
- 10:55 Extending Commercial Telecom PTP Across the US:** Marc Weiss, Time and Frequency Division, National Institute of Standards and Technology; Lee Cosart, Microsemi Corp.
- 11:15 A Comparison of NTP Servers Connected to the Same Reference Clock and the Same Network:** Andrew N. Novick and Michael A. Lombardi, National Institute of Standards and Technology
- 11:35 Challenges in Time Transfer using the Network Time Protocol (NTP):** Steven Sommars, Nokia

Alternates

- 1. Next Generation of Software Defined Timing (SDT) Systems:** J.L. Gutierrez, Seven Solutions, Spain; M. Jiménez, University of Granada, Spain; J. Díaz, E. Ros, Seven Solutions / University of Granada, Spain
- 2. Evolution of the IEEE 1588 Standard:** Douglas Arnold, Meinberg Radio Clocks

Awards Luncheon, 12:00 p.m. - 2:00 p.m., Regency Ballroom

Session A6: Algorithms for GNSS Processing and Sensor Integration 2

2:00 PM - 5:30 PM
Room: Big Sur



Dr. Jean-Marie Sleewaegen, Septentrio, Belgium



Dr. Thomas Pany, IGASPIN GmbH, Austria

- 2:05 **Test Results of GNSS Vector Tracking Loop based on LQG Filter:** Sanghoon Jeon, Minhuck Park, Beomju Shin, Changdon Kee, Mechanical and Aerospace Engineering, Seoul National University, South Korea; Chongwon Kim, Corporate R&D Center, SK Telecom, South Korea
 - 2:35 **A Temporal Algorithm for Satellite Subset Selection in Multi-Constellation GNSS:** Peter F. Swaszek, University of Rhode Island; Richard J. Hartnett, U.S. Coast Guard Academy; Kelly C. Seals, U.S. Coast Guard Academy; Rebecca M. A. Swaszek, Boston University
 - 3:05 **Automatic GPS Phase Scintillation Detector Using a Machine Learning Algorithm:** Yu Jiao, John Hall and Yu (Jade) Morton, Colorado State University
- Break: 3:30 p.m. - 3:55 p.m.**
- 4:00 **Correlator Beamforming for Multipath Mitigation in High-Fidelity GNSS Monitoring Applications:** Sanjeev Gunawardena, John Raquet, Mark Carroll, Air Force Institute of Technology
 - 4:30 **FUNNEL: Filtering Using Neural Networks for Exactness and Leanness:** Alexandr Draganov, Expedition Technology, Inc.
 - 5:00 **MTLL Comparison of Unambiguous Tracking Algorithms:** Boyi Wang, Jiaolong Wei, Zuping Tang, Tian Li, Huazhong University of Science and Technology, China

Alternates

1. **Combined Algorithm of Acquisition and Anti-jamming based on Improved Sparse Fourier Transform(SFT) for GNSS Signals:** Zhen Liu, Jie Huang, Mingquan Lu, Yongjun Zhao, Guangyun Li, National Digital Switching System Engineering Technology Center (CNDSC), China
2. **Impact of Discriminator Spaces and Elevation Angle on GNSS SQM for New Generation Signals:** Chengyan He, Xiaochun Lu, Xue Wang and Yongnan Rao, NTSC, Chinese Academy of Sciences, China

Session B6: Alternative Sensors and Backups to GNSS 2

2:00 PM - 5:30 PM
Room: Windjammer



Dr. Wouter Pelgrum, NextNav LLC



Courtney Mario, Draper

- 2:05 **Initial Results of MF-DGNSS R-Mode as an Alternative Position Navigation and Timing Service:** G.W. Johnson, Alion Science and Technology; P.F. Swaszek, University of Rhode Island; M. Hoppe, German Waterways and Shipping Administration, Germany
 - 2:35 **Optimised Placement of LDACS Stations to Achieve RNP – APCH for Terminal Area Navigation in GNSS Denied Environment:** Rachit Kumar, Okuary Osechas, Elisabeth Nossek, Boubeker Belabbas, Giuseppe Battista, German Aerospace Centre (DLR), Germany; Michael Meurer, DLR, RWTH Aachen University, Germany
 - 3:05 **Temperature Variation Effects on the Stochastic Performance of Smartphones Sensors Using Allan Variance and Generalized Method of Wavelet Moments:** Ahmed Radi, You Li and Naser El-Sheimy, University of Calgary, Canada
- Break: 3:30 p.m. - 3:55 p.m.**
- 4:00 **Comparative Results for Positioning with Secondary Synchronization Signal versus Cell Specific Reference Signal in LTE Systems:** Kimia Shamaei, Joe Khalife, and Zaher (Zak) Kassas, University of California, Riverside
 - 4:30 **Indoor Localization using Region-based Convolutional Neural Network:** Haowei Xu, The Ohio State University & Northwestern Polytechnical University; Zoltan Koppanyi, Charles K. Toth, Dorota Grejner-Brzezinska, The Ohio State University
 - 5:00 **Crowdsourced Novel WiFi Fingerprint Database Update Strategy Leveraging Clustering and Pattern Recognition Techniques:** Boseon Yu, Bumju Shin, Jaewon Bang, Taikjin Lee, Korea Institute of Science and Technology, South Korea

Alternates

1. **Designing an Alternative DME Pulse using Genetic Algorithms:** Euiho Kim, Cheongju University, South Korea
2. **Celestial Aided Inertial Navigation by Tracking High Altitude Vehicles:** Mark S. Kim, Scott J. Pierce, Air Force Institute of Technology; Kevin M Brink, Air Force Research Laboratory

Session C6: GNSS in Challenging Environments

2:00 PM - 5:30 PM
Room: Cypress



Dr. Fabio Dovis, Politecnico di Torino, Italy



Dr. Maktar Malik, ESA, The Netherlands

- 2:05 **Adaptive Blanking as an Innovative Signal Enhancer for GNSS Receivers:** Francis Soualle, Airbus Defence and Space GmbH, Germany; Mathieu Cattenoz, Private
 - 2:35 **Modified Code Tracking Loop Aided by Short Multipath Insensitive Code Loop Discriminator:** Xu Weng, Yanhong Kou, Beihang University, China
 - 3:05 **Robust Outlier Mitigation in Multi-Constellation GNSS-based Positioning for Waterborne Applications:** José A. Pozo-Pérez, Daniel Medina, Iván Darío Herrera-Pinzón, Anja Heßelbarth, Ralf Ziebold, German Aerospace Center (DLR), Germany
- Break: 3:30 p.m. - 3:55 p.m.**
- 4:00 **Benefits of a Tightly-coupled GNSS/INS Real-Time Solution in Urban Scenarios and Harsh Environments:** Gianluca Falco, Gianluca Marucco, Mario Nicola, Marco Pini, Istituto Superiore Mario Boella, Italy
 - 4:30 **Constructive Use of MP/NLOS bias of GNSS Pseudoranges: Performance Analysis by Type of Environment:** N. Kbayer, M. Sahmoudi, ISAE-SUPAERO / TESA, Université de Toulouse, France
 - 5:00 **The Record and Replay Approach for GNSS Receiver Performance Assessment in Road Environment:** Calogero Cristodaro, Fabio Dovis, Laura Ruotsalainen, Politecnico di Torino, Italy

Alternates

1. **Multipath Mitigation Using a Dual-Polarization Antenna—How Good Can We Get?:** Lin Xie, Xiaowei Cui, Sihao Zhao and Mingquan Lu, Department of Electronic Engineering, Tsinghua University, China
2. **Advanced Anti-Jam Indoor Adaptive GNSS Signal Acquisition—Theory and Simulations:** Ilir F. Progri, Gifet Inc.

Session P6a: Advances in Clock Technology and in Optical Fiber Time Transfer

2:00 PM - 3:45 PM

Room: *Spyglass*



Dr. Sven-Christian Ebenhag, SP Technical Research Institute of Sweden



Dr. Dirk Piester, Physikalisch-Technische Bundesanstalt, Germany

- 2:05 **Drifts and Environmental Disturbances in Atomic Clock Subsystems: Quantifying Local Oscillator, Control Loop, & Ion Resonance Interactions:** Daphna G. Enzer, William A. Diener, David W. Murphy, Shanti R. Rao, and Robert L. Tjoelker, Jet Propulsion Laboratory, California Institute of Technology
- 2:25 **On-Orbit GPS Rubidium Clock Lamplight Variations: Statistics of Lamplight Jumps:** James Camparo, Valerio Formichella, and Patrizia Tavella, The Aerospace Corporation
- 2:45 **Development of a High Performance Optically-pumped Cesium Beam Clock for Ground Applications:** Berthoud Patrick, Haldimann Manuel, Ducommun Christophe, Lefebvre Frederic, Pantic Radoslav, Schneller Luc, Kroll Fabiano, Michaud Alain, Oscilloquartz, Switzerland
- 3:05 **UTC Traceable Synchronization for Telecommunication Networks by Fiber-optic Time and Frequency Transfer:** D. Piester, Physikalisch-Technische Bundesanstalt (PTB), Germany; L. Sliwczynski, P. Krehlik, P. Kolodziej, AGH University of Science and Technology, Poland; H. Imlau, H. Ender, Deutsche Telekom Technik GmbH, Germany; H. Schnatz, A. Bauch, PTB, Germany
- 3:25 **Experience with Optical Infrastructure for Time and Frequency Transfer:** Vladimír Smotlacha, and Josef Vojtech, CESNET, Czech Republic

Break: 3:45 p.m. - 3:55 p.m.

Alternates

1. **Time and Frequency Dissemination in an All-optical Coherent Fiber Communication Network:** Sven-Christian Ebenhag, and Per Olof Hedekvist, SP Technical Research Institute of Sweden, Sweden
2. **Microsemi CSAC Updates, Applications and Technical Tradeoffs:** P. Cash, P. Machado, K.R. Overstreet, M. Silveira, M. Stanczyk, D. Taylor, Microsemi
3. **On the Theoretical Approximation of Radiant Grey Body Transfer in Concentric Cylindrical Clock Geometries:** Kyle L. Miskell, Andrew N. Lemmon, The University of Alabama; H. Bryan Owings, Microsemi Corp.
4. **Experimental Study on Time transfer Method in One Direction via Short-distance Optical Fiber:** Kun Liang, Jian Wang, Zhiqiang Yang, Ye Wang, Weibo Wang, Aimin Zhang, National Institute of Metrology, China

Session P6b: Advances in PTTI Measurement Techniques

4:00 PM - 5:45 PM

Room: *Spyglass*



Dr. Archita Hati, NIST



Cameron Everson, Excelitas Technologies

- 4:05 **Local Distribution and Calibration of Timing Signals at NIST:** Joshua Savory, National Institute of Standards and Technology (NIST); Liz Catherine Hernández Forero, Instituto Nacional de Metrología (INM); Kristopher Maurer, Colorado State University (CSU); Stefania Romisch, NIST
- 4:25 **Traceable Calibration of a Phase Noise Standard:** Laurent-Guy Bernier, Daniel Stalder, Jacques Morel, METAS Federal Institute of Metrology, Switzerland; Jakub Kucera, Stefan Dahinden, Anapico AG, Switzerland
- 4:45 **Analyses of GPS Satellite Clocks at Sub-second Time Intervals:** Erin Griggs, Dennis Akos, Sara Hrbek, and David Emmert, University of Colorado
- 5:05 **Rubidium Atomic Clock Error Modeling and Forecasting Based on Parameter Constrained Kalman Filter:** Guoliang Sun, Beihang University, China
- 5:25 **Numerical Modeling Results for the Estimation of the Confidence Intervals for Different Noise Types:** Marina Gertsvolf, National Research Council (NRC), Canada

Alternates

1. **The Absolute Delay Calibration of the Specialized GNSS Time Transfer Receiver. Results and Analysis:** S. Bolginova, N. Koshelyaevsky, V. Fedotov, VNIIFTRI Time and Space, Russia
2. **The Use and Challenges of Precise Time in Electric Power Synchrophasor Systems:** Marc Weiss, National Institute of Standards and Technology (NIST); Alison Silverstein, North American Synchrophasor Initiative (NASPI); Ya-Shian Li-Baboud, NIST; Francis K. Tuffner, Pacific Northwest National Laboratory (PNNL)
3. **Time and Frequency from Electrical Power Lines:** Jonathan Hardis, NIST, Demetrios Matsakis and Blair Fonville, USNO
4. **Time in the Connected Vehicle Ecosystem:** Michael Calabro, Jamie Ter Beest, and Ben Titzer, Booz Allen Hamilton

January 29–
February 1, 2018
Hyatt Regency, Reston, VA

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EXHIBIT HALL

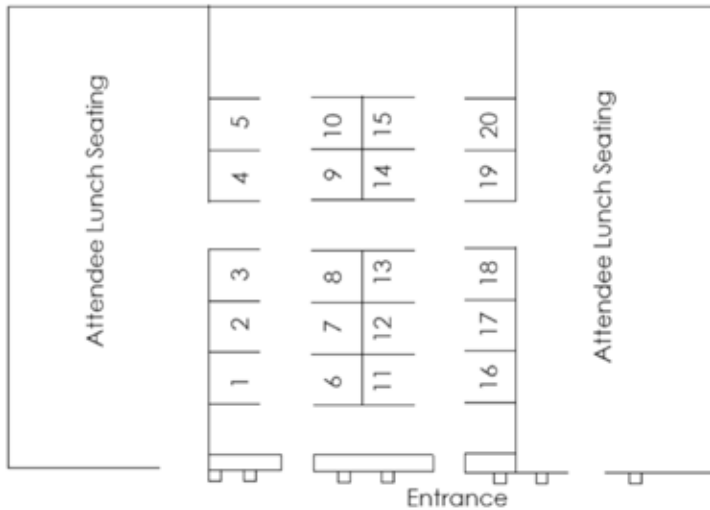


Exhibit Hall Hours:

Tuesday, January 31

8:00 a.m. – 5:00 p.m.

Exhibit Hall Open

8:00 a.m. – 9:30 a.m.

Exhibitor Hosted Breakfast

Wednesday, February 1

8:00 a.m. – 4:30 p.m.

Exhibit Hall Open

Exhibitors as of 1/10/17:

(Alphabetically by Name):

- 10 Brandywine Communications
- 1 CAST Navigation
- 20 EndRun Technologies
- 14 Frequency Electronics, Inc.
- 16 GuideTech
- 15 IFEN Inc
- 17 Jackson Labs Technologies, Inc.
- 6 Jtime! Meinberg USA
- 9 Lange-Electronic GmbH
- 13 Linear Photonics, LLC
- 2 Masterclock, Inc.
- 4 Microsemi Frequency and Time Corporation
- 19a ORCA Technologies LLC
- 18 Oscilloquartz SA
- 3 Septentrio
- 7 Spectracom Corporation
- 5 SpectraDynamics
- 11 Spirent Federal Systems
- 4a The Institute of Navigation
- 19 TimeTech GmbH

For detailed exhibitor profiles and full contact information, visit: www.ion.org/ptti/exhibits.cfm

SPECIAL EVENTS

Special Events for Attendees

The following special events are included in a full-conference registration. Single day registrations include any special events taking place on the day the attendee is registered. Student and retired registrations include meals located in the exhibit hall; a ticket is required for the Awards Luncheon.

Exhibitor Hosted Breakfast

Tuesday, January 31, 8:00 a.m. – 9:30 a.m.

Exhibit Hall, Regency Ballroom

Informal Luncheon

Tuesday, January 31, 12:30 p.m. – 2:00 p.m.

Exhibit Hall, Regency Ballroom

Informal Luncheon

Wednesday, February 1, 12:00 p.m. – 1:30 p.m.

Exhibit Hall, Regency Ballroom

Annual Awards Luncheon

Thursday, February 2, 12:00 p.m. – 2:00 p.m.

Regency Ballroom

Special Events for Speakers and Session Chairs

All session chairs and the presenting author of both primary and alternate presentations, should attend the Speakers' Breakfast or Speakers' Meeting taking place 7:30 a.m. - 8:15 a.m. on the day of their presentation. Names will be checked at the door. Please attend the Speakers' Breakfast only on the morning(s) of your presentation(s).

Tuesday: Regency Ballroom IV

Wednesday: Regency Ballroom I

Thursday: Regency Ballroom I