ION
INSTITUTE OF NAVIGATION

ION GNSS+ 2026

+ SEPTEMBER 14-18, 2026

HYATT REGENCY GRAND CYPRESS

ORLANDO, FLORIDA

SATELLITE DIVISION'S 40TH ANNIVERSARY

ION

1987 - 2026

40TH ANNIVERSARY EVENTS

EXPANDED MASTERS SHORT COURSE PROGRAM

40TH ANNIVERSARY STUDENT SESSION

TRIVIA NIGHT!

ION.ORG/GNSS

ON-SITE PROGRAM

FREE Wi-Fi Network: HYATT-MEETING | Password: GNSS2026

ION GNSS+ 2026 Program Organizers



General Chair
Dr. Dorota Grejner-Brzezinska
University of Wisconsin, Madison



Program Co-Chair
Dr. Andrew Neish
Reliable Robotics



Program Co-Chair
Dr. Okuary Osechas
Zurich University of Applied Sciences



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Plenary Chair
Dr. José-Ángel Ávila-Rodríguez
European Space Agency

Technical Track Chairs

Commercial and Policy Tracks



Track A
Dr. Joy Jiao
Trimble



Track B
Dr. María Caamaño Albuerne
German Aerospace Center (DLR)



Track C
Stefan Wallner
European Space Agency

Research Tracks



Track D
Dr. Yiping Jiang
The Hong Kong Polytechnic University



Track E
Dr. Sriramya Bhamidipati
NASA JPL

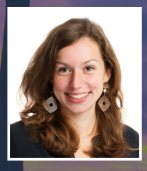


Track F
Dr. Andrea Nardin
Politecnico di Torino

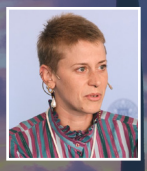
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Emeritus Professor, University of Nottingham



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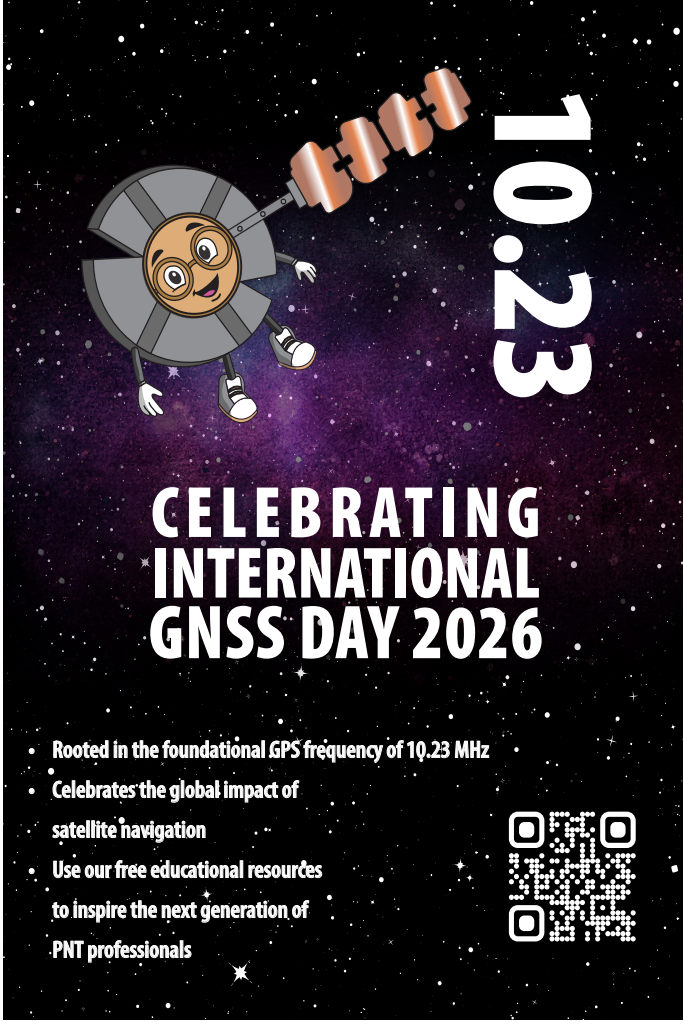
International Technical Advisor
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Swinburne University of Technology



International Technical Advisor
Dr. Okuary Osechas
ZHAW



ION President
Dr. Gary McGraw
Genova Technologies



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navi.ion.org

Conference and Local Area Information

Conference Location

Hyatt Regency Grand Cypress
1 Grand Cypress Blvd, Orlando, FL 32836

Doing Business at ION GNSS+

Ad-Hoc Meeting Space

Space for small meetings of 4-12 attendees is available on a first-come, first-served basis. Attendees/organizations may sign up for a maximum of one hour per day using the sign-up sheets in front of each room. See floor plan on page 4 for room locations.

Business Center

A business center will be provided near the ION GNSS+ registration desk on the second floor of the hotel, to provide access to basic computer services including printing and internet access.

ION Conferences App

The ION Conferences app enables attendees to view the current program, create a custom schedule, view exhibit information and more, right from their mobile device.

Download "ION Conferences" from your device's app store, and click on "GNSS 2026" on the app home screen to download the meeting guide.

Online Job Board

Visit the online job board at ion.org/job-board.cfm to view or post employment opportunities for the navigation community.

Free Wi-Fi

Free Wi-Fi is available in all session rooms and public areas:
Network: HYATT-MEETING
Password: GNSS2026

Getting Around Orlando

The Hyatt Regency Grand Cypress is conveniently located near Walt Disney World, Disney Springs, Universal Orlando Resort and other major Orlando attractions. Rideshare services such as Uber and Lyft are widely available throughout the area and are often the most convenient option for getting around.

The resort also offers scheduled shuttle service to select Disney destinations, Disney Springs and Universal Orlando Resort; check with the hotel for current schedules and reservations. Rental cars and taxis are also readily available for exploring the greater Orlando area.

A shuttle has been arranged exclusively for ION GNSS+ guests on Wednesday and Thursday evenings, providing transportation to Disney Springs.

Conference Policies

Proceedings

Official conference proceedings are scheduled for distribution in October to all eligible conference participants.

Photography/Video Recording by ION

Your presence at ION GNSS+ constitutes your agreement to be photographed, filmed, videotaped or otherwise recorded by conference management, or its agents, and your agreement that your image/voice may be distributed in print/electronic communications media without any compensation being paid to you.

A curated selection of photographs taken by the official show photographer will be uploaded to ion.org/gnss (you must be logged in to view) the week after the conference for attendee viewing, download, and personal use. Photos used by professional media/commercial communications departments should credit: "ION GNSS+ 2026, Photo courtesy of ION."

Photography/Recording by Attendees

Video recording by participants is not allowed without permission of ION during any portion of the conference. Photographs of copyrighted presentations are for personal use only and are not to be reproduced or distributed. Do not photograph images labeled as proprietary. Flash photography, or photography that disturbs those around you, is prohibited.

Code of Ethics/Code of Conduct

By registering for this event, you agree to abide by the ION Code of Ethics and Conference Code of Conduct available at ion.org.

What Will you Find Online?

ION Plenary Session

ION will record the plenary session and post it on the meeting website for on-demand access. The recording will remain available for 30 days after the conference.

Session Papers

Registered attendees may download copies of presentation slides and papers online for free by logging in to the meeting website at ion.org/gnss. Only slides and papers provided to the ION by the presenting author will be available. If a desired document is not available, we recommend you contact the author directly.

Technical Sessions

Individual technical presentations have been pre-recorded and uploaded with slides to the meeting website for viewing beginning on Tuesday. Recordings will remain available for 30 days after the conference. A list of on-demand only presentations is available on page 14 of this program.

On-Demand Conference Content

Access to on-demand conference content is included with your full-conference registration. On-demand presentations will utilize Vimeo.

Technical Tutorials

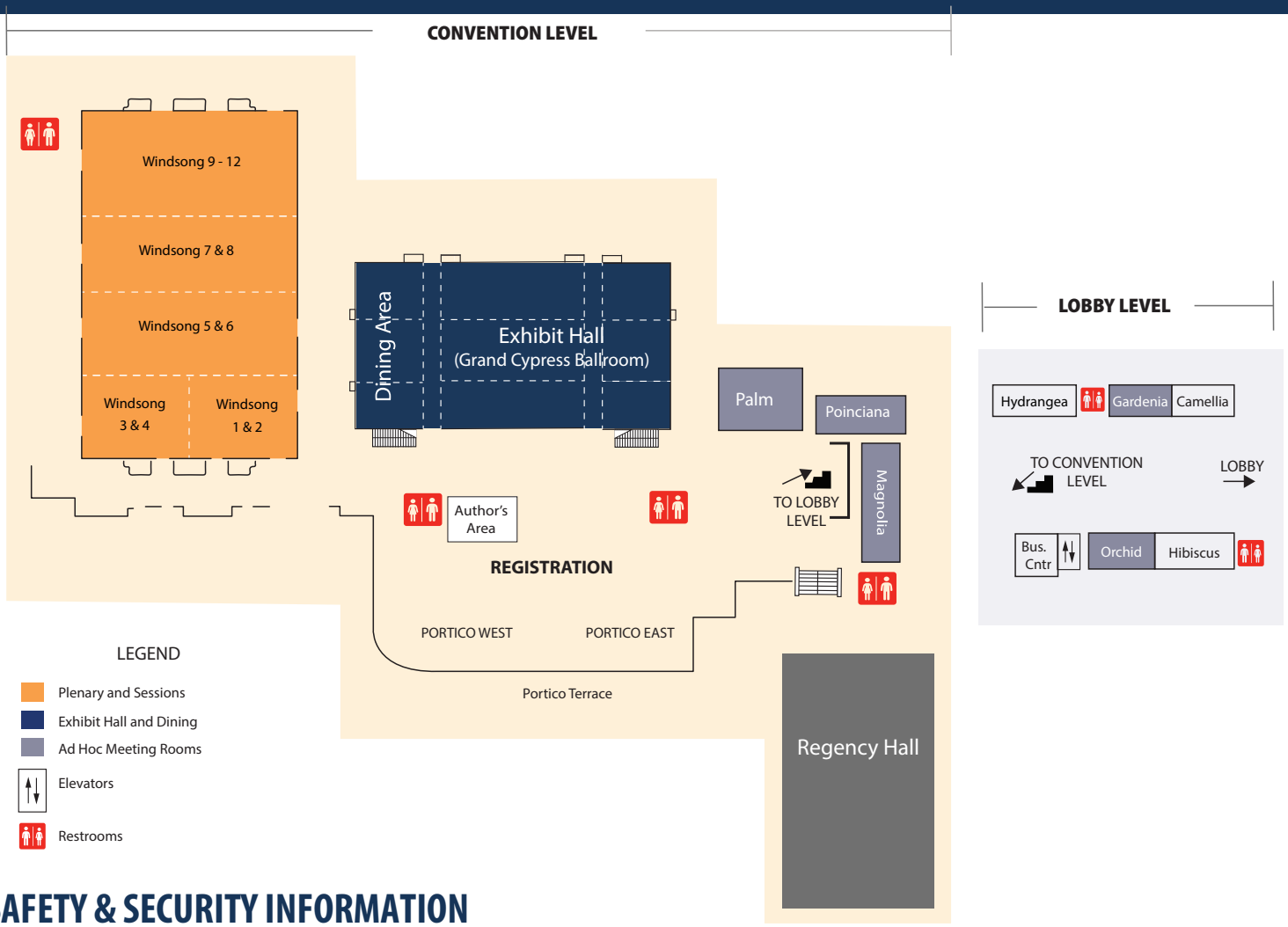
If you have not already registered for a technical tutorial on Tuesday, consider augmenting your experience with a pre-conference tutorial designed to provide in-depth learning of specific GNSS related disciplines (additional fees apply). Courses will be taught in-person by some of the world's leading GNSS educators.

Exhibitor Information

ION GNSS+ will feature our industry partners in expanded exhibitor profiles that will allow you to see who you need to connect with, reach out to them and learn about their latest products and services. Many exhibitors have also uploaded exhibitor demonstrations or special announcements on their profiles.

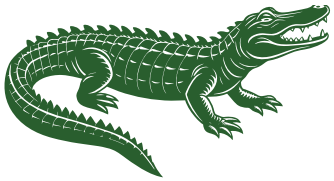
Access online content at ion.org/gnss.

Hotel Floor Plan and Safety Information



SAFETY & SECURITY INFORMATION

To help ensure a safe and enjoyable experience during your visit in Orlando, please keep the following guidelines in mind.



Water Safety

The Hyatt Regency Grand Cypress offers recreational activities such as kayaking and paddleboarding. As with many natural waterways in Florida, wildlife, including alligators, may be present in and around the fresh waterways that border the property. Please do not swim, wade, or place hands, feet, or other body parts in fresh waterways. Always follow posted signage and instructions from resort staff, and maintain a safe distance from any wildlife.

Personal Belongings

While the hotel resort and conference venue provide a welcoming and secure environment, attendees are encouraged to remain mindful of their personal belongings. Please keep valuables such as passports, wallets, laptops, mobile phones, and other electronic devices with you or secured at all times.

Vehicle Security

Do not leave luggage, computers, mobile devices, conference materials, or other valuables visible inside parked vehicles. If items must be left in a vehicle, store them securely out of sight before arriving at your destination. Theft from unattended vehicles can occur in any travel destination, and taking these precautions can help protect your belongings.

Protect Your Identity

Wear your name badge only inside the meeting and convention facility.

Plan for an Emergency

Be aware of your surroundings. Know where the nearest exists are located. Use the buddy system. Exchange contact information with another meeting attendee. In the event of an emergency, agree where you will meet up. Call for help if your buddy doesn't meet up at the agreed location within a reasonable amount of time. See something, say something.

Other

Do not leave beverages unattended; do not accept food or drinks from people you do not know, and do not write your room number on your hotel key.

Special Events and Programs

Monday, September 14

Anniversary Masters Short Course Program and Meet the Masters Cocktail Hour

2:00 p.m–8:00 p.m. | Cocktail Hour 5:00 p.m–6:00 p.m., Portico West & East

Take the opportunity to review the status of current GNSS technology, and hear tales of GNSS history, recounted by GNSS pioneers and developers.

"Meet the Masters" during a Satellite Division Anniversary sponsored cocktail hour from 5:00 p.m. to 6:00 p.m., Portico West & East.

Monday's anniversary short courses are offered to all paid full, single-day/student in-person attendees.

Wednesday, September 16

Attendee Luncheon

12:15p.m.–1:15 p.m., Grand Cypress Ballroom G-I (Exhibit Hall)

This event is included with all full conference, student, exhibit only, and Wednesday registrations. *See registration desk to purchase guest tickets.*

Early Career Navigators Gathering

Wednesday, September 16 | 7:00 p.m.
On-the-Rocks (Poolside)
(Pool Bar, Hyatt Regency Grand Cypress)

About the Event
Hosted by ION and ESA Young NAV community, this gathering is open to all students and early career professionals attending ION GNSS+. It's a great chance to network, connect, and have fun!

What to Expect
Mix, mingle, and make new connections during an interactive networking Bingo game, with prizes awarded to the first three winners and the most creative group photo.

Stay Connected
Don't forget to join our WhatsAPP channel. We look forward to seeing you!

ION

MANAGING EDITOR WANTED

ION is Hiring a Managing Editor at the ION National Office in Manassas, VA

View full posting on page 20.

Thursday, September 17

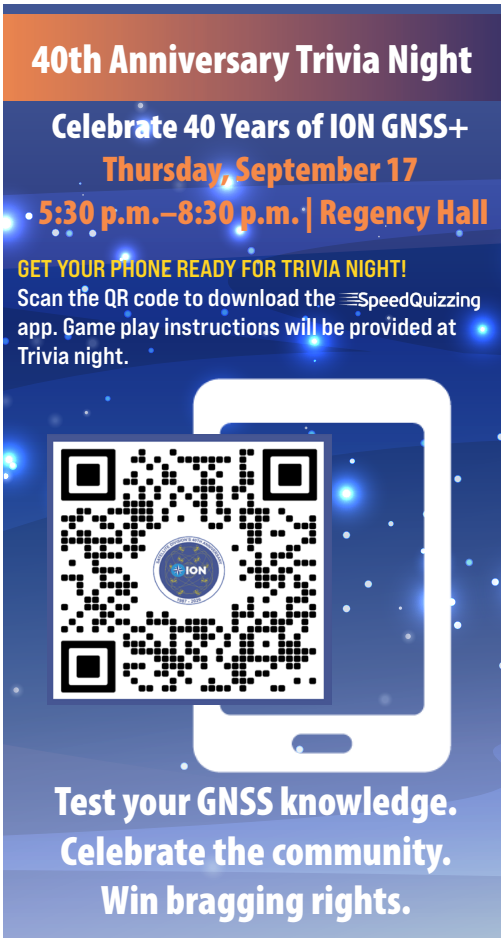
Attendee Luncheon

12:15 p.m.–1:15 p.m., Grand Cypress Ballroom G-I (Exhibit Hall)

This event is included with all full conference, student, exhibit only, and Wednesday registrations. See registration desk to purchase guest tickets.

ION GNSS+ 40th Anniversary Trivia Night

5:30 p.m.– 8:30 p.m., Regency Hall



Join us as the ION Satellite Division celebrates 40 years of ION GNSS+ with an evening of trivia, networking, food, and fun!

Test your knowledge of the art and science of GNSS and its related technologies and history, Satellite Division milestones, and a few surprise topics along the way. Compete for prizes, bragging rights, and a place in ION GNSS+ history-including our Mystery Guest Category, where you'll try to identify GNSS legends before their final reveal.

Enjoy a uniquely American cultural tradition with breakfast for dinner-inspired stations, along with drinks and plenty of opportunities to network with colleagues.

Friday, September 18

Kepler and Parkinson Awards Luncheon

12:15 p.m.–1:30 p.m., Grand Cypress Ballroom

Plated entree (fish). Special meals for dietary restrictions (vegetarian, vegan, etc.) must have been ordered in advance at registration. Must be seated by 12:30 p.m. to be served.



2025 Kepler Award Winner: Logan Scott

The purpose of the Johannes Kepler Award is to honor an individual for sustained and significant contributions to the development of satellite navigation.

The Bradford Parkinson Award, which honors Dr. Parkinson for his leadership in establishing both the U.S. Global Positioning Systems and the Satellite Division of the Institute of Navigation, is given to an outstanding graduate student in the field of Global Navigation Satellite Systems.

This event is included with a full, student, or Friday-only conference registration. Tickets for exhibit-only and/or guests may be purchased during registration or by visiting the ION GNSS+ registration desk on-site.



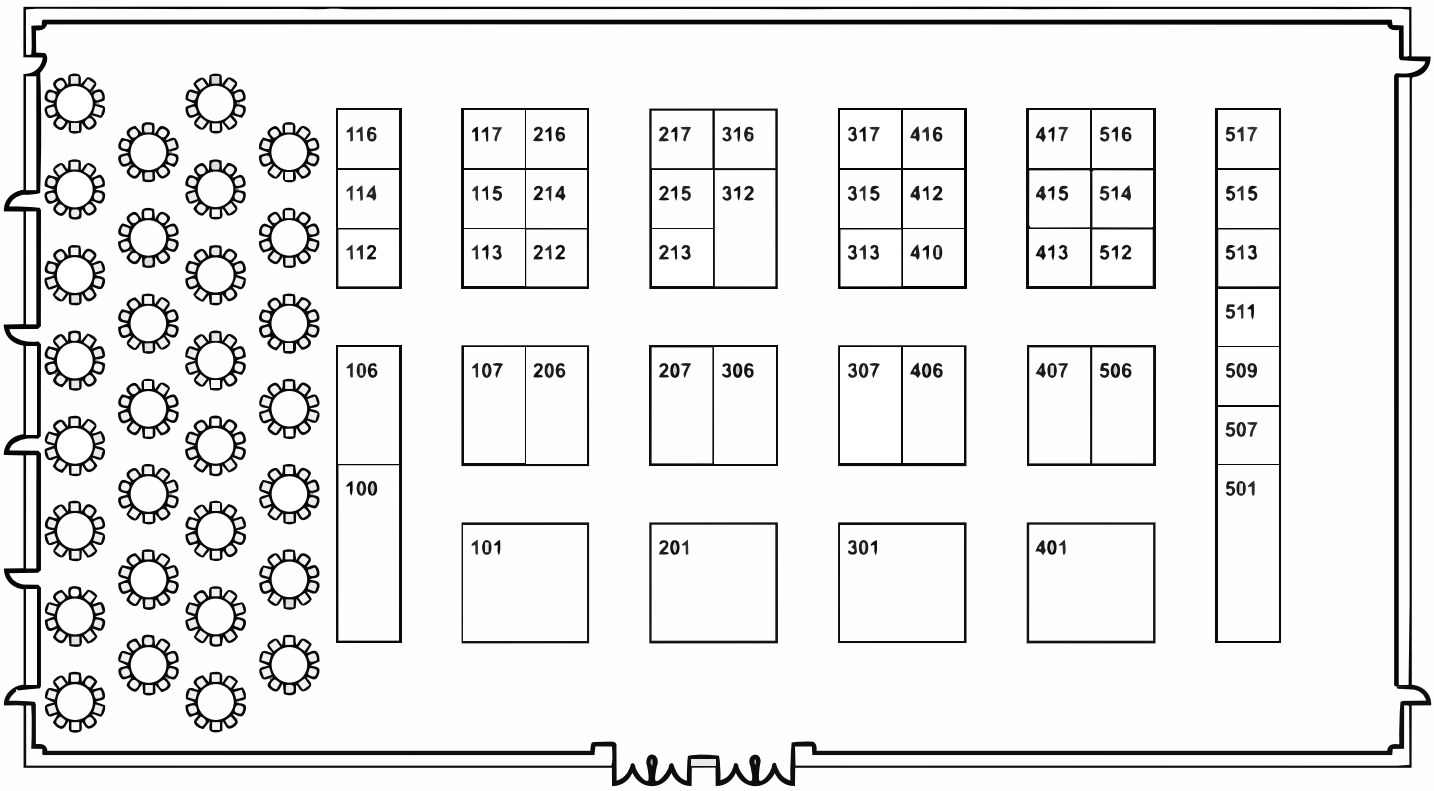
ION GNSS+ Exhibit Hall Information and Exhibitor Directory

EXHIBIT HALL HOURS

Monday	4:00 p.m.–8:00 p.m.	Exhibit Hall Setup; Exhibitors/EACs/Crew Only red Exhibitors and Attendees
Tuesday	8:00 a.m.–4:00 p.m.	Exhibit Hall Setup; Exhibitors/EACs/Crew Only
Wednesday	**8:00 a.m.–10:00 a.m.**	**Hall Open to Registered Exhibitors Only**
	10:00 a.m.–7:00 p.m.	**Hall Open to Registered Exhibitors and Attendees**
	5:30 p.m.-7:00 p.m.	Evening Exhibit Hours, Open to Registered Exhibitors, Attendees, and their Guests 21+
Thursday	**8:00 a.m.–9:00 a.m.**	**Hall Open to Registered Exhibitors Only**
	9:00 a.m.–4:00 p.m.	**Hall Open to Registered Exhibitors and Attendees**
	4:00 p.m.-7:00 p.m.	Exhibit Hall Teardown; Exhibitors/EACs/Crew Only

EXHIBIT HALL FLOOR PLAN

Grand Cypress Ballroom (Convention Level)



ION GNSS+ EXHIBITORS

- **746th Test Squadron (Booth 307)**
- **Acutronic USA Inc. (Booth 117)**
- BlueRISC, Inc. (Booth 315)
- **Carlson Software (Booth 407)**
- **Continental Electronics Corporation (Booth 516)**
- Epson America, Inc. (Booth 507)
- **exail (Booth 115)**
- **Focal Point Positioning (Booth 414)**
- **German Aerospace Center (DLR) (Booth 301)**
- **GMV Aerospace and Defence S.A.U. (Booth 306)**
- GPS World (Booth 515) MEDIA PARTNER
- Hanwha Aerospace (Booth 213)
- **Hemisphere GNSS (Booth 513)**
- **Hexagon | NovAtel (Booth 106)**
- IAI (Booth 107)
- **Ideal Aerosmith (Booth 413)**
- **Indra Group (Booth 506)**
- Inertial Labs (Booth 415)
- **Inside GNSS (Booth 207)** MEDIA PARTNER/SPONSOR
- Institute of Navigation (Booth 501)
- **Iridium (Booth 217)**
- IS4S (Booth 114)
- **Keysight (Booth 201)**
- **LabSat (Booth 101)**
- MEI Micro, Inc. (Booth 215)
- Meinberg USA Inc. (Booth 517)
- **Microchip Technology Inc. (Booth 116)**
- **NAVSYS Corporation (Booth 316)**
- **NavtechGPS (Booth113)**
- **Oscilloquartz (Booth112)**
- OXTS (Booth 216)
- Photodigm (Booth 412)
- Rakon (Booth 509)
- **Rohde & Schwarz USA, Inc. (Booth 206)**
- **Rx Networks, Inc. (Booth 512)**
- Safran – Electronics & Defense (Booth 401)
- **Silicon Sensing Systems Ltd. (Booth 214)**
- **SiTime (Booth 317)**
- Sylphase LLC (Booth 313)
- Trimble Inc. (Booth 212)
- **TUALCOM USA LLC (Booth 312)**
- **UHU Technologies LLC (Booth 511)**
- Xona (Booth 416)
- ZeroDrift Technologies (Booth 417)

Bold: ION Corporate Member

Pre-Conference Masters Short Courses: Monday, September 14

Included with a full, single-day, or student conference registration

Monday's short courses are provided on a complimentary basis to all paid ION GNSS+ attendees. ION Master Instructors are internationally recognized GNSS experts and educators. All ION Master Instructors have generously donated their time and talents to this effort as a service to the GNSS community, with the ION's gratitude. Short courses are presented in a lecture-style format. Course notes are the intellectual property of the ION Master Instructor, and are provided to registered attendees via the meeting website, at the discretion of the instructor.

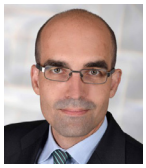
2:00 p.m.–2:50 p.m.

Inertial Navigation for Peppa Pig

Dr. Thomas Pany, University of the Bundeswehr Munich

Room: Windsong 1-2

Position determination using gyroscopes and accelerometers is at the core of almost every high-performance navigation system. Unfortunately, many of the underlying concepts are quite complex. Within a simplified 2D framework, the essential principles will be introduced, including the strapdown equations, error modeling, and why inertial navigation proves that the Earth is spherical.



Dr. Thomas Pany is a professor of satellite navigation at the University of the Bundeswehr Munich and organizer of the Munich Satellite Navigation Summit. He is an ION Fellow.

GNSS Modernization

Dr. Christopher Hegarty, MITRE

Room: Windsong 3-4

When the first ION Satellite Division conference was held forty years ago, there were only 7 GPS and 5 GLONASS operational satellites. This lecture will trace the evolution of the GNSS to its current state with four global and multiple regional constellations, and additionally provide predictions for what's next.



Dr. Christopher Hegarty is a Technical Fellow with MITRE, where he has worked mainly on aviation applications of GNSS. He is a Fellow of the ION and IEEE.

Interacting with Software GNSS Receivers

Dr. Sanjeev Gunawardena , Air Force Institute of Technology

Room: Windsong 5-6

Software receivers allow signals to be processed in new and interesting ways. They are used for education, research, and operational applications. This demonstration will feature live stations where you can interact with the author's pyChips multi-constellation SDR and learn how it is applied across a multitude of applications.



Dr. Sanjeev Gunawardena is a research associate professor with the Air Force Institute of Technology where he leads GNSS technology development. He is an ION Fellow.

3:00 p.m.–3:50 p.m.

Space Applications of GNSS

Dr. Penny Axelrad, University of Colorado

Room: Windsong 1-2

GPS has played a critical role in advancing scientific, defense, and commercial satellite capabilities. Today, international GNSS supports onboard PNT, precise orbit determination, and unique observations in LEO, GEO, and even cislunar space. This class explores the evolution of spaceborne GNSS technology, enabling unprecedented scientific discoveries and societal benefits.



Dr. Penny Axelrad is a University of Colorado Distinguished Professor, and Joseph T. Negler Professor of Aerospace Engineering Sciences. She is a member of the National Academy of Engineering and a Fellow of the ION and AIAA.

3:00 p.m.–3:50 p.m.

Integrity: The Invisible Backbone of Modern Navigation

Dr. Boris Pervan, Illinois Institute of Technology

Room: Windsong 3-4

Aviation does not demand accuracy—it demands integrity. This lecture traces how safety-of-life requirements transformed GNSS from a positioning tool into a risk-bounded system. From RAIM through augmentation systems to ARAIM, and onward to integrity against spoofing, we explore how protection levels, redundancy, and probabilistic risk reshaped navigation science.



Dr. Boris Pervan is Professor and Frank Gunsaulus Faculty Fellow in Mechanical and Aerospace Engineering at Illinois Institute of Technology. He is an ION Fellow.

Using a Sextant: Where Am I?

Dr. Richard J. Hartnett, U.S. Coast Guard Academy

Room: Windsong 5-6

How do modern navigators use a sextant, chronometer, stars, and almanac information to derive ship or aircraft position? Learn about the tools to solve for position: 1) an almanac (or computer) that predicts precise location of celestial bodies as a function of time; 2) a reasonably accurate timepiece; 3) a device to measure the elevation angle of a celestial body (e.g., sextant); 4) a "star finder"; 5) a navigational chart; and 6) a mathematical or tabular method to convert observations to contours (lines) of position. We will focus on the practice of using these six tools to solve for vessel position. Final discussions will focus on experiences with celestial navigation, covering the best times to shoot stars, horizon challenges, sources of error, typical accuracy, and similarities to GPS position-solution methodology.



Dr. Richard J. Hartnett is a professor of Electrical Engineering at the, having retired in 2009 from the USCG as a Captain (O-6).

Eleven Critical Hinge-Factors that Enabled/Enhanced GPS and Made it a System for Humanity

Dr. Bradford Parkinson , Stanford University

Room: Windsong 7-8

Hinge-factors are pivotal (and critical) enabling moments that could have easily gone "the wrong way". This talk will highlight eleven of these critical junctures. The birth and maturation of GPS was very perilous on many dimensions. Most critically, it was strongly opposed by the Operational Air Force, which tried to cancel funding on several occasions. Potential civilian users generally had no awareness of its potential. For GPS success, some hinge-factors required deliberate effort by the original GPS Program, while for others, chance or circumstances enabled success. While Dr. Parkinson had told Congress, contrary to many histories, that there would be a civil positioning capability from the start, the full guaranteed use was many years in the future. Fortunately, these pivotal hinge-factor moments went in the right direction, and GPS has become a "System for Humanity" with more than 5 billion units in use worldwide.



Dr. Bradford Parkinson was the Chief Architect for GPS, and led the original advocacy for the system as an Air Force Colonel. He was appointed a Professor at Stanford University in 1984, after six years of industry experience. He is an ION, AIAA, and IEEE Fellow.

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4:00 p.m.–4:50 p.m.

Ionospheric Mayhem: Space Weather, Solar Storms, and the GNSS We Trust

Dr. Jade Morton, University of Colorado

Room: Windsong 1-2

This tutorial explores how the ionosphere and space weather shape GPS/GNSS performance, from scintillation to signal delays. Through dramatic historical storms, surprising failures, and innovative experiments, we reveal how solar eruptions ripple through navigation systems—and how scientists and engineers detect, model, and outsmart them in an increasingly connected world today.



Dr. Jade Morton is a , University of Colorado Distinguished Professor, a Helen and Hubert Croft Professor of Engineering, and the head of the Satellite Navigation and Sensing (SeNSe) Labora tory at the University of Colorado, Boulder. She is an ION, RIN, and IEEE Fellow.

It's All in the Mix: A System of Systems

Prof. Terry Moore OBE, University of Nottingham

Room: Windsong 3-4

Future resilient PNT will require a 'system of systems' approach, blending complementary navigation technologies. This, however, is not new thinking; for years, multi-sensor integration has been at the core of many positioning solutions. This course will review the background and developments, and will be illustrated through numerous example applications.



Prof. Terry Moore OBE is an Emeritus Professor of the,, where he was previously the Director of the Nottingham Geospatial Institute (NGI). He is an ION and RIN Fellow; and an Officer of the Order of the British Empire (OBE).

Constellations in Your Pocket: How GNSS Conquered the Smartphone

Dr. Frank van Diggelen, Google

Room: Windsong 5-6

The fascinating and surprising tale of science and subterfuge, tiny startups, mighty political forces, and the creative engineering that brought GNSS to every smartphone. Equal parts espionage thriller and technical deep-dive, this fast-paced story will permanently rewire how you understand the device in your hand.



Dr. Frank van Diggelen is a Distinguished Engineer at Google, working on high-accuracy GNSS. He is a pioneer in Assisted GNSS. He is an ION, RIN, and IEEE Fellow.

The Parade of Clocks

Dr. Demetrios Matsakis, Masterclock

Room: Windsong 7-8

As long as we have had civilization, we have had clocks. Dr. Matsakis will trace the story of clocks across cultures and across time, from prehistoric time, to the atomic age. Each technology has a high-tech aspect, and each contributed to the society that fostered it.



Dr. Demetrios Matsakis, Masterclock, is a former Chief Scientist of the Time Service Department at the U.S. Naval Observatory (USNO), keeper of the official Master Clock not only for the Department of Defense but for all of America.

6:00 p.m.–6:50 p.m.

Indoor Navigation as GNSS in Disguise

Dr. Li-Ta Hsu, The Hong Kong Polytechnic University

Room: Windsong 1-2

Indoor navigation appears fundamentally different from GNSS, yet the same geometry, multipath physics, and estimation principles govern both. This lecture demonstrates how GNSS-inspired modeling and factor-graph methods unlock robust indoor positioning, and why seamless navigation across indoor and outdoor environments is fundamentally one unified estimation problem.



Dr. Li-Ta Hsu is an Associate Professor in the Department of Aeronautical and Aviation Engineering (AAE) at The Hong Kong Polytechnic University.

Look at the Stars: LEO PNT with Satellite Mega-Constellations

Dr. Zak Kassas, The Ohio State University

Room: Windsong 5-6

The first post-TRANSIT results with LEO signals of opportunity were demonstrated by Kassas' lab at ION GNSS+ 2018, navigating a UAV with Orbcomm signals. LEO PNT has come a long way since then. Dr. Kassas will overview the most advanced intercontinental LEO PNT results with satellite mega-constellations across land, air, stratosphere, Arctic sea, and the edge of the Earth.



Dr. Zak Kassas is the TRC Endowed Chair of Intelligent Transportation Systems and a Professor of Electrical & Computer Engineering at The Ohio State University, where he is the Director of the U.S. DOT Center for Automated Vehicles Research with Multimodal AssurEd Navigation (CARMEN). He is an ION and IEEE Fellow.

Quantum Navigation: Science Fiction, Science Fact, and What Comes Next

Dr. Allison Kealy, Swinburne University and Dr. Andrew Greentree, RMIT University

Room: Windsong 3-4

This interactive workshop takes participants on a fast-paced journey from Hollywood's portrayal of futuristic navigation to the real quantum technologies emerging today. Through games and scenarios, attendees differentiate between what's myth and what's possible, and explore the breakthroughs likely to occur within the next decade. Participants leave with a clear, practical understanding of quantum navigation's capabilities, limits, and real-world applications across defense, transport, and space.



Dr. Allison Kealy is the Director of the Innovative Planet Institute at Swinburne University, coordinating research programs in PNT, energy transition, and sustainability and resilience. She is a RIN and IAG Fellow.



Dr. Andrew Greentree is the Professor of Quantum Physics at RMIT University where he is a Chief Investigator in the ARC Centre of Excellence for Nanoscale BioPhotonics. He is a Fellow of the UK Institute of Physics.

Pre-Conference Masters Short Courses: Monday, September 14

Included with a full, single-day, or student conference registration

Monday's short courses are provided on a complimentary basis to all paid ION GNSS+ attendees. ION Master Instructors are internationally recognized GNSS experts and educators. All ION Master Instructors have generously donated their time and talents to this effort as a service to the GNSS community, with the ION's gratitude. Short courses are presented in a lecture-style format. Course notes are the intellectual property of the ION Master Instructor, and are provided to registered attendees via the meeting website, at the discretion of the instructor.

6:00 p.m.–6:50 p.m.

From the Halls of Cornell's Campus to the Shores of Italy: The Story Behind the First Public GPS Spoofer

Dr. Todd E. Humphreys, University of Texas at Austin

Room: Windsong 7-8

Long before GPS spoofing was found "in the wild" — first on the Black Sea in 2016, then along the coast of China, and now spreading through the Middle East and Eastern Europe — it was studied and demonstrated by a team from Cornell and UT Austin.



Dr. Todd E. Humphreys holds the Ernest Dashiell Cockrell II Chair in Engineering in the Department of Aerospace Engineering at the University of Texas at Austin, where he is the Director of the Wireless Networking and Communications Group and of the UT Radionavigation Laboratory. He is an ION and RIN Fellow.

7:00 p.m.–7:50 p.m.

Navigation for Aviation Applications

Dr. Maarten Uijt de Haag, Technical University of Berlin

Room: Windsong 1-2

Reliable navigation is essential for aviation applications ranging from commercial and general aviation to unmanned aircraft systems. This course will describe the parameters used to define aircraft navigation performance and discuss their relationship to safety. The course will also provide an overview of navigation systems (e.g., GNSS) currently used to support the various phases of flight and discuss the navigation challenges that aviation is facing.



Dr. Maarten Uijt de Haag is a Professor at the Technical University of Berlin, where he leads the Chair of Flight Guidance and Air Traffic in the Institute of Aeronautics and Astronautics. He is an RIN Fellow, a Senior member of the IEEE, and an Associate Fellow of the AIAA.

Resilient PNT: Some "Assemply" Required

Logan Scott

Room: Windsong 3-4

Widespread jamming and spoofing have exposed the need for resilient PNT systems tolerant of diverse obstacles. Having the right mix of sensors is not enough; they must also be properly integrated, tested, and labeled. This talk explores how resilient systems can be constructed to tolerate threats both known and unknown.



Logan Scott is a consultant specializing in radio frequency signal processing and waveform design. He is an ION Fellow.

Guidance, Navigation, and Control: Nature vs. Engineers

Dr. John Raquet, IS4S

Room: Windsong 5-6

We see many incredible feats in the areas of guidance, navigation, and control in both the natural world and in human engineering. This lecture compares and contrasts these capabilities, expressed as a light-hearted competition. Engineers vs. Nature—who wins?



Dr. John Raquet is currently the director of the IS4S Dayton site, where he leads the development of open-architecture approaches to navigation systems. Previously, he was the founding director of the Autonomy and Navigation Technology Center at the Air Force Institute of Technology. He is an ION Fellow.

ION INSTITUTE OF NAVIGATION

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IEEE/ION Position, Location and Navigation Symposium 2027

April 12-15, 2027

Hilton Portland Downtown

Portland, Oregon

CALL FOR ABSTRACTS

Abstracts Due October 16, 2026

ion.org/plans

Pre-Conference Tutorials: Tuesday, September 15

Additional registration fee required; tutorials will not be live-streamed

The ION GNSS+ pre-conference tutorials have been organized to provide in-depth learning of specific GNSS related disciplines prior to the start of the technical program. All courses will be taught in a classroom setting by some of the world's leading GNSS educators. Electronic course notes will be provided to attendees via the meeting website. Power will not be available for individual laptop computers.

TUTORIAL SCHEDULE

Series 1: Survey of GNSS Systems, Current and Future	Time	Location	Instructor
Introduction to GNSS and Current Systems in Operation	9:00 a.m.–10:30 a.m.	Windsong 1-2	Dr. John Raquet
Using GNSS: Receiver-Side View	10:45 a.m.–12:15 p.m.	Windsong 1-2	Dr. Frank van Diggelen
Integrity and Augmentations	1:15 p.m.–2:30 p.m.	Windsong 1-2	Dr. Mathieu Joerger
High Accuracy, Authentication, and Future Directions of GNSS	2:45 p.m.–3:30 p.m.	Windsong 1-2	Dr. Rui Hirokawa and Dr. Ignacio Fernández Hernández
LEO PNT and Other Signals and Systems	3:45 p.m.–5:00 p.m.	Windsong 1-2	Dr. Thyagaraja Marathe and Dr. Roberto Prieto-Cerdeira

Series 2: Advanced Algorithms for Navigation	Time	Location	Instructor
Particle Filters	9:00 a.m.–10:00 a.m.	Windsong 3-4	Dr. Christian Gentner
Distributed Estimation	10:15 a.m.–11:15 a.m.	Windsong 3-4	Rajnikant Sharma
Factor Graphs	11:30 a.m.–12:30 p.m.	Windsong 3-4	Dr. Li-Ta Hsu
Machine Learning and GNSS Processing	1:30 p.m.–2:30 p.m.	Windsong 3-4	Dr. Adyasha Mohanty
Machine Learning for Relative Navigation Applications	2:45 p.m.–3:45 p.m.	Windsong 3-4	Dr. Scott Nykl
Technology Developments in AI/ML: From Prompts to Agents	4:00 p.m.–5:00 p.m.	Windsong 3-4	Brian Zufelt and Renee Yazdi

Series 3: Space and Spacecraft Navigation	Time	Location	Instructor
Reference Frames, Time Systems, and Orbital Regimes for Lunar and Cislunar Orbits	9:00 a.m.–10:30 a.m.	Windsong 7-8	Dr. Keidai Iiyama
Weak-Signal GNSS Beyond GEO Orbit	10:45 a.m.– 12:15 p.m.	Windsong 7-8	Dr. Kirsten Strandjord
Lunar and Planetary Surface Navigation	1:15 p.m.–2:30 p.m.	Windsong 7-8	Dr. Tara Mina
Deep Space Navigation Techniques and Algorithms	2:45 p.m.–3:45 p.m.	Windsong 7-8	Ryan Mitch
PNT for LEO Constellations	4:00 p.m.–5:00 p.m.	Windsong 7-8	Dr. Mikaela Dobbin

Scheduled Breaks and Lunch (Included)	Time	Location
Morning Refreshments Available	10:15 a.m.–10:45 a.m.	Windsong Pre-function Area
Lunch	12:15 p.m.–1:15 p.m.	Grand Cypress Ballroom G-I
Afternoon Refreshments Available	3:00 p.m.–3:45 p.m.	Windsong Pre-function Area

SERIES 1: SURVEY OF GNSS SYSTEMS, CURRENT AND FUTURE | WINDSONG 1-2



Tutorial Chair: Dr. Ignacio Fernández-Hernández
European Commission

Introduction to GNSS and Current Systems in Operation

9:00 a.m.–10:30 a.m.

This tutorial briefly introduces the fundamentals of satellite navigation and then presents a survey of the GNSS currently in operation: GPS, Galileo, BeiDou, and GLONASS, as well as the regional systems NavIC and QZSS. It explains their satellite and ground segments, signals, messages, and services, highlighting the similarities and differences among them.



Dr. John Raquet is currently the director of the IS4S Dayton site, where he leads the development of open-architecture approaches to navigation systems. Previously, he was the founding director of the Autonomy and Navigation Technology Center at the Air Force Institute of Technology. He is an ION Fellow.

Using GNSS: Receiver-Side View

10:45 a.m.–12:15 p.m.

This tutorial explains how the different GNSS constellations and signals are used in our devices. It presents how signals are tracked in different devices and regions, and how their signal strength, accuracy, and availability affect the user experience, highlighting the main current challenges. The tutorial also shows how we can observe these behaviors ourselves on our devices.



Dr. Frank van Diggelen is a Distinguished Engineer at Google, working on high-accuracy GNSS. He is a pioneer in Assisted GNSS, and the author of two GNSS textbooks. He also teaches GPS: including the on-line GPS course from Stanford University and Coursera, available on YouTube..

Pre-Conference Tutorials: Tuesday, September 15

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Integrity and Augmentations

1:15 p.m.–2:30 p.m.

This tutorial first covers the fundamental concepts of GNSS integrity and their application to civil aviation. Building on those concepts, the tutorial presents the main integrity augmentation systems used today, including Satellite-Based Augmentation Systems (SBAS), Ground-Based Augmentation Systems (GBAS), and Aircraft-Based Augmentation Systems (ABAS). The tutorial also covers GNSS performance evaluation and state-of-the-art methodologies to support safety-of-life applications.



Dr. Mathieu Joerger is an associate professor at Virginia Tech and the associate director of the US DOT University Transportation Center: CARNATIONS, the Center for Assured and Resilient Navigation in Advanced Transportation Systems. He currently serves as the editor-in-chief of NAVIGATION: Journal of the Institute of Navigation.

High Accuracy, Authentication, and Future Directions of GNSS

2:45 p.m.–3:30 p.m.

This tutorial covers other GNSS improvements that are already available or upcoming. It outlines the concepts of higher-accuracy positioning techniques, including differential and absolute positioning methods such as DGNSS, RTK, and PPP. It also presents a survey of current global or regional navigation systems providing PPP/PPP-RTK services. Next, the tutorial presents GNSS capabilities under development or already in operation to protect against spoofing, including message authentication and spreading code protection, as well as other directions for GNSS evolution.



Dr. Rui Hirokawa is the Principal Expert of Mitsubishi Electric Corporation, where he leads the technical development of various space and defense programs, including satellite navigation. He is also working on international standardization and interoperability for high-accuracy GNSS with the RTCM and the United Nations ICG.



Dr. Ignacio Fernández Hernández is with the European Commission, where he leads the design and development of the Galileo high-accuracy and authentication services. He also chairs several international groups on GNSS resilience, PPP, and authentication.

LEO PNT and Other Signals and Systems

3:45 p.m.–5:00 p.m.

This tutorial presents the main unresolved challenges in current GNSS and to what extent LEO PNT can overcome them. It then presents the LEO PNT initiatives PULSAR and Celeste, currently under development, highlighting the target constellation, frequency bands, signal modulations, and expected user performance. The tutorial concludes with a survey of other PNT signals and systems, including satellite and terrestrial communication networks.



Dr. Thyagaraja Marathe is a Staff Research Engineer at Xona Space Systems, focusing on PNT with LEO satellite constellations. His background spans advanced GNSS technologies, including precise positioning, corrections, and receiver innovation.



Dr. Roberto Prieto-Cerdeira is the head of the LEO-PNT Project in the Directorate of Navigation of the European Space Agency. Previously, he worked in the Galileo 2nd Generation Satellite as Payload Manager and was responsible for technology developments and advanced R&D studies related to the evolution of European GNSS Systems.

SERIES 2: ADVANCED ALGORITHMS FOR NAVIGATION | WINDSONG 3-4



Tutorial Chair: Dr. Clark Taylor
Air Force Institute of Technology (AFIT)

Particle Filters

9:00 a.m.–10:00 a.m.

Particle filters are a Bayesian estimation method for nonlinear, non-Gaussian systems. This tutorial presents key particle filter variants, explains their principles through practical examples, and shows how they can be applied to navigation problems, including wireless SLAM-related scenarios.



Dr. Christian Gentner heads DLR's Communications Systems Department, with a research focus on robust localization and navigation in GNSS-denied environments.

Distributed Estimation

10:15 a.m.–11:15 a.m.

This tutorial introduces the core principles of distributed estimation for networked autonomous systems. We cover consensus-based information fusion, covariance intersection for consistent estimation under unknown correlations, and information-theoretic frameworks for decentralized decision-making. The concepts are illustrated through two applied case studies: (i) distributed target tracking over a sensor network, and (ii) cooperative localization and navigation, where agents leverage inter-vehicle ranging and shared observations to reduce and bound state uncertainty without relying on a centralized fusion node.



Rajnikant Sharma is a PNT Research Engineer at IS4S, working on problems related to collaborative autonomy and navigation.

Factor Graphs

11:30 a.m.–12:30 p.m.

This tutorial explains factor graph optimization for navigation and compares it with the extended Kalman filter in estimation accuracy, consistency, smoothing capability, computational structure, and deployment tradeoffs. Using intuitive examples and practical workflows, it helps attendees understand when FGO outperforms EKF, when EKF remains preferable, and how to choose rigorously.



Dr. Li-Ta Hsu is an Associate Professor at The Hong Kong Polytechnic University, specializing in GNSS, sensor fusion, and robust navigation.

Machine Learning and GNSS Processing

1:30 p.m.–2:30 p.m.

This tutorial will teach modern machine learning (ML) techniques for navigation, spanning learned filters, convolutional and graph neural networks, Neural Radiance Fields, and foundation models. Drawing from both foundational theory and current research, the course will cover a range of methods to reflect the rapidly evolving ML landscape. Applications include improving GNSS positioning accuracy, multi-sensor fusion, and uncertainty quantification. Participants will receive executable notebooks and curated resources for practical implementation beyond the session.



Dr. Adyasha Mohanty is a faculty member at Harvey Mudd College, where she directs the robotics research lab. Her research is on hybrid physics and machine learning navigation for multi-sensor-based autonomous systems. She earned her Ph.D. in Aeronautics and Astronautics from Stanford University in 2024.

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SERIES 2: ADVANCED ALGORITHMS FOR NAVIGATION

Machine Learning for Relative Navigation Applications

2:45 p.m.–3:45 p.m

This talk presents monocular computer vision algorithms enabling autonomous mid-flight docking between airborne vehicles. Independent moving platforms can detect, track, approach, and dock using a single camera, producing accurate 6DoF pose estimates. The sensor requires no bore-sighting or extrinsic calibration, despite free rotation and translation in the platform's body frame.



Dr. Scott Nykl is a Computer Science professor at the Air Force Institute of Technology, focusing on vision-based relative navigation for airborne docking.

Technology Developments in AI/ML: From Prompts to Agents

4:00 p.m.–5:00 p.m.

As AI integrates invisibly into daily workflows, understanding practical utility versus high-level marketing becomes critical. We explore effective tools and techniques while navigating significant pitfalls in output quality and data security. The curriculum challenges industry buzzwords, specifically questioning "Prompt Engineering" as a lasting discipline. While making this case, we provide deep dives into effective prompting techniques and parameters that influence model behavior. The central focus is on LLM evolution from reactive generators to Agentic AI. Participants explore how models approach complex problems and transition from using AI as a search engine to a proactive partner. Mechanism transparency grounds every discussion in underlying mechanics. By lifting the veil of mystery surrounding these technologies, this course returns agency to users, transforming them from passive consumers into informed, strategic operators of AI systems.



Brian Zufelt is the Deputy Program Manager for PNT programs at Canyon with over 18 years of experience in embedded systems, computer vision, and machine learning.



Renee Yazdi is the Deputy Lead Engineer for Canyon, where she primarily supports Air Force Research Laboratory (AFRL) PNT projects, SWAC, SDUE, and Internal Research and Development (IR&D) efforts.

SERIES 3: SPACE AND SPACECRAFT NAVIGATION WINDSONG 7-8



Tutorial Chair: Dr. Joanna Hinks
AFRL

Reference Frames, Time Systems, and Orbital Regimes for Lunar and Cislunar Orbits

9:00 a.m.–10:30 a.m.

This tutorial introduces the fundamentals of coordinate frames, time systems, and orbital regimes required for spacecraft navigation in lunar orbits and cislunar space. Emphasis is placed on cislunar dynamics, reference-frame transformations, and relativistic effects affecting time transfer and synchronization, providing a foundation for lunar positioning, navigation, and timing.



Dr. Keidai Iiyama received a PhD from Stanford University, specializing in lunar positioning, navigation, and timing, with a focus on orbit determination and time synchronization for lunar satellites.

Weak-Signal GNSS Beyond GEO Orbit

10:45 a.m.–12:15 p.m.

This tutorial presents weak-signal GNSS processing beyond GEO, addressing challenges outside the traditional Space Service Volume in cis-lunar environments. Signal characteristics, link budgets, antenna geometry, and snapshot-based navigation using raw measurements will be discussed. Multiple high-altitude and lunar datasets, including results obtained by processing the dataset provided by the Lunar GNSS Receiver Experiment, will illustrate performance and design considerations for autonomous space navigation.



Dr. Kirsten Strandjord is an Assistant Professor of Aerospace Engineering at the University of Minnesota, specializing in GNSS, PNT, and cis-lunar navigation.

Lunar and Planetary Surface Navigation

1:15 p.m.–2:30 p.m.

Navigation on the lunar, Martian, and other planetary surfaces presents unique challenges that distinguish it from GNSS-denied terrestrial navigation. This tutorial surveys these challenges and the key design choices involved in planetary rover navigation, including onboard map representations, reference frame definitions, and the selection of a navigation frame, and tradeoffs between onboard autonomy and communication with ground or orbiting assets. We further examine onboard sensing modalities (e.g., inertial, optical, LiDAR) and core paradigms for autonomous surface navigation (e.g., map-based localization, visual-inertial odometry, and SLAM). To anchor the discussion, examples from active missions, including the Mars Perseverance rover, and planned future lunar exploration missions are also presented.



Dr. Tara Mina is a research engineer in the Space Exploration Analysis Laboratory at Georgia Tech. She received her PhD in Electrical Engineering from Stanford University in 2023. Her current work focuses on spacecraft navigation and sensor fusion for lunar and planetary missions.

Pre-Conference Tutorials: Tuesday, September 15

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Deep Space Navigation Techniques and Algorithms

2:45 p.m.–3:45 p.m.

This course will focus on deep-space navigation topics, including dynamics and measurement models specific to spacecraft navigation, standard estimation algorithms such as the Kalman filter, and performance analysis. This course will spend time on theory from a mathematical-derivation perspective, example problems, and practical implementation considerations.



Ryan Mitch is a senior member of the Astrodynamics and Controls Group (SAC) in the JHU/APL Space Exploration Sector, where he has served as both the Navigation Section Supervisor and the Space Systems and Analysis Branch's Technologist.

PNT for LEO Constellations

4:00 p.m.–5:00 p.m.

Large-scale low Earth orbit (LEO) constellations transmitting alternative PNT signals will require accurate orbit and clock knowledge in real time, with less dependence on GNSS than in today's commercial and scientific LEO satellite missions. This lecture will describe the POD models, measurements, and estimation techniques required to meet this growing need.



Dr. Mikaela Dobbin is a researcher at the University of Colorado Boulder, where she earned her PhD in Aerospace Engineering in April 2026. Her work focuses on LEO-based PNT systems.

ATTENDEE PERKS

Discounted Disney Theme Park Tickets

Special event prices on Walt Disney World theme park tickets for ION GNSS+ attendees and their guests.

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Disney Springs Shuttle

A shuttle runs exclusively for ION GNSS+ guests on Tuesday from 7:30 p.m.–11:15 p.m and Wednesday from 7:00 p.m.–11:00 p.m.

Pick up/Drop Off Location:
Portico Bus Area (Convention Level)



Session A1a: Navigation and Positioning Using AI

1. **Set Transformer–Based GNSS Position Correction in Urban Environments:** Z. Li, X. Hou, K. Fang, J. Wang, Beihang University; J. Dong, Aviation Data Communication Corporation

Session B1: Applications Using Communication Technologies, Opportunistic Signals, or Collaborative Positioning

1. **Ray Tracing-Aided Variational Bayesian Adaptive Filter for High-Precision 5G Positioning in Complex Urban Environments:** W. Niu, C. Sun, H. Yang, Y. Xiao, T. Wang, H. Zhang, L. Bai, Beihang University

Session E1: Cislunar, Lunar, and Martian Positioning, Navigation, and Timing 1

1. **LUPIN: Enabling High Performance PNT in the Lunar Environment for Rover Surface Operations – Experimental Results:** J. E. Martínez Esmeral, D. Forte, S. Kay, M. De Benedetti, GMV UK LTD; F-A. Stancu, D. Betco, GMV Romania; M. Manzano Jurado, GMV Aerospace and Defence SAU; F. Thomas Melman, R. D. Swinden, European Space Agency (ESA)
2. **Validation of Joint Doppler and Ranging with GNSS in an Earth-Based Hardware Demonstration:** W. W. Jun, D. Ogbe, P. Carter, Jet Propulsion Laboratory, Caltech

Session F1: Next-Generation GNSS: Signals, Architectures, and Receiver Processing Advances

1. **Circular Receiver Bias Estimation for Integer Ambiguity Resolution:** N. Lelarge and C. Gazzino, Centre National d'Études Spatiales
2. **Impact of Code-Chip Anomalies of BDS B1C/B2a Signals on Ranging Performance:** S. Lu, W. Li, K. Fang, R. Sun, Beihang University

G1: LEO-Based PNT and Integrated Communication and Navigation (Signal Design) 1

1. **Evaluating Jamming Resistance of GNSS and LEO Signals Using a Software-Defined Receiver:** S. Islam, Finnish Geospatial Research Institute (FGI); M. Z. H. Bhuiyan, FGI & Tampere University; F. S. Prol, FGI & University of Vaasa; S. Kaasalainen, FGI

Session D2a: GNSS Integrity in Aviation: ARAIM, GBAS, SBAS and Their New Advancements

1. **Characterization of BDS-3 Signal-in-Space Performance to Support ARAIM:** R. Sun, W. Li, K. Fang, Beihang University; H. Wang, AVIC Chengdu Aircraft Design and Research Institute; K. Guo, Beihang University
2. **Performance Analysis of Dual-Frequency Multi-Constellation GNSS Scintillation Monitoring at Low Elevation Angles for GBAS:** X. Huang, W. Li, K. Fang, Z. Wang, Beihang University; Y. Zhu, Aviation Data Communication Corporation

Session E2a: Cislunar, Lunar, and Martian Positioning, Navigation, and Timing 2

1. **Lunar S-band Pseudolite and Satellite Hybrid Navigation System with EKF Design for Low-Dynamic Rover Navigation:** A. K. Shukla and J. Velani, ISRO

Session F2: Data-Driven and Learning-Based Methods for Satellite Navigation and PNT Systems

1. **A Mamba-Based Framework with Residual Learning for Ionospheric TEC Forecasting:** H. Li, Y. Wu, J. Yan, J. Hu, Y. Liu, Beihang University
2. **Adaptive Multipath and NLOS Mitigation Methods Based on GNSS Measurements by Integrating Scene Classification and Signal Classification:** H. Luo, D. He, Shanghai Jiao Tong University
3. **Cross-Domain GNSS Spoofing Detection via Domain-Adversarial Neural Networks:** J. Lei, J. Xu, N. Liu, C. Sun, W.Zhang, L. Bai, K. Yan, Beihang University
4. **GNSS Spoofing Detection and Parameter Based on STFT:** F. Li, C. Sun, L. Bai, L. Chen, Beihang University

Session G2b: Resilient and Secure PNT Against Interference and Emerging Threats 1

1. **Cross-Domain Feature Fusion for GNSS Spoofing Detection with Lightweight Spatio-Temporal Attention Networks:** J. Ye and X. Chen, Shanghai Jiao Tong University
2. **Wide-Area Maritime GNSS Interference Detection Using AIS and Deep Spatiotemporal Anomaly Networks:** Y. Zhou, X. Chen, Shanghai Jiao Tong University; P Chen, J Yang, Ministry of Natural Resources

Session B3: AI and Machine Learning for GNSS Signal Processing, Error Modeling, and Threat Detection

1. **Deep Learning Frameworks for Ionosphere Modeling: Comparison under Multiple Datasets:** Y. Chen, C. Song, Y. Liu, Beihang University
2. **MSVIB-Net: A Physically-Informed Lightweight AI Framework for Real-Time GNSS Spoofing Detection:** J. Ji, VCSCIT, Wuhan University of Technology; Q. Ye, W. Chen, Wuhan University of Technology; C. Li, L. Du, Z. Pei, Wuhan Institute of Technology; H. Lu, China Transport Telecommunications & Information Center (CTTIC), Wuhan University of Technology; J. Zhang, China CTTIC

Session C3: Fielding Alternative Technologies in GNSS-Denied Environments 1

1. **Evaluation of Simulated GNSS Plus Pseudolite Positioning with a Programmable GNSS-RF-Simulator:** M. P. Blum, M. S. Hameed, T. Pany, University of the Bundeswehr Munich

Session D3: Precise Positioning and its Integrity: Architecture and Algorithm Design

1. **A Refined Integrity Support Message Construction Method for RT-PPP Protection Level Calculation:** L. Yang, X. Qin, Y. Wu, Tongji University

Session F3: Resilient and Secure PNT Against Interference and Emerging Threats 2

1. **Anti-Aliasing GNSS Successive Spoofing Cancellation Based on Phase Interpolation:** X. Xu, H. Wang, M. Lu, H. Li, Tsinghua University

Session A4: High Accuracy Positioning and Correction for Mass Market Devices

1. **Road Tests Assessing PPP-RTK and NRTK Positioning Performance of Low-Cost GNSS for Autonomous Driving Applications:** M. Cutugno, University of Benevento Giustino Fortunato; M. Alicandro, University of l'Aquila; C. Balletti, E. Breggion, F. Guerra, A. Martino, University of Venice Iuav; N. Pascucci, University of l'Aquila; G. Pugliano, University of Naples Federico II; U. Robustelli, University of Naples Parthenope; S. Zollini, D. Dominici, University of l'Aquila

Session C4: Fielding Alternative Technologies in GNSS-Denied Environments 2

1. **Radio SLAM-Based Tightly-Coupled 5G-RSS/GNSS/INS Fusion Positioning Framework for GNSS-Degraded Scenarios:** H. Zhang, J. Li, C. Sun, G. Xu, Y. Sun, T. Wang, W. Niu, W. Feng, L. Bai, Beihang University
2. **Robust 2D Vehicle Trajectory Estimation Under Intermittent/Outage GNSS Using a Low-Cost IMU and Motion Constraints:** X. Zhao, Y. Gao, Z. Wang, L. Li, W. Liu, Beijing Information Science and Technology University

Session D4: Multi-Sensor PNT Optimization: Algorithms for Efficiency and Trustworthiness

1. **Enhanced Distributed Cooperative Localization Using Split Covariance Intersection with Bearing Augmentation:** C. Tu, X. Cui, Tsinghua University, Beijing; State Key Laboratory of Space Network and Communication (SKLSNC); G. Liu. Tsinghua University; M. Lu, Tsinghua University, Beijing & SKLSNC
2. **FMCW-Based Odometry for Low-Altitude UAVs: Velocity-Driven Fusion and Sensor Evaluation:** B. Tian, G. Liu, Z. Jin, M. Guo, M. Lu, R. Zhang, Tsinghua University
3. **GNSS/INS/GRT Integration Based on Factor Graph Optimization in GNSS-Degraded Environments:** X. Ren, M. Sheng, X. Zhang, Z. Yao, Xiangtan University
4. **Road Inertial Feature Anchoring for Drift-Bounded Land Vehicle Localization:** X. Lu, G. Liu, B. Tian, Z. Jin, M. Guo, M. Lu, and R. Zhang, Tsinghua University

Session E4: Remote Sensing, Timing, Space and Scientific Applications

1. **GNSS-IR Soil Moisture Collaborative Inversion Based on Multi-Source Data Fusion and Machine Learning:** N. Li, University of Electronic Science and Technology of China

Session F4: Resilient and Secure PNT Against Interference and Emerging Threats 3

1. **GNSS Jammer Localization in Urban Areas Based on Physics-Informed Transformer using Differential RSS:** H. Bai, Z. Yan, X. Tang, X. Zhu, and X. Chen, Southeast University
2. **Magnetic Interference Detection Method Based on Vertical Gyroscope for Heading Measurement:** Y. Guan, G. Liu, Z. Jin, M. Guo, M. Lu, R. Zhang, Tsinghua University
3. **Spatio-Temporal Graph Neural Network for GNSS Spoofing Detection: A Cross-Scenario Generalization Study:** X. Li, X. Hou, K. Guo, K. Fang, J. Li, Beihang University

Session A5: Future Augmentation Systems, Correction Services, and Integrity

1. **BeiDou Airborne Multipath Model for Dual-Frequency Signals in DFMC GBAS:** J. Ming, W. Li, K. Fang, X. Huang, Beihang University

Session B5a: GNSS Modernization and Market Trends: From Aviation, Railway, and Maritime to Urban Air Mobility and Autonomous Systems

1. **Galileo Emergency Warning Satellite Service: The Story:** J. P. Boyero, F. Domps, E. Guyader, European Commission; V. Chatelee, M. Lopez, European Union Agency for the Space Programme; E. Bouton, M. Beliazi, European Space Agency
2. **On the Kinematic Field Performance of Autonomous GNSS Accelerometers:** Y. Luo, AUROXAT Inc.

Session D5: Atmospheric Modeling and Mitigation with GNSS and LEO-PNT Systems

1. **A Research of the Relationship Between GNSS PWV and Thunderstorm Activity in Hong Kong:** J. Wang, W. Jian, W. Huang, Nanchang University; M. Yu, Jiangxi Normal University; J. Xiong, H. Guo, Nanchang University; Q. Tian, Guangzhou Institute of Tropical and Marine Meteorology
2. **Sequential Westward Ionospheric Scintillation Onset Pattern: Potential for Low-Latitude GNSS Disruption Forecasting:** T. Liu, X. Mi, W. Chen, The Hong Kong Polytechnic University

Session A6: Navigation in Challenging Environment with Mass Market Devices, Smartphones, and Wearables

1. **Improving Clustering-Based Fingerprinting Localization Technology Using Multi-MNO LTE Signals in Mountainous Areas:** J. H. Lee, J-I. Jeon, and Y. Cho, Electronics and Telecommunications Research Institute

Session B6: High-Precision GNSS Positioning with Integrity

1. **A Frozen-Kalman-Filter Method with Fixed Thresholds for Double-Differenced Carrier-Phase Jump Detection:** W. Zhang, Y. Wang, C. Sun, B. Yuan, W. Feng, T. Zhang, Beihang University

Session E6: Beyond GNSS: LEO-Based and Terrestrial Signals of Opportunity for PNT 2

1. **Stability Analysis of LEO Satellite Orbit Prediction Using SPP Results Under Degraded Data Conditions:** H. Su, National Time Service Center (NTSC), Chinese Academy of Sciences (CAS), University of Chinese Academy of Sciences UCAS; K. Wang, Haoran Jia, NTSC, CAS; UCAS; X. Yang, NTSC, CAS, UCAS

Session F6a: Open-Source Data and Tools for PNT Research and Development

1. **Beidou-SDR-SIM: An Open Source Tool for Generating BDS-3 B1C Signal:** H. Wang, Y. Zhang, X. Zhu, J. He, S. Zhao, Y. Shen, Xidian University
2. **Design of a Miniaturized Real-Time GNSS Signal Simulation System with GPU Acceleration on the Jetson Platform:** Z.H. Yu, University of Electronic Science and Technology of China
3. **Open Positioning: A Crowdsourcing Ecosystem for Seamless Indoor–Outdoor Positioning:** B. Duan, The University of Edinburgh; F. Zampella, Huawei Technologies Research and Development (UK) Limited; T. Arslan, The University of Edinburgh; F. Alsehly, Huawei Technologies Research and Development (UK) Limited

ION GNSS+ Plenary Session

Tuesday, September 15, 2026 | 6:00 p.m.–8:00 p.m.
Room: Windsong 9-12

The plenary session will be recorded and made available to registered attendees on the conference website.



Welcome, Meeting Highlights and Introduction of Technical Committee

Satellite Division Chair
Dr. Dorota Grejner-Brzezinska
University of Wisconsin–Madison



Opening of the Plenary Session

Plenary Chair
Dr. José Ángel Ávila Rodríguez
European Space Agency

Keynote Addresses

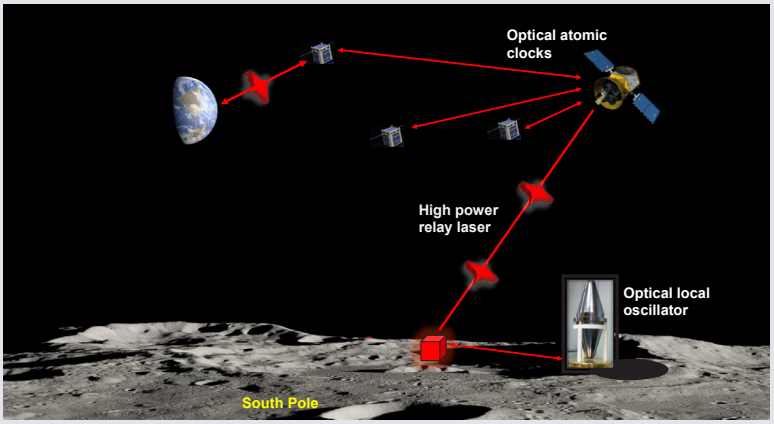
Optical Clocks: From Quantum Science to Applications

Dr. Jun Ye
JILA Fellow, NIST Fellow, and Professor of Physics, University of Colorado, Boulder

Quantum science and laser technology have fueled revolutionary developments in atomic physics and precision metrology. Quantum-state engineering and system scaling have drastically enhanced the performance of atomic clocks and are opening new opportunities for fundamental discoveries and novel applications. Minute-long optical atomic coherence has been demonstrated for tens of thousands of atoms. Recently emerged nuclear clocks provide another powerful platform for performance scaling.



Dr. Jun Ye is a Fellow of JILA, a Fellow of NIST, and a member of the National Academy of Sciences. His research focuses on developing new tools for light-matter interactions and their applications in precision measurement, quantum science, and frequency metrology. He has co-authored 450 scientific papers and delivered 750 invited talks. Among his awards and honors are 5 Gold Medals from the US Commerce Department, N.F. Ramsey Prize (APS), I.I. Rabi Award (IEEE), I.I. Rabi Prize (APS), and W.F. Meggers Award (OSA). His recent honors include the Breakthrough Prize in Fundamental Physics, the Berthold Leibinger Future Prize, the Niels Bohr Institute Medal of Honour, the Herbert Walther Award, and the Vannevar Bush Fellowship. The web page for the research group, including highlights for many highly talented and enthusiastic young researchers, is http://jila.colorado.edu/YeLabs/.



Navigation in the Age of Generative AI

Dr. Nicolas Roy
Hunsaker Professor of Aeronautics and Astronautics, MIT

Generative AI models can process sensor data and extract rich semantic signals to an unprecedented degree. UAVs, self-driving cars, and underwater robots can now use pre-trained models to detect a wide range of objects with minimal additional training, make accurate predictions in highly dynamic environments, and even predict the best trajectory to follow to accomplish increasingly complex missions. I will talk about some of the successes and challenges of using generative AI, and the open questions as generative AI becomes a key technology for navigation.



Dr. Nicholas Roy is the Jerome C. Hunsaker Professor of Aeronautics and Astronautics at MIT, specializing in robotics, machine learning, autonomous systems, planning and reasoning, human-computer interaction, and micro air vehicles. In 2012, with two of his students, he co-founded Project Wing, the drone delivery project at [X]. He is currently the lead of the Autonomy Architecture team at Zoox.



Session A1a: Navigation and Positioning Using AI

Room: Windsong 1-2 (8:30 a.m.–10:05 a.m.)



Dr. Adyasha Mohanty
Harvey Mudd College



Dr. Dong-Kyeong Lee
Qualcomm

8:35 Actuation-Aware Quadrotor Navigation: A Learned Dynamics Factor for Robust Visual-Inertial Estimation: Y. Feng, The Hong Kong Polytechnic University, & Nankai University; Y. Wang, The Hong Kong Polytechnic University; F. Wang, Nankai University; H. Zhang, Technical University of Munich; W. Wen, The Hong Kong Polytechnic University

8:57 Bird's-Eye-View Mapping from Vehicle Cameras via 3D Foundation Models: M. Partha, D. Neamati, D. Jayram, and G. Gao, Stanford University

9:20 Design and Performance Analysis of a ConvNeXt-Based Positioning System Using 5G-Integrated Multi-Radio Matching-Map Images: J. Jeon, J. H. Lee, Y. Cho, Electronics and Telecommunications Research Institute

9:43 Wheel-Mounted/GNSS Fusion with AI-Aided Position Updates: G. Versano and I. Klein, University of Haifa

10:05-10:35, Break. Refreshments in Exhibit Hall

Alternate

1. Efficient Satellite Acquisition for Initial Positioning Using Deep Learning – Graph Convolutional Networks: L-H. Chu, Y-L. Lo, Y-C. Lin, S-X. Yang, AIROHA

Session A1b: Indoor Navigation

Room: Windsong 1-2 (10:35 a.m.–12:15 p.m.)



Dr. Li-Ta Hsu
The Hong Kong Polytechnic University



Dr. Christian Gentner
German Aerospace Center (DLR)

10:40 UWB-Anchored Digital Twins from a Single Smartphone: Unified Anchor Localization and 3D Environment Reconstruction: T. Sukegawa, Nagaoka University of Technology and National Institute of Advanced Industrial Science and Technology; S. Ogiso, R. Ichikari, M. Kourogi, T. Kurata, National Institute of Advanced Industrial Science and Technology; K. T. Nakahira, Nagaoka University of Technology

11:03 An Infrastructure-Efficient Indoor Positioning–Navigation–Timing System Based on Dual-Anchor Downlink TDOA and TOA: Y. Zhan, G. Liu, X. Cui and M. Lu, Tsinghua University

11:26 Mitigating Heading Drift in Foot-Mounted Inertial Navigation through UWB Ranging: M. Schmidhammer, A. Joshi, P. Hager, and C. Gentner, German Aerospace Center (DLR)

11:48 Flight Test Evaluation of an Autonomous Cooperative LiDAR/IMU-Based Indoor Navigation System: A-S. Polz and M. Uijt de Haag, Technische Universität Berlin

Alternate

1. The Description of Giftet® MC-CDMA Indoor Geolocation System Prototype: I. F. Progri, Giftet Inc.

Session B1: Applications Using Communication Technologies, Opportunistic Signals, or Collaborative Positioning

Room: Windsong 11-12



Dr. Ramsey Faragher
Royal Institute of Navigation



Dr. Michael Angermann
Google Inc.

8:35 The ESA OpSTAR Mission: An in-Orbit Demonstrator of Optical Links Enabling Highly Accurate Synchronization and Ranging for Next-Gen GNSS Architectures: G. Giorgi, J. Poliak, A. Accorinti, T. Schmidt, German Aerospace Center (DLR); J. Speidel, N. Tarkian, OHB; D. Blonski, D. Ibanez, J. Á. Ávila Rodríguez, European Space Agency

8:57 Analysis of Meta Signal Processing Options and Application to Communication Signals: D. Dötterböck, M. Hameed, M. Bochkati, T. Pany, Universität der Bundeswehr München

9:20 Benefits of Leveraging a Hybrid SATCOM Constellation (GEO, MEO, LEO and HEO) Using PNT as a Service (PNTaaS): A. Brown, C. Reese, NAVSYS Corporation; G. Goussetis, Heriot-Watt University

9:43 Assisted Navigation Message Authentication Implemented on Android: C. O'Driscoll, Independent Consultant; I. Fernandez-Hernandez, European Commission; J. Winkel, Independent Consultant; T. Willems, European Commission Advisor

10:05-10:35, Break. Refreshments in Exhibit Hall

10:40 Modern Northstar: Starlink LEO PNT Across Land, Air, Stratosphere, and Arctic Seas: Z. Kassas, S. Hayek, W. Barrett, S. Kozhaya, P. El-Kouba, F. Mooseli, J. Sanderson, and J. Saroufim, The Ohio State University

11:03 Enabling Broad, Accelerated Alternative PNT Trialing Through a Patented Novel Lab-Based Test Methodology: J. Ackermann, R. Wong, F. Krefft, and M. G. Holbrow, Keysight

11:26 SAR/Galileo Two-Way Communication (TWC) Service, a Bi-Directional Channel for Search and Rescue Forces: M. Fontanier, E. Jurado, S. Becquet, J. Pla, CNES; P. Novell, EUSPA; A. Rolla, European Commission; E. Bouton, European Space Agency

11:48 Enhanced Long-Range Navigation (eLoran) for Resilient Positioning, Navigation, and Timing (PNT) in the Maritime Domain: K. Sheridan, A. Grant, J. Safar, C. Hargreaves, General Lighthouse Authorities of the United Kingdom & Ireland (GLA) Research & Development (GRAD)

Alternates

1. Real-Time Multi-Service SIS Monitoring Capabilities of the Galileo G2STB V2 Infrastructure: A. García, E. Lopez, J. V. Moreno, M. A. Perez, C. Sánchez, A. Lobit, M. Rhodes, A. Leiro, F. J. Sobrero GMV; G. Galluzzo, S. Circiu, S. Wallner, G. Lopez, European Space Agency/ESTEC

2. A Unified Hybrid Terminal Integrating GNSS and LEO-PNT with 5G and LEO Signals of Opportunity: Consolidated System Design and Measured Performance: E. Domínguez-Tijero, J. Fidalgo, M. Meneses, F. A. Pinto, D. García, F. J. Mata, GMV; D. Giustiniano, G. Santaromita, T. Otim, F. Pigato, IMDEA; A. Reus, M. Fernández, Q. Liu, F. Fabra, G. Seco-Granados, J. A. López-Salcedo, Universitat Autònoma de Barcelona

View On-Demand Only Paper Presentations at ion.org/gnss. List on page 14

Session C1: Navigation Resilience to Interference and Cyber-Attacks 1

Room: Windsong 9-10



Emilio Perez Marcos
German Aerospace Center (DLR)



Dr. Jason Anderson
Xona Space Systems

8:35 Resilient Urban Vehicle Navigation in GNSS-Denied Environments via Tightly Integrated Inertial Propagation, Deep Motion Inference, GIS Route Constraints, and Opportunistic Visual Landmark Corrections: S. Dasgupta, M. U. Ahmad, M. S. Irfan, M. Rahman, J. D. Larson, The University of Alabama

8:57 Navigation and Timing Performance of LEO PNT in GNSS-Degraded and Live Environments: T. Flynn, Iridium

9:20 Testing Maritime Resilient PNT Based on VDES-R Non-NOminal Conditions: F. Mistrapau, V. Kosjer, C. G. Ciobanu, V. G. Olteanu, M. Turner, A. Owens, GMV

9:43 Lessons Learned from Studying GNSS Vulnerabilities in the Maritime, Aviation and Automotive Sectors, and Best Practice Guidelines for Resilient PNT: R. Faragher, Royal Institute of Navigation

10:05-10:35, Break. Refreshments in Exhibit Hall

10:40 Suppressing Multiple GNSS Interferers with Local-Gradient Adaptive Notch Filtering: B. Soner, sobu labs; F. Ott, Fraunhofer Institute for Integrated Circuits IIS

11:03 Single-Antenna Spatial Authentication of GNSS Signals Using Supercorrelation: Real-World Meaconing Demonstration: L. Bennett, J. Rossouw van der Merwe, J. G. Garcia, M. Crockett, J. Ellis-Gray, H. Mwenegoha, O. Kurt, H. Eriksson-Martin, P. Esteves, S. Mole, and M. del Castillo, Focal Point Positioning

11:26 Multi-Layer Anti Spoofing Strategy: Architecture and Test Results: M. Saidani, H. Ayyad, A. Guinamard, SBG Systems

11:48 Multi-Layered Mitigation Strategies for Precise Navigation During GNSS Jamming and Spoofing: F. Rothmaier, X. Chen, M. Glomsda, S. Blatt, S. Junker, Trimble Services GmbH

Alternates

1. **Recycle the Spectrum: Cognitive Beacon Estimation of Unknown LEO Satellites for PNT:** S. Kozhaya and Z. M. Kassas, The Ohio State University
2. **ML-Driven Spatial Awareness Technique for GNSS Analog Antenna Array Using Spatial Probing:** M. Hassan, Royal Military College of Canada; S. Abuelsaad, Queen's University; M. K. Emara, Calian GNSS; A. Noureldin, Royal Military College of Canada and Queen's University; H. Elghamrawy, Royal Military College of Canada
3. **Operational Validation of GNSS RFI Indicator for Aviation Applications:** N. Caccioppoli, G. Berz, M. Mabilleau, D. Duchet, EUROCONTROL; E. Canestri, EUSPA
4. **Beyond Legacy L1 C/A: Characterizing Advanced Multi-Frequency Spoofing Against Multi-Frequency GPS Receivers for Autonomous Navigation:** M. U. Ahmad, M. S. Irfan, S. Dasgupta, M. Rahman, T. N. Bandi, The University of Alabama

Session D1a: PANEL: Advancing Autonomy in Aviation

Room: Windsong 3-4 (8:30 a.m.–10:05 a.m.)



Tim Murphy
Boeing



Dr. Maarten Uijt de Haag
TU Berlin

CANCELED

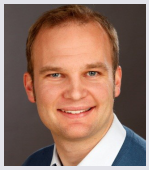
A discussion on the cutting edge of autonomous and highly automated flight and the future of aerial mobility. Industry leaders, researchers, and policymakers will explore how autonomy is reshaping aviation—from commercial aviation and next-generation air traffic systems to fully autonomous cargo aircraft, air taxis and drone operations. What technological breakthroughs are driving autonomous flight? How can we ensure safety, reliability, and certification for highly autonomous aerial vehicles? What role will autonomy play in enabling seamless integration of smaller autonomous aircraft, drones, and eVTOLs into our airspace?

Session D1b: PANEL: Aviation PNT Risks and Resilience: Experience from the Cockpit

Room: Windsong 3-4 (10:35 a.m.–12:15 p.m.)



Captain Bulent Atas
Turkish Airlines



Dr. Michael Felux
ZHAW

GPS interference has become a persistent operational reality, prompting new technologies and procedures, yet their effectiveness and long-term adequacy remain open questions. Industry, operators, research, and academia will explore how real-world pilot experience can inform more robust, system-wide resilience strategies against evolving GNSS disruptions.

Panel Members:

1. Captain Mark Walton, FRAeS
2. Dr. Evan Dill, NASA
3. Captain Berna Sen, Ryanair

Session E1: Cislunar, Lunar, and Martian Positioning, Navigation, and Timing 1

Room: Windsong 7-8



Dr. Keidai Iiyama
Stanford University



Dr. Masaya Murata
Japan Aerospace Exploration

8:35 Onboard Navigation System Design for Altus-1 and Strategies for LCRNS SISE Compliance: T. Mina, Georgia Institute of Technology; J. Leonard, KinetX Aerospace; D. Gaylor, S. Stewart, Intuitive Machines; J. Christian, Georgia Institute of Technology

8:57 Japan's LNSS Demonstration Mission Updates: Technical Progress, Development and Policy Frameworks: T. Shibukawa, K. Kakihara, S. Matsuo, J. Critchley-Marrows, S. Kippen, T. Ono, T. Takasu, O. Arai, ArkEdge Space Inc.

9:20 First Observations of Earth's Plasmasphere and Ionosphere from the Lunar Surface: Results from the LuGRE Mission: R. Ghidoni, M. Guerra, C. Cesaroni, L. Spogli, Istituto Nazionale di Geofisica e Vulcanologia; A. Minetto, A. Nardin, Politecnico di Torino; L. Alfonsi, Istituto Nazionale di Geofisica e Vulcanologia; F. Dovis, Politecnico di Torino

9:43 High-Efficiency Ephemeris Parameterization for Lunar PNT Systems Using Mean-Osculating Transformation: Y. Matsumoto, R. Nakamura, K. Akiyama, S. Ueda, Japan Aerospace Exploration Agency

10:05-10:35, Break. Refreshments in Exhibit Hall

10:40 Time-Correlated Ephemeris Errors and Relativistic Effects for Single-Satellite Doppler Localization of Lunar Rovers: K. M. Y. Coimbra and G. Gao, Stanford University

11:03 Multi-Layered Satellite Constellation Design and Orbit Determination for LANS IOC Stage Performance Augmentation: J. Oh, S. Kim, B. Park, Sejong University

11:26 Mars Positioning with GNSS-SDR: An End-to-End Simulation Testbed: R. Verdeguer Moreno, I. Acosta Bayona, J. Williams, J. Williams, Keysight Technologies ; M. A. Gomez Lopez, Universidad Carlos III de Madrid; J. Arribas Lázaro, CTTC

11:48 A Performance Prediction Framework for Lunar PNT Based on Terrestrial GNSS Modeling: H. Park, I. Jung, Korea Aerospace Research Institute; O-J. Kim, Sejong University

Alternate

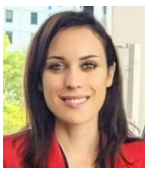
1. Cis-Lunar Navigation Using Direct Position Estimation Using LuGRE Data: S. Umashankar, M. Sandacz, K. Strandjord, University of Minnesota

Session F1: Next-Generation GNSS: Signals, Architectures, and Receiver Processing Advances

Room: Palm



Domenico Di Grazia
St Microelectronics



Dr. Melania Susi
Topcon Positioning Systems

8:35 PRN Code Segmentation for High-Data-Rate GNSS Signal Design with Low-Complexity: J.H. Noh, D. W. Lim, Korea Aerospace Research Institute

8:57 Opportunities and Implications of G2 Galileo Quasi Pilot Signals in GNSS Receivers for Fast Time Retrieval and Meta-Signal Processing: E. Garbin, C. Moriana, F.A. Pinto, A. Iregui, F. Conde-Pumpido, R. Romero, G. Cueto-Felgueroso; GMV; E. Shytermeja, J. A. Garcia-Molina, European Space Agency

9:20 Harmonic Superposition (HS) Modulation for the Future of Radionavigation: P. A. Dafesh, The Aerospace Corporation

9:43 Signal Design Impacts on GNSS and LEO-PNT L1 Band Acquisition Complexity: A Case Study with Xona Pulsar: J. Leclère, R. Joshi, T. Marathe, T. G. R. Reid, Xona

10:05-10:35, Break. Refreshments in Exhibit Hall

10:40 Geometry-Aided Kalman-Based Tracking Loops for Ionospheric Scintillation Monitoring: R. Vasconcelos Pacelli, Aeronautics Institute of Technology (ITA), Federal University of Ceará (UFC); R. Florindo, ITA, German Aerospace Center (DLR); F. Antreich, ITA; A. L. F. de Almeida, UFC; A. Aragon-Angel, A. Rovira-Garcia, Polytechnic University of Catalonia

11:03 Multipath Performance Assessment of Preliminary RNSS Signals Using an Empirically Adapted Channel Model: J. Son, H-J. Hong, J-H. Won, Inha University

11:26 Hardware-in-the-Loop Evaluation of Tracking Performance for Distortion-Optimized Multilevel Coded Spreading Signals: F. C. Beck, German Aerospace Center (DLR) & Chair of Navigation RWTH Aachen University; A. Minetto, Politecnico di Torino; I. E. Mehr, Fondazione LINKS; A. Nardin, Politecnico di Torino; S. Thölert, DLR & RWTH Aachen University; F. Dovis, Politecnico di Torino; M. Meurer, DLR & RWTH Aachen University

11:48 Characterization of Hardware GNSS Receiver Power Consumption Under Duty Cycling: S. Kocher, F. Garzia, S. Urquijo, A. Rügamer, Fraunhofer IIS; J. Robert, Friedrich-Alexander University Erlangen-Nürnberg, Fraunhofer IIS

Alternate

1. Weil Code Generation and Cross-Correlation Analysis for GEO/QGEO PRN Selection in Navigation Signal Simulation: H. S. Seo, Y. S. Choi, Y. B. Kim, MicroInfinity Co., Ltd.

Session G1: LEO-Based PNT and Integrated Communication and Navigation (Signal Design) 1

Room: Windsong 5-6



Dr. Florin Catalin Grec
European Space Agency



Claire Mah
Xona Space Systems

8:35 Acquisition Performance for Upcoming LEO-PNT Constellations in Different Frequency Bands: O. M. Picchi, External consultant for European Commission, Joint Research Centre (JRC); A. Gonzalez Garrido, B. Motella, F. Menzione, M. Paonni, European Commission, JRC; O. Julien, External consultant for European Commission, DG DEIS

8:57 ESA's Celeste In-Orbit Demonstration: Initial Ranging Results: S. De Bast, J-M. Sleewaegen, W. De Wilde, Septentrio

9:20 Experimental Investigation of UHF and S-Band Navigation Signal Propagation Characteristics for LEO-PNT Applications: I. Jeong, J. Lee, Y. Park, O. Kim, Sejong University

9:43 Exploring the Potential Capabilities of NB-IoT for Future LEO-PNT Missions: F. Fabra, A. Giménez, J. A. López-Salcedo, G. Seco-Granados, Universitat Autònoma de Barcelona (UAB); E. Domínguez, F. A. Pinto-Benel, GMV; F. Grec, R. de Gaudenzi, European Space Agency

10:05-10:35, Break. Refreshments in Exhibit Hall

10:40 First Independent Assessment of Xona's Pulsar Signal Quality, Positioning Performance, and Compatibility: S. Thoelert, F. C. Beck, German Aerospace Center (DLR), RWTH Aachen University

11:03 Study Into Resilient Signal Designs for LEO-PNT: Trade-off and Priorities for Ensuring Robust and Secure Architectures: N. Sakamoto, J. Critchley-Marrows, H. Shiono, T. Shibukawa, S. Matsuo, T. Yasuda, T. Ono, and T. Takasu, ArkEdge Space Inc.

11:26 Celeste: First In Orbit LEO-PNT Demonstration: C. Catalán, C. Pisonero, E. Fernández, A. Juez, GMV; E. Breeuwer, M. Cordero, P. Giordano, European Space Agency

11:48 Acquisition, Tracking, and Differential Positioning with Starlink Direct-to-Cell Signals: First Study: F. Mooseli, J. Saroufim, and Z. M. Kassas, The Ohio State University

Blue Text = Student Award Winner

Session A2a: PANEL: AI/ML in PNT: Opportunities, Challenges and Future Trends

Room: Windsong 3-4 (1:45 p.m.–3:25 p.m.)



Dr. Juliette Marais
University Gustave Eiffel

AI and ML are transforming PNT through jamming/spoofing management, sensor fusion, or GNSS-denied navigation. This panel brings together experts to discuss the opportunities and challenges of deploying data-driven methods, and foster a dialogue on robustness, generalization, integrity, explainability and certification, to ensure trustworthy, resilient, and intelligent next-generation PNT systems.

Panel Members:

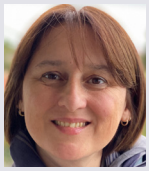
1. Dr. Ivan Petrunin, Cranfield University
2. Dr. Luis Serrano, NeuraLoc
3. Sebastian Bernhardt, German Aerospace Center (DLR)

Session A2b: PANEL: Trends in Cybersecurity and PNT

Room: Windsong 3-4 (3:55 p.m.–5:30 p.m.)



Dr. Joe Rushanan
The MITRE Corporation



Renee Yazdi
Canyon Consulting

Exploring the intersection between the broad fields of cybersecurity and PNT by presenting questions like: "How do we secure PNT and/or assure location-based privacy as cloud computing, universal connectivity, pervasive low-cost devices such as wearables, and geolocated IoT devices continue to proliferate?" Embedded PNT can create cyber vulnerabilities within a system, but on the flip side, "Can PNT, properly managed, improve a system's cyber security posture?" On both sides of the conversation, challenges like AI, autonomy, privacy, and enterprise management are changing the dialogue.

Panel Members:

1. Miguel Manteiga Bautista, Galileo Programme Manager, European Space Agency
2. Dr. Ignacio Fernández Hernández, European Commission DG DEFIS
3. Chelsea Gibson, Co-Founder & CEO, Marestella
4. Dr. Zak Kassas, Professor and Director of USDOT Center CARMEN+, The Ohio State University
5. Logan Scott, Logan Scott Consulting

Early Career Navigators Gathering

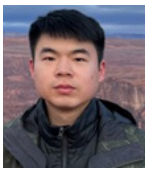
Wednesday, September 16
7:00 p.m.
On-the-Rocks (Poolside)
See details on page 5.

Session B2: Aviation, Aeronautics, and Uncrewed Aerial Applications

Room: Windsong 11-12



Daniel Gerbeth
German Aerospace Center (DLR)



Dr. Wang Hu
Amazon Prime Air

1:50 Availability of DFMC GBAS with an Improved Message Type for GAST E: S. Saito, Electronic Navigation Research Institute, National Institute of Maritime, Port and Aviation Technology; T. Murphy, Boeing; G. McGraw, M. Caamano, German Aerospace Center (DLR); J. Wichgers, Collins Aerospace; M. Tuffaha, M. Topland, L. Lavik, Indra Navia

2:12 3D Gaussian Splatting for Robust Autonomous Navigation in Low-Texture Taxiway Environments: J. W. Baik, A. L. Abbott, Virginia Tech; D. R. Choate, J. Rife, Tufts University; A. Sarkar, Virginia Tech

2:35 Deriving DME Integrity Parameters from Flight Campaign Data: Methodology and Preliminary Results: S. Khanafseh, O. Coskun, B. Kujur, Illinois Institute of Technology; O. Osechas, Zurich University of Applied Science; V. Vitan, G. Berz; EUROCONTROL; B. Pervan Illinois Institute of Technology

2:58 Enhanced DME Flight-Test Performance Assessment and Ranging Error Modeling: G. Zampieri, German Aerospace Center (DLR) & RWTH Aachen; P. Lunardi, L. Saini, Thales; D. Biella, Consultant; G. Cuciniello, L. Garbarino, CIRA; B. M. Weaver, DLR; M. Meurer, DLR & RWTH Aachen; G. McGraw, Consultant

3:25 - 3:55, Break. Refreshments in Exhibit Hall

4:00 Aircraft Navigation Aided by Vehicle Equations of Motion: E. M. Graupe, M. S. Hemati, and D. Gebre-Egziabher, University of Minnesota

4:23 Contribution to Validation of the Radio-Frequency Interference Detector from EUROCAE ED-259A/RTCA DO-401: C. Amielh, G. Lebossé, D. Gonzalez-Conde, M. Brunot, L. Azoulai, and A. Aka, Airbus Operations SAS

4:46 Update on Galileo Performance Characterization for H-ARAIM: S. Perea, S. Wallner, European Space Agency; M. Odriozola, A. Nuckelt, S. Schloetzer, Airbus Defense and Space GmbH; F. Belmonte, Deimos Space; E. Canestri, European Union Agency for the Space Programme; M. Sgammini, J.P. Boyero, European Commission

5:08 Testing Real-Time Galileo High Accuracy Service for Airborne Receiver: A. Rovira-Garcia, J. Sanz, Universitat Politecnica de Catalunya; M. Pini, M. Berardo, M. Nicola, G. Marucco, Civitanavi Systems by Honeywell Aerospace; M. P. Di Donato, Centro Italiano Ricerche Aerospaziali; T. Krieger, P. Außerlechner, FlyNow Aviation GmbH

Alternates

1. **Assessment of a MFMC GBAS Prototype in the Brazilian Region Using Real-Flight Data:** F. T. Linhares de Souza, J. F. Galera Monico, M. H. Shimabukuro, I. Tsuchiya, W. da Costa Silva, G. Poleszuk dos Santos Rosa, C. Menezes da Silva, A. L. Palmeira Brandão, J. P. Voltare Zaupa, L. Gonçalves Ferreira, H. Y. Yamashiro, São Paulo State University (UNESP)
2. **Evaluation and Improvement of DFMC SBAS Availability in the Arctic Region:** T. Yamamoto, M. Mogamiya, H. Araki, S. Miyamoto, CORE Corporation; T. Takahashi, M. Kitamura, T. Sakai, Electronic Navigation Research Institute
3. **How Aviation Traffic in the United States can Recover from a Major GPS/GNSS Outage:** E. Etienne, Stephen Belt, Saint Louis University

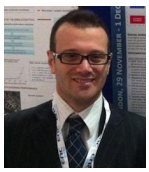
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Session C2: Navigation Resilience to Interference and Cyber-Attacks 2

Room: Windsong 9-10



Gerhard Berz
Eurocontrol



Dr. Ciro Gioia
European Commission/JRC

1:50 A Decision-Level Bayesian Framework for Robust GNSS Spoofing Detection: Y. Ma, Tsinghua University; Y. Deng, Tsinghua University & SAIC Motor R&D Innovation; M. Lu, H. Li, Tsinghua University

2:12 Towar a Spoofing-Resilient GNSS/INS Receiver: Separation and Tracking of Matched-Power Spoofing Signals: B. Kujur, S. Khanafseh, B. Pervan, Illinois Institute of Technology

2:35 AI-Based Anomaly Detection for GNSS Jamming and Spoofing: Insights from the JammerTest 2025 Trials: X. Esneu, S. Lelièvre, S. Kalyanaraman, Collins Aerospace

2:58 Receiver Position and Attitude Estimation Using Direction-of-Arrival Measurements from Starlink and OneWeb LEO Satellites: P. El-Kouba, S. Kozhaya, and Z. M. Kassas; The Ohio State University

3:25 - 3:55, Break. Refreshments in Exhibit Hall

4:00 Empirical Assessment of GNSS Interference Impacts on Control and Navigation in a Commercial Level 2 Automated Vehicle: M-A. Lalonde, PMG Technologies; H. Shafique, Transport Canada; A. Saleh, PMG Technologies

4:23 GNSS Resilience Performance of the Galileo Evolution Signals Using OSNMA and Ranging Authentication: E. Shytermeja, L. Musumeci, G. Caparra, X. Otero-Villamide, S. Walner, G. Lopez-Risueno, European Space Agency

4:46 Galileo Signal Authentication Service Early Capabilities: From Service Implementation to User Assessment: M. A. Ramírez, S. Cancela, D. Calle, GMV; F. Fuchs, Airbus; R. Terris, UAB; I. Fernández-Hernández, T. Willems, J. Winkel, European Commission

5:08 Protecting Mission Critical Infrastructure: The World Needs Better Timing: G. Biran, Oscilloquartz

Session D2a: GNSS Integrity in Aviation: ARAIM, GBAS, SBAS and Their New Advancements

Room: Windsong 5-6 (1:45 p.m.–3:25 p.m.)



Dr. Eugene Bang
Gyeongsang National University



Ernesto Etienne
Federal Aviation Administration

1:50 How far can GBAS Ground Stations be from the Airport?: J. F. Galera Monico, F. T. Linhares de Souza, I. Tsuchiya, M. H. Shimabukuro, São Paulo State University (UNESP)

2:12 Assessment of Multipath Limiting Antenna Calibration Effects on DFMC GBAS Performance: M. Caamano, S. P. Hehenberger, S. Caizzone, D. Gerbeth, German Aerospace Center, (DLR); M. Nietlispach, M. Felux, Zurich University of Applied Sciences, ZHAW; G. A. McGraw, Genova Technologies/ DLR Consultant

2:35 Mitigating the Impact of Small-Scale Ionospheric Threats on WAAS Availability Using ROTI: H. Swain, J. Ovadia, C. Pong, E. Altshuler, Sequoia Research Corp.

2:58 Carrier-Phase Outage Mitigation in Synthetic GNSS Meta-Signal Reconstruction for Dynamic Scenarios: D. Di Grazia, F. Pisoni, S. Crasta, S. Ardiero, M. Renna, G. Gogliettino, STMicroelectronics srl

3:25 - 3:55, Break. Refreshments in Exhibit Hall

Alternate

1. **Managing Safety and Certification Co-Evolution in SBAS Programs: TRACE Technical-Assistance Playbook from SouthPAN:** J. She, The MITRE Corporation

Session D2b: Joint Comm/Nav Signal Design and Constellation Design: Applications in 5G/6G, LEO, and Opportunistic PNT (System Design)

Room: Windsong 5-6 (3:55 p.m.–5:30 p.m.)



Dr. Bing Xu
The Hong Kong Polytechnic University



Dr. Felix Antreich
Aeronautics Institute of Technology

4:00 5G Non-Terrestrial Networks for Integrated Positioning and Communication: Signal, System Design and Performance Analysis: F. Grec, R. de Gaudenzi, European Space Agency

4:23 LEO-PNT Payload Validation for ESA's First Celeste In-Orbit Demonstration Satellite: M. Manzano, D. G. Arjona, N. Pérez, R. Contreras, S. Camargo, P. Vidal GMV; O. Koch, OHB; L. M. Brugarolas, Alén Space; F. Zangerl, T. Lindgren, Beyond Gravity; S. Carrasco Martos, F-C. Grec, M. Anghileri, European Space Agency

4:46 Network Aided Opportunistic LEO-PNT– Experimental Validation Using Dual-Station Sequential Tracking: F. Menzione, O.M. Picchi, European Commission Joint Research Center (JRC); C. A. Lichtenberger, F. Binder, University of the Bundeswehr Munich; J. Fortuny-Guash, F. Bonavitacola, A. Gonzalez-Garrido, European Commission, JRC

5:08 Optimal Reconfiguration of Lunar Navigation Constellations: M. Kura, K. Iiyama, and G. Gao, Stanford University

Alternate

1. Joint 5G NR-NTN and GNSS Overlay in MEO: Experimental Assessment of Navigation Data Robustness Under DSSS–OFDM Coexistence: I. Edjekouane, University of Luxembourg; A. Gonzalez Garrido, European Commission, Joint Research Center (JRC); J. Krivochiza, SES S.A.; J. Querol, S. Chatzinotas, University of Luxembourg

Session E2a: Cislunar, Lunar, and Martian Positioning, Navigation, and Timing 2

Room: Windsong 7-8 (1:45 p.m.–3:25 p.m.)



Dr. Fabio Dovis
Politecnico di Torino



Joel Parker
NASA Goddard

1:50 A CDMA Two-Way Ranging Approach to Assist in Providing PNT at the Moon and Beyond: F. Taylor III, T. Zapel, and D. Akos, University of Colorado Boulder

2:12 Cornerstone Lunar PNT: The Mature Technological and Engineering Foundation for the First Lunar Infrastructure Node: Y. Bar-Sever, W. Bertiger, W. Lu, and S. Turyshev, Jet Propulsion Laboratory, California Institute of Technology

2:35 Characterization of GNSS Observables from LuGRE Lunar Surface Operations: I. Cossu, O. Vouch, A. Minetto, A. Nardin, S. Zocca, F. Dovis, Politecnico di Torino

2:58 Enabling Enhanced Lunar PNT: Development and Validation of a Lunar Surface Station Demonstrator: S. Garlaschi, F. Caputo, S. Tedesco, M. Rotoloni, A. Sentelli, L. Canzian, A. Dalla Chiara, Qascom Srl; R. D. Swinden, F. T. Melman, D. V. Psychas, Y. Audet, N. Boasman, European Space Agency ESTEC

3:25 - 3:55, Break. Refreshments in Exhibit Hall

Alternate

1. Lunar Navigation System by Beacon: M. Cardone, F. Lotti, Agenzia Spaziale Italiana (ASI); F. Ciavarella, Sapienza Università di Roma

Session E2b: Novel Paradigms in Navigation

Room: Windsong 7-8 (3:55 p.m.–5:30 p.m.)



Dr. Ryan McKnight
Ohio University



Stefano Binda
European Space Agency

4:00 Toward Resilient Alternative Navigation: AI-Driven Anomaly Detection for NV-Diamond Quantum Magnetometers in UAV and LEO Platforms: M. Michael, A. Marchl, I. Cortés, RobNav GmbH; J. R. van der Merwe, Consultant; R. Said, F. Jelezko, University of Ulm; R. T. Dinani, M. Nesladek, IMEC; D. Seybold, J. Seybold, TeleOrbit GmbH

4:23 A Trade Study of Optical Global Localization Approaches for Lunar Rovers: S. Bhamidipati, J. Nash, D. Atha, S. Daftry and I. Nesnas, NASA Jet Propulsion Laboratory, California Institute of Technology

4:46 Enhancing Lunar PNT Using G3 GNSS Space Service Volume: H. More, E. E. Zini, S. Corvo, F. Paggi, Thales Alenia Space

5:08 Toward an Asteroid-Based Autonomous Navigation Framework for Deep Space CubeSats: H. Shim and S. Soldini, University of Liverpool

Alternate

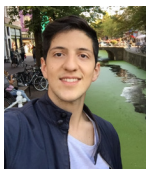
1. A Semi-Autonomous Small-Satellites Constellation for Global Navigation in Martian Orbit: G. Paialunga, M. Zannoni, P. Tortora, University of Bologna

Session F2: Data-Driven and Learning-Based Methods for Satellite Navigation and PNT Systems

Room:Windsong 1-2



Dr. Nesreen Ziedan
Zagazig University



Dr. Lotfi Massarweh
Delf University of Technology

1:50 Blind, Laser-Validated Environment Estimation for Crowdsourced GNSS Reference Stations: H. Shiono, N. Kubo, Tokyo University of Marine Science and Technology

2:12 Integrity Risk Mapping for Signals-of-Opportunity-Based Urban UAS Navigation: A. Wu, A. Sweet, and G. Gao, Stanford University

2:35 A Cognitive High-Sensitivity Receiver for Aerial Navigation Using Cellular 5G Signals Under Co-Channel Interference: S. Shahcheraghi and Z. M. Kassas, The Ohio State University

2:58 GFlowLoc: GFlowNet-Driven Adaptive Fusion for Robust Positioning in GNSS-Challenged Environments: A. Khudoyberdiev and J. Ryoo, The State University of New York, Korea and IDCITI Corporation

3:25 - 3:55, Break. Refreshments in Exhibit Hall

4:00 QGSL-GNSS: Q-Learning-Based Adaptive Graph Structure Learning for Semi-Supervised GNSS Interference Classification: S. Jeeru, R. O. Omslandseter, P-A. Andersen, University of Agder; N. Sokolova, A. J. Morrison, SINTEF Digital; L. Jiao, University of Agder

4:23 Dual-Frequency Multi-Constellation (DFMC) SBAS Network Optimization Using Genetic Algorithms: S. Pullen, S. Oak, S. Lo, J. Blanch, and T. Walter Stanford University; M. Crews, C. Frey, and B. Barrett, Lockheed Martin

4:46 Ambiguity Resolution in PPP-RTK Network Processing Using Machine Learning: L. Urquhart, York University & u-blox; S. Bisnath, York University; R. Leandro, u-blox

5:08 Machine-Learning-Based Smartphone GNSS Precise Point Positioning with an Error-Aware Attention Framework: L. Tan, C. Hayden, S. Bisnath, York University

Session G2a: 40th Anniversary Track: STUDENT SESSION

Room: Palm (1:20 p.m.–3:25 p.m.)



Dr. Penina Axelrad
The University of Colorado, Boulder

1:27 Machine-Learning Based Ensemble Method of Estimating Ionospheric Refraction from Smartphones: C. Hayden, L. Tan, and S. Bisnath, York University

1:50 3D Map-Aided Integrity Prediction and Monitoring for Enhanced Sensor-Integrated Urban Navigation: C-W. Wang and S-S. Jan, National Cheng Kung University

2:12 Using INS to Mitigate GNSS Multipath in Dense Vegetation: R. Kadach and K. O'Keefe, University of Calgary

2:35 INS-Aided Doppler Feedforward for Robust GNSS Carrier Tracking Under Vehicle and Rocket-Class Dynamics: J-Y. Lin and K-W. Chiang, Taiwan Space Agency, National Cheng Kung University

2:58 Lander-Aided Differential Doppler and One-Way Ranging for Lunar Rover Navigation with a Single Relay Satellite: K. M. Y. Coimbra and G. Gao, Stanford University

3:25 - 3:55, Break. Refreshments in Exhibit Hall

Session G2b: Resilient and Secure PNT Against Interference and Emerging Threats 1

Room: Palm (3:55 p.m.–5:30 p.m.)



Dr. Beatrice Motella
EC Joint Research Centre



Dr. Capucine Amielh
Airbus

4:00 Real-World Assessment of Hexagon | NovAtel GNSS Anti-Jamming and Anti-Spoofing Technologies: A. Broumandan, I. Tremblay, M. Palmer, C. Phillips, T. Taylor and S. Kennedy, Hexagon|NovAtel

4:23 A Synchronous GNSS Spoofing Attack Model by Exploiting Basic Safety Message Transmissions for Connected and Automated Vehicles: M. S. Irfan, M. U. Ahmad, Z. Zaman, S. Dasgupta, M. Rahman, The University of Alabama

4:46 Bridging Reference Frames and Maps Using PPP-RTK Correction: R. Hirokawa and N. Hayase, H. Mineyama, Mitsubishi Electric Corporation

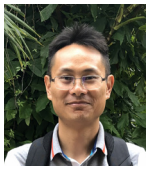
5:08 Initial Analysis of All Nippon Airways (ANA) Airborne GNSS SNR Data: J. Zhang, Y-C. Ko, J. J. Braun, J-P. Weiss, University Corporation for Atmospheric Research; E. Takasaki, E. Ishida, T. Kato, ANA Holdings INC.

Session A3: Latest Advancement from GNSS Receiver and Localization Algorithm Manufacturers

Room: Windsong 1-2



Dr. Zhenlan Cheng
u-blox



Dr. Jason Qian
Applanix

8:35 Positioning and Timing Accuracy Performance of Septentrio Mosaic-G5 Based on Galileo High Accuracy Service (HAS): M. Lonchay, M. Tarik, I. Paakkonen, J-M. Sleewaegen, F. Boon, Septentrio

8:57 StarPoint – Evolution of the Topcon Global PPP Correction Service: 24/7 Continuous Operation with Low-Latency Delivery and Enhanced Service Robustness: D. Nikitin, F. Serkin, M. Susi, K. Kolosov, Topcon Positioning System

9:20 MediaTek High Accuracy Solution with Multiple Assistance Protocols: P-H. Jau, H. Chen, J-Y. Wang and C-T. Weng, MediaTek Inc.

9:43 Position-Domain Ionospheric Mitigation: Offset Reduction via Linear Combination of Single-Frequency Positions: H. Kawauchi, Y. Kajikawa, M. Hasegawa, Sony Semiconductor Solutions Corporation

10:05-10:35, Break. Refreshments in Exhibit Hall

10:40 TruePoint.CM: High Availability NRTK Solution: V. Bellad, A. Boda, H. Wewala, N. Valentine, D. Clemente, A. Soliman, S. Vana, Rx Networks

11:03 LEO PNT ASIC as a Complement to GNSS Receivers and Embedded Systems: W. Johnson, Iridium Communications

11:26 A Scalable GNSS / LEO PNT Baseband Platform: Designed to Be Outgrown: N. Mikhaylov, Softnav GmbH

11:48 Carlson VASCO®-R Triple-Antenna Receiver for High-Performance and Cost-Effective Machine Control Ecosystem: M. Sotak, Z. Kana, J. Viana, J. Pileckas, Carlson Software Inc.

Alternates

1. **Evolution of Rx Networks TruePoint PPP Products: REACH and FOCUS:** H. Wewala, A. Boda, A. Soliman, S. Vana, V. Bellad, Rx Networks
2. **Scaling Early Earthquake Warnings Globally: Crowdsourcing the World's Largest Seismic Network on Android:** S. Malkos, Google

Session B3: AI and Machine Learning for GNSS Signal Processing, Error Modeling, and Threat Detection

Room: Windsong 7-8



Dr. Nadezda Sokolova
SINTEF Digital



Dr. Simona Circiu
European Space Agency (ESA)

8:35 Closing the Loop: AI-Driven GNSS Interference Detection and Mitigation in Real Time: A. Chamorro, J. Riesco, E. Carbonell, M.P. Bejarano, M.A. Ramirez, A. Gonzalez, GMV

8:57 Analyzing and Characterizing Multi-Source Interference Effects at Jammertest Norway 2025: L. Heublein, I. Cortes Vidal, T. Feigl, A. Rügamer, F. Ott, Fraunhofer Institute for Integrated Circuits IIS

9:20 A Supervised Architecture for GPS Interference Classification and Agile PNT Situational Awareness: N. Lewis, National Research Council Post-Doctoral Fellowship Program, Air Force Research Laboratory (AFRL); E. Rennspiess, AFRL; A. Patel, Georgia Institute of Technology; B. Howell, S. Minas, K. Pham, AFRL

9:43 Robust AI-Based Smartphone Positioning via Physics-Informed Feature Selection: J. Liu, Y. Gao, University of Calgary

10:05-10:35, Break. Refreshments in Exhibit Hall

10:40 Artificial Intelligence for GNSS Interference Monitoring: Detection and Characterization: A. N. Ivan, S. S. Mihai, A. C. Pandele, I. Mihu, Romanian InSpace Engineering; J. Hauser, R. Lesjak, JOANNEUM RESEARCH; F. Stoican, Three Tensors

11:03 Dense Autoencoder-Based Anomaly Detection for GNSS CORS Measurement Quality Monitoring: R. Manzano, E. Tai, National Autonomous University of Mexico; K. O'Keefe, University of Calgary

11:26 Using Machine Learning for Enhanced Global Ionosphere Mapping in Trimble's RTX Correction Service: U. Weinbach, M. Brandl, A. Goss, X. Liu, and M. Rexer, Trimble Inc.

11:48 Time–Frequency-Based Classification and Mitigation of GNSS NLOS and Multipath Errors Using Neural Networks: H. Jo, M-J. Kim, O-J. Kim, Sejong University

Session C3: Fielding Alternative Technologies in GNSS-Denied Environments 1

Room: Windsong 9-10



Nunzio Gambale
Locata



Dr. Peter Swaszek
University of Rhode Island

8:35 SAF2NAV: Agnostic Multi-Sensor Fusion Framework for GNSS Denied Navigation: P. Bénet, M. Saidani, K. Benmakhlouf, B. Doré, A. Guinamard, SBG Systems

8:57 Resilient 5G-Based Positioning, Navigation, and Timing: S. Deshpande and A. Raghupathy, NextNav Inc.

9:20 Demonstration of a Xona Space Systems Pulsar X1 and X5 Positioning and Timing Receiver: J. J. Morales, L. Herrera, K. Hammar, D-R. Emenonye, and C. T. Ardito, StarNav LLC

9:43 Multi-DME/AHRS Integrated Navigation with EKF-Based RAIM to Support RNP Arrivals and Departures in Terminal Airspace: S. Narayanan, T. Geels, D. K. Kushwaha, Collins Aerospace; O. Osechas, Zurich University of Applied Sciences; S. Khanafseh, Illinois Institute of Technology

10:05-10:35, Break. Refreshments in Exhibit Hall

10:40 A Normalized Fault-Free Approach for LiDAR/INS Landmark Localization: M. Nemana, B. Pervan, S. Khanafseh, K. Nagai, and B. Kujur, Illinois Institute of Technology

11:03 Applying Conformal Prediction to Uncertainty Quantification of Vision-Based Aircraft Surface Navigation: A. Sarkar, S. Thapa, J. W. Baik, M. Joerger, Virginia Tech; J. Rife, Tufts University

11:26 LEO PNT-Based, GNSS-Independent Timing Synchronization for Telecom Networks: C. Meyer, Iridium

11:48 Design and Experimental Evaluation of a Multi-Radar/Inertial Integrated Navigation System: S. Karadogan, G. Mongold, S. Wang, and M. Joerger, Virginia Tech

Alternate

1. **1D INS/ODO Recursive Navigation Method for Railway Trains in GNSS-Denied Environments:** Y. Zhang, W. Jiang, J. Wang, B. Cai, J. Liu, X. Ba, D. Lu, Beijing Jiaotong University

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ION

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Must be a U.S. citizen.

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Session D3: Precise Positioning and its Integrity: Architecture and Algorithm Design

Room: Windsong 5-6



Dr. Xiaolong Mi
The Hong Kong Polytechnic University



Dr. Richard Langley
University of New Brunswick

8:35 Fast-PPP Performance Under Different SSR Product Providers: Orbit, Clock, and Bias Coherence in the IONO4HAS CPF: J. Sanz, J. M. Juan, C. C. Timote, A. Rovira, A. Aragón-Angel, G. Gonzàlez-Casado, Universitat Politècnica de Catalunya; R. Orús-Pérez, European Space Agency; I. Fernández-Hernández, T. Willems, European Commission

8:57 A Spatio-Temporal Stochastic Model for Ionosphere-Weighted GNSS Positioning in Low-Latitude Regions: X. Chen, The Hong Kong Polytechnic University & Chinese Academy of Sciences (CAS); X. Mi, W. Chen, The Hong Kong Polytechnic University; Y. Yuan, H. Xu, CAS

9:20 Integrity Monitoring of SSR Services for a Dual Automotive and Rail Augmentation Network: M. Cardone, Italian Space Agency; A. Neri, A. Vennarini, A. Persia, V. Ioannucci, F. Rispoli, Radiolabs

9:43 Advancing High Precision GNSS Positioning Through Incremental Factor Graph Optimization for PPP and RTK: T. Dome, M. Ortiz Rejon, Y. Zheng, E. Benedetti, GMV; M. Sun, I. Petrunin, Cranfield University

10:05-10:35, Break. Refreshments in Exhibit Hall

10:40 Enhancing RTK Ambiguity Resolution in Urban Environments Using TD-CMC Screening: J. Lee, D. Gerbeth, M. Caamano, C. Zhu, German Aerospace Center (DLR)

11:03 Receiver Placement and Number Selection of Ground-Based Integrity Monitor Via Convex Optimization: Y-F. Lai, J. Blanch, T. Walter, Stanford University

11:26 FT-Transformer-Based Ambiguity Validation in PPP-AR with Probabilistic Reliability Evaluation: D. Wuran, N. El-Sheimy, H. Yang, University of Calgary

11:48 Satellite Based OSR Augmentation Service: HN-RTK Using Spherical Cap Harmonics Analysis: S. Kim, Y. Jo, Y. Lee, B. Park, Sejong University; C. Lim, LIG Nex1

Alternates

1. **Coordination of Ground-to-Space Reference Networks for High-Precision GNSS:** X. X. Zheng, King Abdullah University of Science and Technology (KAUST); X. Liu, J. A. López-Salcedo, G. Seco-Granados, Universitat Autònoma de Barcelona (UAB), Institut d' Estudis Espacials de Catalunya; T. Y. Al-Naffouri, KAUST
2. **Achieving Centimeter-Level Accuracy in a Novel Real-Time On-Board LEO POD Framework:** A. Chilakapati, A. Patil, L. Kabdal, VyomIC; B.P. Dakshayani, Ex-ISRO

Session E3a: PANEL: PNT for Lunar Exploration

Room: Windsong 3-4 (8:30 a.m.–10:05 a.m)



Dr. Samuele Fantinato
Qascom

The expanding frontier of PNT beyond Earth. Experts will discuss architectures and technologies enabling reliable PNT in LEO through GEO and onward to lunar environments. Topics include cislunar navigation networks; lunar surface and orbital positioning concepts; interoperability with Earth-based GNSS; and integration of optical, radiometric, and crosslink techniques. The panel will explore challenges in timing synchronization, signal design, and interplanetary scalability, highlighting how extraterrestrial PNT capabilities are shaping the next era of space exploration and infrastructure.

Panel Members:

1. Joel Parker, NASA HQ
2. Dr. Grace Gao, Stanford University
3. Dr. Wouter Pelgrum, Blue Origin
4. Dr. Filippo Rodriguez, Telespazio
5. Dr. Masaya Murata, Japan Aerospace Exploration Agency

10:05-10:35, Break. Refreshments in Exhibit Hall

Session E3b: PANEL: Synergistic Services: Fusing PNT and Communications

Room: Windsong 3-4 (10:35 a.m.–12:15 p.m)



Dr. Todd Humphreys
The University of Texas at Austin



Dr. Florin Catalin Grec
European Space Agency

Positioning and timing services within existing wireless communications networks are becoming a vital component of modern PNT infrastructure. Leveraging large bandwidths and widespread deployment, these systems offer high-accuracy alternatives to traditional GNSS. LEO non-terrestrial networks (NTNs) are particularly promising for providing near-global, high-strength, wideband PNT signals. This panel will explore the fundamental tension at the heart of any joint PNT-communications system: PNT favors deterministic, low-entropy signals with high temporal coherence, while communications require randomized, high-entropy data for high throughput. Experts will discuss the present reality and future promise of integrated communications and PNT systems, including techniques to optimize one service while meeting minimum operational requirements for the other. Discussions will span system design, waveform development, resilience to GNSS outages, and spectrum-sharing policies.

Panel Members:

1. Francesco Grilli, Qualcomm
2. Dr. Vijitha Weerackody, Johns Hopkins Laboratory
3. Logan Scott, LS Consulting
4. Dr. Alison Brown, Navsys Corporation

Session F3: Resilient and Secure PNT Against Interference and Emerging Threats 2

Room:Windsong 11-12



Dr. Richard Hartnett
US Coast Guard Academy



Dr. Heidi Kuusniemi
Tampere University

8:35 Geometry and Time Constraints Against Spoofing: Extended Validation and Model Enhancements: I. Fernandez-Hernandez, European Commission; C. O'Driscoll, Independent Consultant; J. Winkel, Independent Consultant; T. Willems, European Commission Advisor; A. Galan-Figueras, ESAT

8:57 Validating Galileo SAS Range Authentication and Positioning with Live Signal-in-Space: R. Terris-Gallego, Ò. Sarda-Martin, E. Takiguchi-Medina, J. A. López-Salcedo, G. Seco-Granados, Univ. Autonoma de Barcelona/IEEC; A. Galan-Figueras, KUL; I. Fernandez-Hernandez, DG DEFIS, European Commission

9:20 Field-to-Lab Validation of 3D Interference Modeling for GNSS CRPA in NAVWAR Environments: M. Gomez-Lopez, R. Verdeguer Moreno, J. Arribas Lázaro, Instituto Nacional de Tecnica Aeroespacial

9:43 Influence of a Three-Null, Low-Power, Dual-Band Analog CRPA on GNSS Measurements and Positioning: B. Adu, J. Lin, A-S. Abubakari, S. Sasani, S. Bisnath, York University; I. Goode, J. Silliker, Calian GNSS Ltd.

10:05-10:35, Break. Refreshments in Exhibit Hall

10:40 Performance Characterization of Pulsar's Software-Defined Watermark Verifier: J. Anderson and K. Gunning, Xona Space Systems

11:03 Simultaneous TDOA Localization of Distributed Russian GNSS Interference Emitters: B. Gattis, T. Schmitz, E. Gattis, University of Colorado Boulder; J. Cydejko, Gdynia Maritime University; D. Akos, University of Colorado Boulder

11:26 Trajectory-Based Navigation Vulnerability Index (NVI) for GNSS Jamming Impact Assessment: A. Elsayem, Royal Military College of Canada; M. Karaim, University of Zawia; H. Elghamrawy, Royal Military College of Canada; A. Noureldin, Royal Military College of Canada and Queen's University

11:48 Multi-Domain Framework for GNSS Interference Corroboration and PNT Integrity Assessment: S. Park and P-W. Son, Chungbuk National University

Alternates

1. **Design and Implementation of a Nationwide Open PPP-RTK Correction Message Authentication Service: QZSS CLAS CMA in the QZSS Signal Authentication Service:** T. Yamada, Mitsubishi Electric Corporation; T. Kuwazawa, Mitsubishi Electric Engineering; Y. Hatanaka, M. Miya, S. Fujita, and R. Hirokawa, Mitsubishi Electric Corporation
2. **A Multi-Layer LEO-Aided GNSS Spoofing Detection Method Based on Differential Doppler Inconsistency:** C. Kalmeijer, A. El-Mowafy, A. Allahvirdi-Zadeh, Curtin University
3. **An Intersection-Union Test for Common-Mode C/N0 Drop Detection in a Self-Calibrating GNSS Jamming Monitor:** N. Lum, S. Malani, and M. Joerger, Virginia Tech

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Session A4: High Accuracy Positioning and Correction for Mass Market Devices

Room: Windsong 1-2



Dr. Etienne Favey
u-blox AG



Xifeng Wen
Fugro Norway AS

1:50 Systematic Measurement-Level Assessment of Smartphone GNSS Quality Across Generations: Signal Tracking, Carrier Phase Stability, and Code Multipath Analysis: H. Sharma, D. Dötterböck, T. Pany, University of Bundeswehr Munich

2:12 1.3cm Single-Epoch Ranging from a Standalone Galileo Receiver via Network-Free Narrowlane Resolution: J. Sully, Phasar Labs

2:35 MADOCA-PPP-AR with Multi-Frequency, Multi-Constellation and Ionosphere Correction: H. Araki, M. Suetake, K. Terao, M. Mogamiya, T. Yamamoto, CORE Corporation

2:58 StarCourse: Precise AGNSS and Ionosphere Corrections for Mass-Market Devices: A. Boda, S. Vana, V. Bellad, P. Passos Jr., R. Adamski, R. Chou, H. Wewala, Rx Networks

3:25 - 3:55, Break. Refreshments in Exhibit Hall

4:00 Scalable High-Performance PPP-RTK with Precise Coordinate Transformation: A. Goss, M. Rexer, S. Blatt, C. Rodriguez-Solano, U. Weinbach, M. Brandl, N. Reussner, X. Chen, Trimble Inc.

4:23 Real-Time SSR to OSR Processing on Device for GNSS Applications: S. Vana, H. Wewala, N. Valentine, R. Adamski, A. Boda and V. Bellad, Rx Networks

4:46 Precise+®: Supercorrelation® for Precise GNSS Positioning in Deep-Urban Environments: J. Gonzalo Garcia, H. Mwenegoha, O. Kurt, H. Eriksson-Martin, C. Higgins, J. Latham, D. Jamal, S. Gibbs, M. Crockett, S. Mole, J. Ellis-Gray, M. del Castillo, Focal Point Positioning

5:08 High Accuracy Service Proposals for Galileo Second Generation: J. Miguez, F. De Oliveira Salgueiro, V. Lucas-Sabola, J.V. Perello-Gisbert, R.Orus-Perez, J. A. Garcia-Molina, S. Wallner, G. Lopez-Risueño, European Space Agency ESTEC; I. Fernandez-Hernandez, European Commission

Alternates

1. **Competitive Analysis of Precise Point Positioning with Galileo High Accuracy Service:** A. Ferreira, M. Orejas, K. Y. Kouedjin, J. Viana, Carlson Software Inc.
2. **Bringing Galileo EWSS to End Users with a Mass-Market Smartphone App:** P. Novell, M. Brêthes, C. Archibald, EUSPA; D. del Valle, G. Alonso, J. D. Calle, F. J. Sobrero, GMV; G. Nardone, KINETON

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Session B4a: PANEL: CRPA in Civil Aviation

Room: Windsong 3-4 (1:45 p.m.–3:25 p.m.)



Sandy Kennedy
Hexagon



Dr. Murat Efe
Tualcom

GNSS antennas are significant contributors to GNSS aviation positioning performance, in benign RF conditions and especially in contested conditions. The increasing presence of intentional and unintentional RF interference (RFI) is threatening flight safety globally. Controlled Radiation Pattern Antenna (CRPA) technology has been commonly employed to increase GNSS resiliency against RFI; however, export regulations have complicated the adoption of CPRA technology in civil aviation. Following the relaxing of US ITAR restrictions on CRPAs in September 2025, this panel of experts from industry and academia will discuss the benefits and challenges of deploying CRPA technology in aviation.

Panel Members:

1. Dr. Sai Kalyanaraman, Collins Aerospace
2. Tim Murphy, Boeing Commercial Airplanes
3. Dr. Mirko Stanisak, Aerodata AG
4. Dr. Michael Meurer, German Aerospace Center (DLR)

3:25 - 3:55, Break. Refreshments in Exhibit Hall

Session B4b: PANEL: Complementary PNT - Resilient Navigation to Support Global PNT Requirements

Room: Windsong 3-4 (3:55 p.m.–5:30 p.m.)



Michael McDowell
Collins Aerospace

Aviation depends on GNSS, but it is increasingly under threat. DME and inertial are already available as backups, but newer technologies offer more promise. What is the flight plan to the future for alternative and complementary position and navigation for aviation?

Panel Members:

1. Captain Bülent Atas, Turkish Airlines
2. John Barry, Federal Aviation Administration Certification & RTCA SC-227
3. Paolo Lunardi, Thales DME Expert
4. Erik Ringnes, Honeywell Aerospace

Session C4: Fielding Alternative Technologies in GNSS-Denied Environments 2

Room: Windsong 9-10



Dr. Samer Khanafseh
Illinois Institute of Technology



Dr. John Janeski
The Aerospace Corporation

1:50 Online Camera-LiDAR Extrinsic Calibration Using Planar Landmark Detection for GNSS-Denied Navigation: T. W. Moleski, J. P. Wilhelm, Ohio University

2:12 Vision-Based 3D Map Matching with Tight Integration of Vision/Radar/INS/GNSS for Positioning Autonomous Systems: I. Popov, D. Krupity, N. Giustini, P. Nooralishahi, G. Virbalis, J. Georgy, and C. Goodall, Trusted Positioning Inc, a TDK Group Company

2:35 Empirical Modeling of Non-Holonomic Constraint Errors for Land Vehicle Navigation H. Kinatas and M. Joerger, Virginia Tech

2:58 Self-Referenced Geometric Consistency Monitoring for Multi-Antenna Air Platforms: T. Becker, Independent Researcher

3:25 - 3:55, Break. Refreshments in Exhibit Hall

4:00 Assessing Quantum Inertial Sensors in Realistic Navigation Contexts Through Simulation and Modelling: O. Towlson, T. Gorrell, N. Boreham, S. Chamberlin, N. Aslam, M. Pattinson, GMV; C. Gilliam, A. Seedat, M. Holynski, S. Lellouch, University of Birmingham

4:23 Quantum Inertial Navigation Drift Correction Using Self-Attentive Long Short-Term Memory Neural Networks: A. Sanfilippo, S. Analysis Technology, LLC; D. Baken, Shield Analysis Technology, LLC

4:46 Railway Localization with Magnetic Field Distortions: Calibration, Sensor Fusion, and Evaluation: B.n Siebler, A. Lehner, B. Merk, S. Sand, German Aerospace Center (DLR); U. D. Hanebeck, Karlsruhe Institute of Technology

5:08 Leveraging VOR for RNP Departures: O. Osechas, ZHAW; V. Gordo, INECO; P. Swaszek, University of Rhode Island; R. Hartnett, Coast Guard Academy

Alternates

1. **RADIOBEACON – A Metropolitan Beacon System:** A. Dalla Chiara, F. Pattaro, F. Bernardi, M. Fregolent, N. Montini, M. Rotoloni, A. Sentelli, Qascom; G. Incerti, A. Mattioni, M. Leopardi, RINA Consulting; M. Cardone, F. Lotti, Agenzia Spaziale Italiana
2. **UUV-NAV: The New ASI Project for the Localization of Underwater Vehicles:** M. Cardone and F. Lotti, ASI, Agenzia Spaziale Italiana

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Session D4: Multi-Sensor PNT Optimization: Algorithms for Efficiency and Trustworthiness

Room: Windsong 5-6



Dr. Young-Hee Lee
German Aerospace Center (DLR)



Dr. Jeremy Vezinet
ENAC

1:50 Conformal Prediction for Statistically Controlled Perception Risk in Semantic Segmentation for GNSS-Integrated Navigation Systems: S. Gopalakrishnan, L. Ordonez, and A. Mohanty, Harvey Mudd College

2:12 GVG-SLAM: GNSS/VGGT-SLAM Integrated Navigation Method for Outdoor Environments: D. Wuran, F. C. Braga, S. Uprety, N. El-Sheimy, H. Yang, University of Calgary

2:35 The Kidnapped UAV Problem: Self-Supervised Detection and Recovery of Localization Failures for GNSS-Denied Navigation: Z. Deng and L. Sentis, The University of Texas at Austin, AIVE AI Systems

2:58 Uncertainty Analysis and Realistic Validation of Landmark-Based Visual Navigation for Urban Air Mobility: Y-H. Lee, C. Zhu, and J. Giedl, German Aerospace Center (DLR)

3:25 - 3:55, Break. Refreshments in Exhibit Hall

4:00 Adaptive Partial State Updates for MagNav Based on Map Uncertainty: B. Blakely and A. Nielsen, Air Force Institute of Technology

4:23 Enhanced INS/GNSS State Estimation Using GNSS-Based Acceleration Measurements: G. Versano and I. Klein, University of Haifa

4:46 Observability-Constrained Optical Flow-Inertial Navigation for Consistent State Estimation: H. Lee, J. Park, H. Lee, S. Lee, Y. Kim, and H. Bang, Korea Advanced Institute of Science and Technology

5:08 Evaluating MEMS IMU Tiers with LiDAR Odometry and Advanced State Estimation in GNSS-Degraded Environments: A. Clare, Trimble and University of Calgary; K. O'Keefe, University of Calgary

Session E4: Remote Sensing, Timing, Space and Scientific Applications

Room: Windsong 11-12



Dr. Seebany Datta-Barua
Illinois Institute of Technology



Dr. Tara Mina
Georgia Institute of Technology

1:50 ESA Scout HydroGNSS Reflectometry Mission – Initial Commissioning Results: J. Rawlinson, M. Unwin, P. Garner, R. de Vos Van Steenwijk, Surrey Satellite Technology Ltd.; J-P. Lejault, M. Pastena, M. P. Clarizia, European Space Agency; N. Pierdicca, Sapienza, University of Rome; E. Cardellach, Institut d'Estudis Espacials de Catalunya, Institute of Space Sciences (ICE-CSIC)

2:12 Assessment of Spatial and Temporal Averaging Impacts on GNSS Reflectometry TEC Retrieval: A Simulation Study: J. Huang, B. Breitsch, and Y. J. Morton, University of Colorado Boulder

2:35 3D Ray Tracing Analysis of Residual Ionospheric Errors in GNSS RO Bending Angles for a Non-Spherically Symmetric Ionosphere Using IRI-2020: J. Chang, J. Lee, Korea Advanced Institute of Science and Technology; S. Sokolovskiy, Z. Zeng, J. Braun, University Corporation for Atmospheric Research

2:58 Evaluation of Ground-Based Navigation Performance Due to LEO Satellite State Errors: K. Shively and D. M. Bevly, Auburn University

3:25 - 3:55, Break. Refreshments in Exhibit Hall

4:00 Evolution of GNSS Receiver Architecture for Extended Space Mission Profiles: M. Wis, A. Fernandez, R. Prata, A. Cardeósa, S. Garcia, J. Silva, and J. Cobos, INDRA Space

4:23 Sidelobe vs. Side of Main Lobe: GNSS Signal Reception and Filtering Using LuGRE Experiment Data: M. Kura, K. Iiyama, and G. Gao, Stanford University

4:46 Precise Orbit Determination for a Spaceborne Optical Clock Experiment: Y. Kim, M. Dobbin, D. Scheeres, P. Axelrad, University of Colorado Boulder

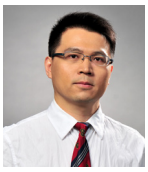
5:08 Towards Operational GNSS Integrity for Autonomous LEO Navigation: Cross-Mission Experimental Results from the ISCO Project: J. García Espinosa, GMV Aerospace and Defence SAU; D. Forte, GMV UK LTD; G. Moreno López, M. Fernández Usón, GMV Aerospace and Defence SAU; J. D. McHugh, GMV UK LTD; J. Fernández Sánchez, D. Ramírez Rodríguez, GMV Aerospace and Defence SAU; J. E. Martínez Esmeral, GMV UK LTD; A. Groth, GMV Innovating Solutions Sp. z o.o; M. Manzano Jurado, GMV Aerospace and Defence SAU; F. De Oliveira Salgueiro, European Space Agency

Session F4: Resilient and Secure PNT Against Interference and Emerging Threats 3

Room:Windsong 7-8



Katrin Dietmayer
Fraunhofer Institute (IIS)



Dr. Xin Chen
Shanghai Jiao Tong University

1:50 Alternative PNT in GNSS-Denied Environments: A Flexible, COTS SDR System for Monitoring and Navigation: F. Taylor III, J. Spagnolli, B. Gattis, and D. Akos, University of Colorado Boulder

2:12 Global Navigation Satellite System Interference in the Baltic States During 2023-2025: J. M. Juul, Tallinn University of Technology; A. Venables, R. Ottis, Tallinn University of Technology; A. Roberts, and, P. Papadimitratos, KTH Royal Institute of Technology

2:35 AIS-GNSS Fusion for Maritime Fairway Integrity Under Jamming and Spoofing: H. Kuusniemi, Tampere University, Finnish Geospatial Research Institute, National Land Survey; S. S. Vemuri, Tampere University

2:58 Galileo SAS Performance Specification and Characterization: B. Motella, S. Damy, Joint Research Centre, European Commission; A. Grenier, OpenGNSS; J. Simon, T. Rodriguez, J. Gáñez Fernandez, EU Agency for the Space Programme (EUSPA); I. Fernandez-Hernandez, European Commission DG DEFIS; C. O'Driscoll, Independent Consultant

3:25 - 3:55, Break. Refreshments in Exhibit Hall

4:00 Complexity-Scalable Direct Geolocation and Cancellation of Terrestrial GNSS Jammers: Single-Satellite and Multi-Antenna Experiments in Low Earth Orbit: G. Pojani, J. Tegedor, J. Fortuny-Guasch, F. Menzione, European Commission, Joint Research Centre; D. Evans, T. Oerther, European Space Agency; M. Henkel, Technical University of Graz; J. S. Lindbjør, Testnor

4:23 Bearing Estimation of CW GNSS Interference Using a Two Element Coherent Receiver: P. Graham, J. Yeluri, F. Taylor, D. Akos, University of Colorado; Y-H. Chen, S. Lo, Stanford University

4:46 Blind Spoofing Detection and Jamming Mitigation for Resilient GNSS Array Receivers: T. Bamberg, German Aerospace Center (DLR); M. Brachvogel, M. Meurer, DLR & RWTH Aachen University

5:08 From Jammertest to Field Deployment: ASPIS as a Scalable GNSS Anti-Spoofing Solution Across Security and Safety Use Cases: F. Gottifredi, J. Locantore, A. Basciu, S. Manzoni, WAY4WARD

40th Anniversary Trivia Night

Celebrate 40 Years of ION GNSS+

Thursday, September 17

5:30 p.m.–8:30 p.m. | Regency Hall

GET YOUR PHONE READY FOR TRIVIA NIGHT!

Scan the QR code to download the SpeedQuizzing app.
Game play instructions will be provided at Trivia night.

Test your GNSS knowledge | Celebrate the community | Win bragging rights

Session A5: Future Augmentation Systems, Correction Services, and Integrity

Room: Windsong 1-2



Dr. Adria Rovira
Universitat Politecnica Catalunya



Dr. Santiago Perea
European Space Agency

8:35 MultilaYer LEO Extended GNSS (MYLE-GNSS): An End-to-End Simulator for Multi-Service Integrity Analysis: H. Engwerda, Royal Netherlands Aerospace Centre; L. Massarweh, Delft University of Technology; M. Sgammini, F. Menzione, J. P. Boyero, European Commission – Joint Research Centre; J. Casals Sadlier, Royal Netherlands Aerospace Centre

8:57 Assessment of Cyber-Secure GBAS Using Adaptive Beamforming in the Presence of Interference: D. Gerbeth, M. Caamano, German Aerospace Center (DLR)

9:20 From Simulation to Flight: H-ARAIM Availability and Integrity Performance Assessment: E. Domínguez-Tijero, A. Sararu, P. Dinda, R-A-M. Prefac, GMV; J. Tabacek, T. Vaispacher, M. Kucera, Honeywell; N. Blanco Delgado, E. Canestri, EUSPA

9:43 Experimental Validation of a High-Integrity Surface Navigation Architecture for Unmanned Aircraft Systems: D. J. Larimer, K. Ghasemian, S. Khanafseh, K. Nagai, Illinois Institute of Technology; R. Mcknight, S. Ugazio, Ohio University; B. Pervan, Illinois Institute of Technology

10:05-10:35, Break
Refreshments served outside of session rooms

10:40 HASIC: Enabling Integrity for High Accuracy Services Across Galileo and EGNOS Infrastructures: A. González, P.F. Navarro, D. Gutierrez, J.C. Lopez, I. Rodriguez, GMV, Spain

11:03 End-to-End Demonstration of Xona's GNSS Correction Service: W. De Wilde, S. De Bast, J-M. Sleewaegen, F. Hernalsteen, Hexagon/Septentrio; A. Pant, S. Tantry, K. Urrutia Avila, K. Gunning, T. Marathe, Xona Space Systems; M. Z. H. Bhuiyan, M. Liaquat, Finnish Geospatial Research Institute

11:26 Development, Operation, and Performance Evaluation of QZSS MADOCA-PPP Toward Multi-GNSS and Multi-Frequency High-Accuracy Positioning: T. Ito, M. Kato, H. Maeda, Lighthouse Technology and Consulting Co., Ltd.; Y. Sakai, R. Itabashi, M. Kishimoto, National Space Policy Secretariat QZSS Strategy Office, Cabinet Office, Government of Japan

11:48 Gaussian Mixture Model (GMM) Overbounding of Time-Correlated Noise in Kalman Filtering: S. Wang and M. Joerger, Virginia Tech

Alternate

1. **A Modified Compact SSR Format for Improved Bandwidth Efficiency Using Common Inter-Frequency Phase Bias (IFPB):** Y. Lee, Y. Jo, S. Kim, B. Park, Sejong University

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Session B5a: GNSS Modernization and Market Trends: From Aviation, Railway, and Maritime to Urban Air Mobility and Autonomous Systems

Room: Windsong 7-8 (8:30 a.m.–10:05 a.m.)



Matt Harris
Reliable Robotics



Irma Rodríguez Pérez
GMV

8:35 Galileo System Performance Towards Full Operational Capability: M.-S. Circiu, G. Galluzzo, A. Lemke, S. Wallner, J. Hahn, European Space Agency; M. Caparrini, J. de Blas, EUSPA; E. Lopez, A. Lobit, C. Serrano, GMV; M. Odriozola, A. Nuckelt, M. Lang, S. Schloetzer, Airbus Defence and Space

8:57 The New Galileo Quasi-Pilot Signals: Introduction on First Generation Galileo Satellites and Outlook to Galileo 2nd Generation Quasi-Pilot: G. Molineaux, S. Wallner, J. Hahn, J.A. Garcia-Molina, G. Lopez-Risueno, C. Vasquez Alocen, ESA; M. Caparrini, M. Lopez-Martinez, EUSPA; EC-JRC: M. Paonni, EC-JRC; F. Formaggio, G. Houot, Airbus Defence and Space

9:20 A Regulator-Ready Validation Framework for User-Segment GNSS Error Models in Rail and Maritime Integrity Applications (EU-funded ENTICE Project): S. P. Ilamparithi, F. Mistrapau, G. Moreno López, C. G. Ciobanu, GMV; C. Ettore, N. Blando Delgado, EUSPA

9:43 Use of EU Space Data for Automated Navigation in Inland Waterways: Prototype Implementation and First Pilots´ Results: H. Llorca, M. López, A. Sánchez, M. Cueto, F. Buendía, O. Dutta, F. Mistrapau, GMV; D. Karbach, WSV; Y. Hacha, TRESCO; F. Bethke, BM; C. Hargitai, HAC; G. Mezo, RSOE; C. Aguilera, EUSPA; M. Wolska, European Commission

10:05-10:35, Break
Refreshments served outside of session rooms

Alternates

1. **Bridging the Gaps: Extending Protection Level Availability via Sensor Fusion on Low-Cost Platforms:** A. Copeland, D. Ayres-Sampaio, R. El Khayat, M. Maruthi, J. Traugott, Trimble
2. **Meta-Signal Processing Using Second Generation Galileo Signals:** C. Gioia, M. Paonni, A. Piccolo, European Commission Joint Research Centre; O. Julien, A. Consult, Advisor to the European Commission; S. Wallner, European Space Agency; M. Ceccato, Quascom Aerospace and Defence; F. Formaggio, Airbus

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Session B5b: Safety Assurance of AI-Enhanced PNT Systems for Autonomous Platforms

Room: Windsong 7-8 (10:35 a.m.–12:15 p.m.)



Dr. Jason Rife
Tufts University



Dr. Ilaria Martini
Leonardo

10:40 Explainable AI for Safety of Life Applications in GNSS: S. Bernhardt, German Aerospace Center (DLR) Galileo Competence Center; M. Caamano, DLR; H. Shiraishi, Hitachi, Ltd.; M. Heider, University of Augsburg

11:03 Machine Learning-Augmented Gaussian Overbounding and its Application to GNSS Multipath Error Modeling: T. Wang, S. Wang, J. Wang, and X. Zhan, Shanghai Jiao Tong University

11:26 Error Modeling for Vision-Based Positioning on Feature-Sparse, Flat Terrain: D. Choate and J. Rife, Tufts University

11:48 AI Enhanced GNSS Quality Classification to Improve the Accuracy and Reliability of Autonomous Vehicle Navigation: P. Nooralishahi, D. Krupity, N. Giustini, C. Cathcart, L. Paudel, M. Y. Koopaei, J. Georgy, C. Goodall, Trusted Positioning Inc, a TDK Group Company

Alternates

1. **AI-Enhanced Detection, Localization, and Vulnerability Assessment of Jamming and Spoofing for Safety-Critical Users:** P. Tanyà, A. González, R. Herrera, M. Gómez, GMV Aerospace and Defence
2. **TruTrack: An Integrated AI and Sensor Fusion System Platform for High-Reliability Vehicle Tracking Intelligence:** S. Shah, D. Shah, D. Dalal, A. Jadav, V. Javeri, National Institute of Technology

Session C5: Precise, Secure Timing and Time Transfer

Room: Windsong 9-10



Stephen Mitchell
Johns Hopkins APL



Laura Agazzi
German Aerospace Center (DLR)

8:35 Complete System Validation of Optical Fiber-Assisted Galileo Timing Service Monitoring in the G2STB: F. J. Sobrero, A. Leiro, A. J. García, C. García GMV; E. Strazzer, N. Rana, D. Coulibaly, Thales Alenia Space; G. Galluzzo, B. Quaranta, S. Perea, C. Plantard, European Space Agency; E. Dierikx, Y. Xie, VSL

8:57 Adopting a Non-GNSS Architecture for LEO-PNT Systems: Developing More Resilient Systems Through a Multi-Tiered Approach: J. Critchley-Marrows, T. Shibukawa, N. Sakamoto, V. Nery, K. Kakihara, T. Yasuda, T. Ono, T. Takasu, ArkEdge Space; E. Galletti, M. Murata, S. Kogure, Japan Aerospace Exploration Agency

9:20 Algorithm and Firmware Development on a Modular Time Generating Unit for a GNSS-Resilient UTC Realization: M. J. Coleman, US Naval Research Laboratory; D. B. Squires, Brandywine Communications, Inc.

9:43 Resilient Intelligent Mesh as a GNSS-Alternate for Robust PNT: T. N. Bandi, S. Dasgupta, J. Verma, A. Alsharif, A. Hauser, P. Kung, and M. Rahman, University of Alabama

10:05-10:35, Break
Refreshments outside of session rooms

10:40 Assessing TWSTFT Resilience to RF Interference Using a Geostationary-Satellite Link Simulator: A. M. Osman, Oak Ridge National Laboratory

11:03 Time Transfer Using Xona Pulsar: First Results from In-Orbit Validation LEO Satellite: S. Tantry, T. Marathe, A. Pant, and T. Reid, Xona

11:26 Distributed Common-View Timing Using the OneWeb LEO Broadband Constellation: S. A. Negru, I. Petrunin, Cranfield University; R. Zuo, Eutelsat

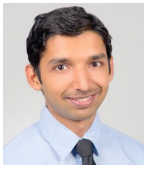
11:48 Improving GNSS Jamming and Spoofing Resilience Through Low SWaP-C Precision MEMS Timing: J. Nguyen, R. Rotstein, T. Hohman, SiTime

Alternates

1. **Sequential Separate Clock Drift Anomaly Detection Method for GNSS Time Synchronization Attack:** W. Li, M. Zhong, M. Lu, and H. Li, State Key Laboratory of Space Network and Communications, Tsinghua University
2. **Operational C-Band Ground-to-LEO Time Transfer with TrustPoint LEONS Using Commercial Hosted Signal Capture:** F. Ahmed, G. Schmitt, F. Ahenkora, and P. Shannon, TrustPoint, Inc.
3. **A Comparison of Kalman Filter Noise Models for PNT Clocks:** J. P. Coleman, B. E. Robertson, and D. N. Mavris, Georgia Tech Aerospace Systems Design Lab
4. **Enhancing Timing Solutions with Time Difference Carrier Phase:** C. Gioia, European Commission Joint Research Centre; G. Portelli, University of Naples Parthenope; A. Angrisano, Messina University; S. Troisi, S.e Gaglione, University of Naples Parthenope

Session D5: Atmospheric Modeling and Mitigation with GNSS and LEO-PNT Systems

Room: Windsong 5-6



Dr. Shrivathsan Narayanan
Collins Aerospace



Dr. Anthea Coster
MIT Haystack Observatory

8:35 Which GPS Signal Loses Lock Most Often During Scintillation: L1, L2C, or L5? A January 2026 Storm Case Study: A. K. Sun, B. Breitsch, Y. J. Morton, University of Colorado Boulder; W. Younas, Boston University; K. B. Deshpande, Embry-Riddle Aeronautical University

8:57 Identification of Dispersive GNSS Occultation Arcs Observed by LuGRE Along the Blue Ghost Mission 1 Trajectory: A. Minetto, F. Fiorina, L. Sciacca, S. Zocca, A. Nardin, F. Dovis, Politecnico di Torino; M. Guerra, R. Ghidoni, C. Cesaroni, Istituto Nazionale di Geofisica e Vulcanologia

9:20 Auroral Zone GNSS Scintillation Survey of Solar Maximum of Cycle 25: K. Ignasi Britto, A. English, and S. Datta-Barua, Illinois Institute of Technology

9:43 Applying Space Weather Information to GBAS: A Concept for Improved Availability: L. Marini-Pereira, M. Caamano, D. Gerbeth, V. Wilken, P. David, S. Bernhardt, German Aerospace Center (DLR)

10:05-10:35, Break.
Refreshments outside of session rooms

10:40 Enhancement of Outer-Grid Ionospheric Correction Using Adaptive k-NN Regression with the Obliquity Factor and DCB-Corrected Undifferenced STEC: Y-W. Jeon, Inha University; K-D. Park, Inha University & PPSOL Inc.

11:03 Ionospheric Scintillation Modeling for LEO-Transmitted Signals: Limits of the Parabolic Propagation Approximation: A. K. Sun, B. Breitsch, J. Morton, C. Rino, University of Colorado Boulder

11:26 Near-Real-Time Radio Backpropagation for Ionospheric Phase-Screen Retrieval from GNSS Scintillation Observations: R. Florindo, Aeronautics Institute of Technology (ITA), German Aerospace Center (DLR); R. Vasconcelos Pacelli, ITA, Federal University of Ceará (UFC); M. Kriegel, DLR; F. Antreich, ITA

11:48 MADOCA-PPP Assistance Method Using Ionospheric Delay Correction via FCNN: K. Achioku, M. Yamamoto, T. Egashira and Y. Kubo, Ritsumeikan University

Alternates

1. **Bootstrapped Tracking of LEO Satellite Signals for Opportunistic PNT and Space Weather Study:** C. Yang, QuNav, Y.T. J. Morton, H. Bourne, J. Li, S. Taylor, University of Colorado at Boulder; A. Soloviev, QuNav
2. **Giftet® 4-Parameter Ionospheric Channel Model: Part 2—Theory and Simulations:** I. F. Progri, Giftet Inc.

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Session E5: Beyond GNSS: LEO-Based and Terrestrial Signals of Opportunity for PNT 1

Room: Windsong 11-12



Dr. Andrew Sun
University of Colorado, Boulder



Dr. Flavia Causa
University of Naples, Federico II

8:35 Quantitative Performance Evaluation of LEO-Augmented PNT for UAS in Degraded GNSS Environments via High-Fidelity 3D Simulation: R. Verdeguer Moreno, R. Hart, Keysight Technologies; P. Tarantino, C. Dupuis, Xona Space Systems

8:57 Tracking of Starlink Doppler Shift and Code/Carrier Divergence Using Edge Pilots: M. L. Psiaki and J. R. Bowman, Virginia Tech

9:20 Beamforming Supported Iridium Doppler Observations for Opportunistic LEO Positioning: Experimental Evaluation and Performance Analysis: S. Bitterich, RWTH Aachen University; M. Brachvogel, RWTH Aachen University, Germany & German Aerospace Center (DLR); C. Oezmaden, M. Niestroj, RWTH Aachen University; M. Meurer, RWTH Aachen University & DLR

9:43 Mind the Beam: Starlink PNT Challenges and Mitigation Strategies: J. Saroufim, S. Hayek, and Z. M. Kassas, The Ohio State University

10:05-10:35, Break.
Refreshments outside of session rooms

10:40 Availability Enhancement by Orbital Altitude Adjustment for GNSS-Independent LEO PNT: M. Murata, E. Galletti, K. Akiyama, and S. Kogure, Japan Aerospace Exploration Agency

11:03 A Framework for Integrity-Ensured URA Generation in Dedicated LEO PNT Systems: D. Min, Sam Pullen, Stanford University; J. Do, J. Lee, Korea Advanced Institute of Science and Technology

11:26 ESA Celeste Programme Prospects and Results for First In-Orbit Demonstration Satellites: P. Giordano, N. BniLam, E. Breeuwer, F. Salgueiro, C. Vazquez, M. Cordero Limon, F-C. Grec, M. Anghileri, and R. Prieto Cerdeira, European Space Agency (ESA)/ESTEC; F. Gini, ESA/ESOC

11:48 Multi-Cell Acquisition and Tracking of 5G Signals for High-Altitude Opportunistic Navigation: F. Mooseli and Z. M. Kassas, The Ohio State University

Alternates

1. **GMV GSharp® FALCON for LEO Satellites: Accurate and Versatile RT-POD Software:** S. Camargo, J. González, L. Bravo, D. de la Calle, M. A. Ramírez, and A. Chamorro, GMV
2. **Path Integrals for Modeling the Ionosphere in LEO PNT:** J. Halfhill, Tufts University, Draper Scholar; J. Rife, Tufts University; S. Bermudez, Draper

Session F5a: PANEL: Emerging Scientific Use Cases for PNT Signals

Room:Windsong 3-4 (8:30 a.m.–10:05 a.m.)



Dr. Lucilla Alfonsi
INGV



Dr. Jade Morton
University of Colorado, Boulder

Emerging applications that leverage precise timing and location from geophysics, climate, and space weather monitoring to Earth observation, ionospheric science, and autonomous environmental sensing. Panelists will highlight how modern GNSS and alternative PNT sources (such as LEO and lunar constellations) are advancing data fidelity, synchronization, and global accessibility and share current research frontiers and future directions where PNT technologies underpin transformative science and interdisciplinary innovation.

Panel Members:

1. Dr. Fabio Dovis, Politecnico di Torino
2. Dr. David Mencin, EarthScope
3. Dr. Clara Chew, Muon Space
4. Dr. Seebany Datta-Barua, Illinois Institute of Technology

10:05-10:35, Break.
Refreshments outside of session rooms

Session F5b: PANEL: Navigation and Spatial Intelligence in Embodied AI

Room:Windsong 3-4 (10:35 a.m.–12:15 p.m.)



Dr. Michael Fu
HyperHit AI Inc.

Leading AI and navigation scientists to address the critical challenges facing navigation in embodied agents such as drones, humanoids, and quadrupeds. Effective autonomy is currently constrained by two key factors: the operation in perceptually-degraded environments (e.g., indoor, subterranean, dense canopy, low-light) and the strict size, weight, power, and cost (SWaP-C) limitations of onboard sensors and computation. We will dissect the most pressing open problems in navigation, mapping, and perception. The discussion will highlight recent advancements in: Vision-and-Language Navigation (VLN), AI-driven 3D Reconstruction, Reinforcement Learning, and Visual and Navigation Foundation Models. Furthermore, the panel will examine the evolving role of GNSS, its integration with other sensing modalities, and the strategies for achieving robust localization in signal-denied environments.

Panel Members:

1. Dr. Mainak Biswas, Qualcomm
2. Dr. Grace Gao, Stanford University
3. Dr. Li-Ta Hsu, The Hong Kong Polytechnic University

Kepler & Parkinson Awards Luncheon • 12:15 p.m.–1:30 p.m. | Grand Cypress Ballroom
Lunch served until 12:30 p.m.; late arrivals will not be served.
Vegetarian, vegan, and other special meals must have been ordered in advance at registration.

Session A6: Navigation in Challenging Environments with Mass Market Devices, Smartphones, and Wearables

Room: Windsong 1-2



Dr. Esther Anyaegbu
Spirent



Dr. Kirsten Strandjord
University of Minnesota

1:50 Building Model Renewal Based on GNSS Diffraction Features: A Feasibility Analysis: Y. Chen, D. Hai, and G. Zhang, The Hong Kong Polytechnic University

2:12 Enhanced FGO-Based Smartwatch Positioning with Cycle Slip Handling: X. He, Technische Universität Berlin; S. Nie, H. Yang, University of Calgary

2:35 Site-Dependent Urban GNSS Localization Using Smartphone NMEA-Derived SNR Maps: Y. Lee, Youngsu Cho, Electronics and Telecommunication Research Institute

2:58 Enhancing GNSS Positioning in Challenging Environments with Tightly-Coupled INS/GNSS Integration for Multi-Modal Vehicle Navigation: Y-E. Lu, G-J. Tsai, and S-Y. Li, S-X. Yang, AIROHA

3:25 Human Body Proximity Effects on Smartphone GNSS Positioning: Characterization and Mitigation: S. Nie, X. Wang, H. Yang, University of Calgary

3:48 Redefining Commercial RTK Accuracy, Availability, and Reliability: Competitive Field Validation of Carlson Software's Next-generation GNSS Smart Antenna in GNSS-Degraded Environments: J. Viana, J. Latova, Z. Kana, M. Sotak, J. Olofsson, A. Ferreira, A. Rocha, D. Fox, J. Raasakka, Carlson Software Inc.

4:10 Lane-Level Smartphone Navigation Using OSR/SSR-Assisted PPP-RTK with Carrier-Phase Processing on a Samsung Exynos Platform: Y-W. Ahn, J. Lee, R. Di, J-K. Lee, A. J. Jahromi, K. Li, S. Raman, J. Cui, Device Solutions America, Samsung Semiconductor Inc.

4:33 A New Solution for Bridging the Gap Between Field Capture and Lab Simulation for Ultra-Realism in PNT Testing: S. Smith, P. Hansen, and E. Anyaegbu, Keysight Technologies

Alternates

1. **OSNMA Mass-Market Receivers Performance in Urban Environments:** L. Musumeci, X. Otero, G. De Pasquale, E. Shytermeja, G. Caparra, European Space Agency
2. **Graph-Cut RANSAC for GNSS Outlier Detection in Urban Environments:** T. Kim, J. Yun, J. Park, B. Park, Sejong University

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Session B6: High-Precision GNSS Positioning with Integrity

Room: Windsong 9-10



Dr. Sunil Bisnath
York University



Rebecca Wang
Stanford University

1:50 Kalman Filter Innovation-Based Monitoring of Finite-Duration Multi-Measurement Faults: L. Carey, M. Marti, M. Joerger, Virginia Tech; S. Langel, MITRE

2:12 Integrity Monitoring of NRTK Corrections Against Station Faults and Atmospheric Modeling Uncertainty: W. Gai, X. Zhan, and Y. Zhai, Shanghai Jiao Tong University

2:35 Extending ARAIM to Incremental Smoothing-Based GNSS/IMU Fusion: Efficient Protection Level Computation via Rank Updates: J. Hu, X. Wang, and W. Wen, The Hong Kong Polytechnic University

2:58 Non-Stationary GNSS Code-Minus-Carrier Multipath Error Modeling Using Sliding Window: K. Ghasemian, K. Nagai, D. Larimer, S. Khanafseh, B. Pervan, Illinois Institute of Technology

3:25 Converged Atmospheric Estimates versus Corrections from PPP-RTK Server: Which and When to Trust?: J. Hu, X. Mi, The Hong Kong Polytechnic University; P. Li, Chang'an University; M. Ding, W. Chen, The Hong Kong Polytechnic University

3:48 Assessment of SouthPAN SBAS Early Open Services Using the GNSS Analysis Software: Ginan v4.1: S. McClusky, K. Harima, E. Du, R. Maj, S. Allgeyer, V. Rooke, A. Riddell, Geoscience Australia

4:10 Rapid Search for Ultra-Short Baseline Carrier Phase Ambiguities Using IMU Sensor: J. Xu, Quectel Wireless Solutions Co., Ltd.; Y. Wang, Hefei College Finance & Economics; H. Li, Anhui University; H. Zhang, Hefei College Finance & Economics

4:33 A Robust Cycle Slip Detection Algorithm for High-Precision Positioning During Ionospheric Disturbances in High Latitudes: Y. Lee, B. Park, Sejong University

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Session C6a: PANEL: PNT from LEO Satellites

Room: Windsong 3-4 (1:45 p.m.–3:20 p.m.)



Matteo Paonni
European Commission/JRC



Dr. Eldar Rubinov
FrontierSI

Industry, government, and academia explore how LEO constellations are reshaping PNT. Panelists will discuss dedicated and hybrid PNT payloads, integration with traditional GNSS and terrestrial networks, and emerging signal processing and security innovations. The session will examine constellation architectures, user applications, and system performance, highlighting benefits such as enhanced resilience, precision, and coverage. Attendees will gain insight into how LEO constellations, alone or combined with GNSS, dedicated or standalone systems, are enabling next-generation PNT services for autonomous systems, communications, and critical infrastructure.

Panel Members:

1. Dr. Tyler Reid, Xona
2. Patrick Shannon, TrustPoint
3. Dr. Roberto Prieto, European Space Agency
4. Eric Chatre, EU LEO-PNT European Commission
5. Dr. Masaya Murata, Japan Aerospace Exploration Agency (JAXA)
6. Sophie Kippen, ArkEdge
7. Kevin Rutankabandi, Wheere
8. Dr. Joshua Morales, StarNav
9. Dr. Ilaria Martini, Leonardo S.p.A.

Session C6b: PANEL: Status of GNSS

Room: Windsong 3-4 (3:25 p.m.–4:55 p.m.)



Dr. José Ángel Ávila Rodríguez
European Space Agency



Dr. Chris Hegarty
The MITRE Corporation

The latest and greatest from the constellation providers. Learn about what is new in Galileo and where GPS stands. What launches are coming up and which ones got canceled.

Panel Members:

1. **GPS:** Col Neil B. Barnas, USSF, Commander & SPD, System Delta 831 US Space Force
2. **Galileo:** Eric Châtre, Head of EU GNSS Exploitation and Evolution, European Commission and Miguel Manteiga, Galileo Project Manager, European Space Agency
3. **QZSS:** Motohisa Kishimoto, Senior Coordinator, QZSS Strategy Office, National Space Policy Secretariat, Cabinet Office 5
4. **KPS:** Dr. Byoung-Sun Lee, Programme Director at KASA, Korea AeroSpace Administration
5. **BeiDou:** Dr. Xiaochun Lu, International Cooperation Center of China Satellite Navigation Office

Session D6: Advanced Receiver Design for GNSS: New Architectures, and Multipath Mitigation

Room: Windsong 11-12



Dr. Gregor Möller
Vienna University of Technology



Dr. Kana Nagai
Illinois Institute of Technology

1:50 Pseudolite at its Finest: Comprehensive Performance Report of uGPS, GNSS Signal Generation in an Active Tunnel: A. Khudoyberdiev, H. Kim, J. Ryoo, The State University of New York, Korea Department of Computer Science, Stony Brook University

2:12 Performance Evaluation of a 3D-Printed Luneburg Lens Antenna for Enhanced GNSS Signal Reception: D. Gómez-Casco, N. BniLam, B. Wadsworth, X. Otero Villamide, P. Crosta, European Space Agency

2:35 Multi-Channel and Multi-Frequency Software-Defined Satnav Receiver Front-End for Array-Based Precision Multi-Constellation Signal Integrity Monitoring Applications: E. McKnight, L. Reich, and Sanjeev Gunawardena, Air Force Institute of Technology

2:58 Pseudorange and Carrier Phase Estimation from Intermittent Open-Loop GNSS Observations: J. Xu, B. Breitsch, Y. J. Morton, University of Colorado Boulder

3:25 Bayesian Direct Position Estimation for GNSS Urban Positioning: S. Vicenzo, C. L. Tsang, B. Xu, The Hong Kong Polytechnic University; P. Closas, Northeastern University

3:48 Efficient Processing Multipath Detection Using L5 Signals for 3DMA-Based Machine Learning Algorithms: N. I. Ziedan, Zagazig University

4:10 Performance Comparison of GPS L1C Multipath Mitigation Using Correlation Processing Techniques: K. Seals, U.S. Coast Guard Academy

4:33 GNSS Pilot-Signal Tracking Under Wideband Jamming with Deeply Integrated INS: K. Nagai, S. Khanafseh, B. Pervan, Illinois Institute of Technology

Session E6: Beyond GNSS: LEO-Based and Terrestrial Signals of Opportunity for PNT 2

Room: Windsong 5-6



Pietro Giordano
European Space Agency



Joanna Halfhill
Tufts University

1:50 Doppler-RTT Fusion Positioning Technique Using a Single LEO Satellite for Fast Position Convergence in Emergency Scenarios: W. Park, B. Park, Sejong University, South Korea

2:12 Comparative Analysis of Different Doppler Positioning Algorithms with LEO and MEO Constellations: A. Angrisano, Messina University; S. Gaglione, University of Naples Parthenope; C. Gioia, F. Menzione, A. Piccolo, European Commission Joint Research Centre

2:35 Capabilities and Analysis of Multi-Layer Vector Tracking with LEO-Expanded GNSS Constellations: N. Redding and S. Martin, Auburn University

2:58 Impact of Correction Latency and Oscillator Quality on Differential LEO-PNT Systems: Q. Bader, Queen's University; A. Noureldin, Royal Military College of Canada and Queen's University

3:25 Successfully Using Pseudo-Bearings in Alternative Positioning Systems: P. Swaszek; R. Hartnett, US Coast Guard Academy; O. Osechas, Zurich University of Applied Sciences

3:48 Insights on Doppler-Based Positioning with a Single LEO Satellite and Experimental Validation: Q. Liu, M. Fernández-Temprado, A. Reus-Bergas, Universitat Autònoma de Barcelona (UAB), CERES, IEEC; M. Meneses, D. García, E. Domínguez, F. A. Pinto, F. J. Mata, J. Fidalgo, GMV; G. Seco-Granados J. A. López-Salcedo, UAB, CERES, IEEC

4:10 Improving Low Altitude Navigation with LEO PNT and Multi-Drone Cooperation: F. Causa, G. Fasano, University of Naples Federico II; A. Piccolo, F. Menzione, Joint Research Center

4:33 Pulsar Constellation Evolution and PPP Convergence Using LEO GNSS: C. Mah, T. Marathe, A. Vishwanath, M. Gala, T. G. R. Reid, Xona

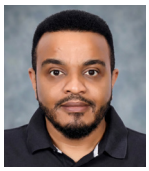
Alternates

1. **Real-Data Analysis of Latitude-Dependent Satellite Geometry Effects on Doppler-Based GNSS Positioning and Pseudorange–Doppler Integration:** H-Y. Choi, Inha University; K-D. Park, Inha University & PPSOL Inc.
2. **Localizing the Position of LTE Transmitters for SOP Navigation:** I. Braaten, K. Strandjord and D. Gebre-Egziabher, University of Minnesota
3. **Evaluation of 5G-R PRS for Train Localization in Railway Constrained Environments:** C. Zhou, D. Lu, B. Cai, J. Wang, J. Liu, W. Jiang, B. Sun, Beijing Jiaotong University; W. Wang, ZTE Corporation; X. Chen, Nantong University

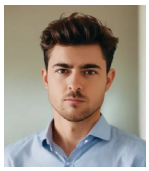
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Session F6a: Open-Source Data and Tools for PNT Research and Development

Room:Windsong 7-8 (1:45 p.m.–3:20 p.m.)



Dr. Mohammed Khider
Google Inc.



Dr. Alex Minetto
Politecnico di Torino

1:50 ASPN and pntOS: An Open-Source Ecosystem for Building Navigation Systems: K. Kauffman, D. Carson, J. Raquet, Integrated Solutions for Systems

2:12 Toward Realistic Evaluation of GNSS Anti-Spoofing: A Spoofing Dataset from Urban Experiments: J. Fang and B. Xu, The Hong Kong Polytechnic University

2:35 Smartphone GNSS Booster for Real-Time Centimeter-Level Kinematic Positioning: An Open Hardware and Software Approach: T. Suzuki, Chiba Institute of Technology

2:58 Months to Minutes: Creating GNSS Analysis Tools at the Speed of AI: F. van Diggelen, S. Barbeau, J. Wang, M. Khider, I. Fattouch, D. Orendorff, Google Inc.

Alternates

1. **BUC-NAV: Urban GNSS/INS Dataset with Tactical-Grade IMU and Multi-Receiver Architecture:** R-A. Cioaca, University Politehnica of Bucharest; F. Stoican, Three Tensors S.R.L; University Politehnica of Bucharest; A. Pandele, A-A. Marinache, Romanian InSpace Engineering S.R.L; C. Rusu, P. Irofti, Three Tensors S.R.L, University of Bucharest; G. Caparra, European Space Agency, ESTEC
2. **G-PEARL: GNSS Performance Analysis, Experimental Assessment and Reporting Tool:** S. Zocca, A. Minetto, A. Nardin, O. Vouch, F. Dovis, Politecnico di Torino-DET
3. **MADOCA-PPP Library (MALIB) Open-Source Software for PPP Research Development and Demonstration:** H. Yamada, S. Matsushita, K. Yoshida, E. Imada, M. Ozaki, T. Nagano, and S. Kogure, Japan Aerospace Exploration Agency

Session F6b: LEO-Based PNT and Integrated Communication and Navigation (Signal Design) 2

Room:Windsong 7-8 (3:20 p.m.–4:55 p.m.)



Dr. Gonzalo Seco Granados
Universitat Autonoma de Barcelona



Dr. Francesco Menzione
European Commission

3:25 Evolution of GNSS to Multi-Layer MEO/LEO Receivers and Processing Challenges: C. Moriana, I. Prieto, F. Conde-Pumpido, G.M. Bause, E. Garbin, G. Cueto-Felgueroso, GMV; R. Sarnadas, N. Bni Lam, F. Grec, ESA

3:48 Rapidly Converging Position Estimation Under Dynamic LEO Satellite Visibility: Y. Takayama, T. Nagano, A. Osugi, Furuno Electric Co. Ltd.; T. Marathe, J. Leclère, C. Mah, B. Chan, Xona

4:10 LEO PNT Compatibility with Spaceborne GNSS Receivers: A. Kriezis, M. Turner, C. Mah, M. O'Meara and T. G. R. Reid, Xona

4:33 Leveraging Inter-Satellite Links for POD of LEO Satellites with Limited GPS Availability: M. Dobbin, P. Axelrad, University of Colorado Boulder; Y. Bar-Sever, Jet Propulsion Laboratory

Alternates

1. **Estimating LEO Satellite Clock Errors from a Sparse Regional Ground Network: A GPS-Validated Extended Kalman Filter Approach:** G. Nix and D. M. Bevly, Auburn University
2. **Statistically Consistent Integration of Global and Regional SSR for LEO Real-Time POD:** J. Lee, D. Won, J. Lee, and E. Lee, Korea Aerospace Research Institute

Schedule of Events

MONDAY, SEPTEMBER 14 | MASTERS SHORT COURSE PROGRAM FEATURING DISTINGUISHED LECTURERS
(included with full, single-day and student registrations)

2:00 p.m.–2:50 p.m. | Windsong 1-2 Inertial Navigation for Peppa Pig	2:00 p.m.–2:50 p.m. | Windsong 3-4 GNSS Modernization	2:00 p.m.–2:50 p.m. | Windsong 5-6 Interacting with Software GNSS Receivers	
3:00 p.m.–3:50 p.m. | Windsong 1-2 Space Applications of GNSS	3:00 p.m.–3:50 p.m. | Windsong 3-4 Integrity: The Invisible Backbone of Modern Navigation	3:00 p.m.–3:50 p.m. | Windsong 5-6 Using a Sextant: Where Am I?	3:00 p.m.–3:50 p.m. | Windsong 7-8 Hinge-Factors that Enabled GPS
4:00 p.m.–4:50 p.m. | Windsong 1-2 Ionospheric Mayhem	4:00 p.m. - 4:50 p.m. | Windsong 3-4 It's All in the Mix: A System of Systems	4:00 p.m. - 4:50 p.m. | Windsong 5-6 Constellations in Your Pocket	4:00 p.m.–4:50 p.m. | Windsong 7-8 The Parade of Clocks
5:00 p.m.– 6:00 p.m. | Meet the Masters Cocktail Hour | Portico West & East			
6:00 p.m.–6:50 p.m. | Windsong 1-2 Indoor Navigation as GNSS in Disguise	6:00 p.m.–6:50 p.m. | Windsong 3-4 Quantum Navigation	6:00 p.m.–6:50 p.m. | Windsong 5-6 LEO PNT with Satellite Mega-Constellations	6:00 p.m.–6:50 p.m. | Windsong 7-8 Story Behind the First Public GPS Spoofer
7:00 p.m.–7:50 p.m. | Windsong 1-2 Navigation for Aviation Applications	7:00 p.m.–7:50 p.m. | Windsong 3-4 Resilient PNT: Some "Assemply" Required	7:00 p.m.–7:50 p.m. | Windsong 5-6 GNC: Nature vs. Engineers	

TUESDAY, SEPTEMBER 15 • PRE-CONFERENCE TUTORIALS
(additional registration and fee required)

9:00 a.m.–5:00 p.m. | Series 1: Survey of GNSS Systems, Current & Future Windsong 1-2	9:00 a.m.–5:00 p.m. | Series 2: Advanced Algorithms for Navigation Windsong 3-4	9:00 a.m.–5:00 p.m. | Series 3: Space and Spacecraft Navigation Windsong 7-8

6:00 p.m.–8:00 p.m. | ION GNSS+ Plenary Session | Windsong 9-12

WEDNESDAY, SEPTEMBER 16

	TRACK A Mass-Market Applications	TRACK B Transportation	TRACK C Secure Constellations	TRACK D Navigation for Autonomy	TRACK E Frontiers of Navigation	TRACK F/G Processing Methods
8:30 a.m.–12:15 p.m.	8:30 a.m.–10:05 a.m. A1a: Navigation & Positioning Using AI Windsong 1-2 10:40 a.m.–12:15 p.m. A1b: Indoor Navigation Windsong 1-2	B1: Applications Using Communication Technologies, Opportunistic Signals, or Collaborative Positioning Windsong 11-12	C1: Navigation Resilience to Interference & Cyber-Attacks 1 Windsong 9-10	8:30 a.m–10:05 a.m. D1a: PANEL: Advancing Autonomy in Aviation **CANCELED** 10:35 a.m.–12:15 p.m. D1b: PANEL: Aviation PNT Risks and Resilience: Experience from the Cockpit | Windsong 3-4	E1: Cislunar, Lunar & Martian Positioning, Navigation, & Timing 1 Windsong 7-8	F1: Next-Generation GNSS: Signals, Architectures, & Receiver Processing Advances | Palm G1: LEO-Based PNT & Integrated Communication & Navigation (Signal Design) 1 Windsong 5-6
12:15 p.m.–1:15 p.m., Buffet Lunch in Exhibit Hall | 1:15 p.m. - 1:45 p.m., Free Time in Exhibit Hall						
1:45 p.m.–5:30 p.m.	1:45 p.m.–3:25 p.m. A2a: PANEL: AI/ML in PNT: Opportunities, Challenges & Future Trends Windsong 3-4 3:55 p.m.–5:30 p.m. A2b: PANEL: Trends in Cybersecurity & PNT Windsong 3-4	B2: Aviation, Aeronautics, & Uncrewed Aerial Applications Windsong 11-12	C2: Navigation Resilience to Interference & Cyber-Attacks 2 Windsong 9-10	1:45 p.m.–3:25 p.m. D2a: GNSS Integrity in Aviation: ARAIM, GBAS, SBAS & Their New Advancements | Windsong 5-6 3:55 p.m.–5:30 p.m. D2b: Joint Comm/Nav Signal Design & Constellation Design: Applications in 5G/6G, LEO, & Opportunistic PNT (System Design) | Windsong 5-6	1:45 p.m.–3:25 p.m. E2a: Cislunar, Lunar & Martian Positioning, Navigation, & Timing 2 | Windsong 7-8 3:55 p.m.–5:30 p.m. E2b: Novel Paradigms in Navigation Windsong 7-8	F2: Data-Driven & Learning-Based Methods for Satellite Navigation & PNT Systems Windsong 1-2 1:20 p.m.–3:25 p.m. | G2a: 40th Anniversary Track: STUDENT SESSION | Palm 3:55 p.m.–5:30 p.m. | G2b: Resilient & Secure PNT Against Interference & Emerging Threats 1 Palm

5:30 p.m.–7:00 p.m. | Evening Hours in Exhibit Hall (Grand Cypress Ballroom) with Cash Bar

THURSDAY, SEPTEMBER 17

8:30 a.m.–12:15 p.m.	A3: Latest Advancement from GNSS Receiver & Localization Algorithm Manufacturers Windsong 1-2	B3: AI & Machine Learning for GNSS Signal Processing, Error Modeling, & Threat Detection Windsong 7-8	C3: Fielding Alternative Technologies in GNSS-Denied Environments 1 Windsong 9-10	D3: Precise Positioning & its Integrity: Architecture & Algorithm Design Windsong 5-6	8:30 a.m.–10:05 a.m. E3a: PANEL: PNT for Lunar Exploration Windsong 3-4 10:35 a.m.–12:15 p.m. E3b: PANEL: Synergistic Services: Fusing PNT & Communications Windsong 3-4	F3: Resilient & Secure PNT Against Interference & Emerging Threats 2 Windsong 11-12
12:15 p.m.–1:15 p.m. | Buffet Lunch in Exhibit Hall (Grand Cypress Ballroom)					**1:15 p.m.–1:45 p.m. | Free Time in Exhibit Hall**	
1:45 p.m.–5:30 p.m.	A4 High Accuracy Positioning & Correction for Mass Market Devices Windsong 1-2	1:45 p.m.–3:25 p.m. B4a: PANEL: CRPA in Civil Aviation Windsong 3-4 3:55 p.m.–5:30 p.m. B4b: PANEL: Complementary PNT - Resilient Navigation to Support Global PNT Requirements Windsong 3-4	C4: Fielding Alternative Technologies in GNSS-Denied Environments 2 Windsong 9-10	D4: Multi-Sensor PNT Optimization: Algorithms for Efficiency & Trustworthiness Windsong 5-6	E4: Remote Sensing, Timing, Space & Scientific Applications Windsong 11-12	F4: Resilient & Secure PNT Against Interference & Emerging Threats 3 Windsong 7-8
5:30 p.m.– 8:30 p.m. | Satellite Division's 40th Anniversary Trivia Night | Regency Hall						

FRIDAY, SEPTEMBER 18

8:30 a.m.–12:15 p.m.	A5: Future Augmentation Systems, Correction Services, & Integrity Windsong 1-2	8:30 a.m.–10:05 a.m. B5a: GNSS Modernization & Market Trends | Windsong 7-8 10:35 a.m.–12:15 p.m. B5b: Safety Assurance of AI-Enhanced PNT Systems for Autonomous Platform Windsong 7-8	C5: Precise, Secure Timing & Time Transfer Windsong 9-10	D5: Atmospheric Modeling & Mitigation with GNSS & LEO-PNT Systems Windsong 5-6	E5: Beyond GNSS: LEO-Based & Terrestrial Signals of Opportunity for PNT 1 Windsong 11-12	8:30 a.m.–10:05 a.m. F5a: PANEL: Emerging Scientific Use Cases for PNT Signals Windsong 3-4 10:35 a.m.–12:15 p.m. F5b: PANEL: Navigation & Spatial Intelligence in Embodied AI Windsong 3-4
12:15 p.m.–1:30 p.m., Awards Luncheon | Grand Cypress Ballroom (Lunch served until 12:30 p.m.; late arrivals will not be served. Special meal requests (veg./gluten-free, etc.) due at time of registration)						
1:45 p.m.–4:55 p.m.	A6: Navigation in Challenging Environment with Mass Market Devices, Smartphones, & Wearables Windsong 1-2	B6: High-Precision GNSS Positioning with Integrity Windsong 9-10	1:45 p.m.–3:20 p.m. C6a: PANEL: PNT from LEO Satellites Windsong 3-4 3:25 p.m.–4:55 p.m. C6b: PANEL: Status of GNSS | Windsong 3-4	D6: Advanced Receiver Design for GNSS: New Architectures, & Multipath Mitigation Windsong 11-12	E6: Beyond GNSS: LEO-Based & Terrestrial Signals of Opportunity for PNT 2 Windsong 5-6	1:45 p.m.–3:20 p.m. | F6a: Open Source Data & Tools for PNT Research & Development | Windsong 7-8 3:25 p.m.–4:55 p.m. | F6b: LEO-Based PNT & Integrated Communication & Navigation (Signal Design) 2 Windsong 7-8

Tracks A/B/C: Commercial & Policy sessions covering mass market applications, transportation, & secure constellations.

Tracks D/E/F/G: Research sessions covering navigation for autonomy, frontiers of navigation, & processing methods.