



PLANS 2012

POSITION LOCATION AND NAVIGATION SYMPOSIUM

April 23-26, 2012 • Tutorials April 23 • Marriott Resort & Spa, Myrtle Beach, South Carolina

ON SITE PROGRAM

SPECIAL EVENTS:

Tuesday, April 24

Spouses Coffee Hour

9:00 a.m. – 10:00 a.m., Osprey Room

This hour will give you the opportunity to learn about the Myrtle Beach area while meeting up with former touring companions and developing new friendships. The hotel concierge will be on site to advise you.

Informal Luncheon

12:00 p.m. – 1:00 p.m., Atlantic Ballroom 1-5
(Exhibit Hall)

This event is included in the price of a FULL registration. Guest tickets may be purchased on site at a cost of \$70 each.

Exhibitor Hosted Reception

6:00 p.m. – 8:00 p.m., Atlantic Ballroom 1-5
(Exhibit Hall)

Join exhibitors as they host an evening of information and cuisine. A cash bar will be offered. This event is included with any type of registration. Spouses and traveling companions 21 and older are welcome.

Wednesday, April 25

Informal Luncheon

12:00 p.m. – 1:00 p.m., Atlantic Ballroom 1-5
(Exhibit Hall)

This event is included in the price of a FULL registration. Guest tickets may be purchased on site at a cost of \$70 each.

Thursday, April 26

Awards Luncheon

12:00 p.m. – 2:00 p.m., Atlantic Ballroom 4/5

The IEEE AESS will present the Carlton Award, Kershner Award and the Fried Award. The Carlton Award acknowledges what is judged the best paper in the AESS Transactions in each calendar year. The Kershner Award is presented to recognize the outstanding lifetime achievements of an individual who has made substantial contributions in the field of navigation. The Fried Award recognizes the best technical paper presented at the PLANS conference.

This event is included in the price of a FULL registration. Guest tickets may be purchased on site at a cost of \$70 each.

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Conference Wireless Access Code: ion273826

Session Papers Online: Registered attendees may download copies of session papers online for FREE. To access PLANS conference papers go to <http://www.plansconference.org> and follow the instructions. Access is only available to attendees who have a FULL REGISTRATION for the technical conference. Those who pre-registered for the conference will find their Registration ID on the back of their conference name badge.

REGISTRATION ID

Institute of Navigation
8551 Rixlew Lane, Suite 360
Manassas, VA 20109

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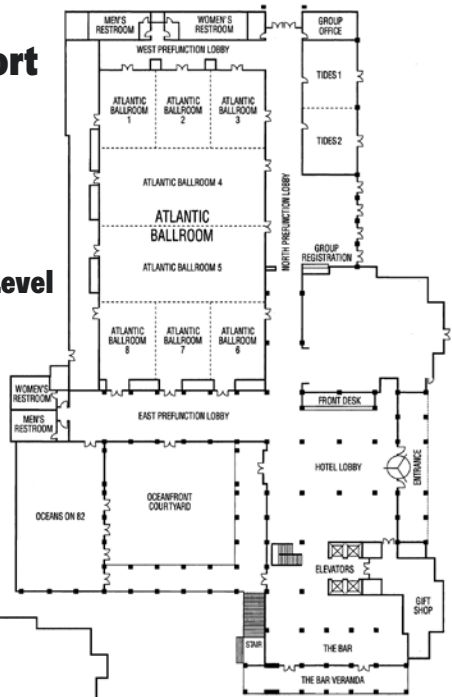
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Last Name: DOE



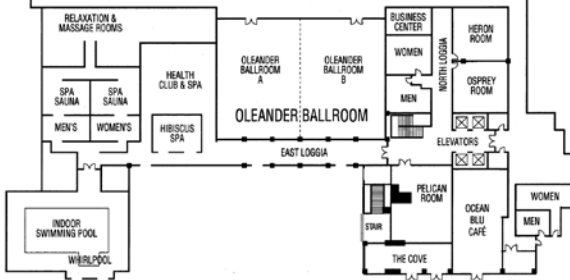
PLANS 2012 Area Map

Myrtle Beach Marriott Resort & Spa at Grande Dunes, Myrtle Beach, SC

Upper Level



Lower Level



PLANS 2012 Conference Hours

Registration Only

Sunday, April 22..... 5:00 p.m. – 7:00 p.m.

Tutorials

Monday, April 23..... 8:00 a.m. – 12:00 p.m. &
1:00 p.m. – 5:00 p.m.

Technical Sessions

Tuesday, April 24..... 8:30 a.m. – 12:00 p.m. &
2:00 p.m. – 5:30 p.m.

Wednesday, April 25..... 8:30 a.m. – 12:00 p.m. &
2:00 p.m. – 5:30 p.m.

Thursday, April 26..... 8:30 a.m. – 12:00 p.m. &
2:00 p.m. – 5:00 p.m.

PLANS 2012 Executive Committee

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Northrop Grumman

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USAF 46th Range Group &
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Alliant Tech Systems &
Dr. Cosimo Stallo
University of Rome, Italy

Tutorials

Technical Session Overview

April 24-26, Myrtle Beach, SC

PLANS 2012

Mon. Morning
8:00 a.m. – 12:00 p.m.

Dr. Dorota Grejner-Brezinska:
Sensor Integration for Personal Navigation
Tides

Dr. Mohinder Grewal:
Fundamentals of Kalman Filtering for Navigation
Atlantic 7

Mr. Ralph E. Hopkins:
Contemporary & Emerging Inertial Sensor Technologies
Atlantic 8

Dr. Christopher Hegarty:
An Introduction to the GPS Signals & Receiver Processing
Atlantic 6

Tues. Morning
8:30 a.m. – 12:00 p.m.

Session A1:
High Performance Inertial Sensor Technologies
Atlantic 6/7

Session B1:
Receiver & Antenna Technology I
Oleander B (Lower Level)

Session B2b:
Receiver & Antenna Technology II
Oleander B

Session C1:
Indoor Personal & First-Responder Navigation
Tides

Tues. Afternoon
2:00 p.m. – 5:30 p.m.

Session A2:
Low Cost Inertial Sensor Technologies
Atlantic 6/7

Session B2a:
Atmospheric Effects & Modeling
Oleander B (Lower Level)

Session B2c:
Urban Personal & Vehicular Navigation
Tides

Wed. Morning
8:30 a.m. – 12:00 p.m.

Session A3:
Multisensor Integrated Systems & Sensor Fusion Technologies I
Atlantic 6/7

Session B3:
Interference, Spectrum Issues & Robust Navigation
Oleander B (Lower Level)

Session C3:
Vision/Integrated Navigation Systems for Indoor Applications
Tides

Wed. Afternoon
2:00 p.m. – 5:30 p.m.

Session A4:
Multisensor Integrated Systems & Sensor Fusion Technologies II
Atlantic 6/7

Session B4:
Precise Positioning, Multipath Mitigation, & Advanced Processing Algorithms
Oleander B (Lower Level)

Session C4:
Vision/Integrated Navigation for Vehicular & Robotic Applications
Tides

Thurs. Morning
8:30 a.m. – 12:00 p.m.

Session A5:
Sensor Manufacturing, Error Modeling & Testing
Atlantic 6/7

Session B5:
Modernized GNSS
Oleander B (Lower Level)

Session C5:
Weak Signal Processing
Tides

Thurs. Afternoon
2:00 p.m. – 5:00 p.m.

Session A6:
Emerging & Alternative Sensor Technologies & Precision Timing Systems
Atlantic 6/7

Session B6:
GNSS Augmentation Systems
Oleander B (Lower Level)

Session C6:
Terrestrial Radionavigation & RF-Positioning
Tides

Technical Committee

Technical Program Co-Chairs:
Dr. Gary McGraw,
Rockwell Collins

Dr. Michael Veth,
USAF 46th Range Group

Program Track Chairs:
Track A:
Mr. Randall Currey,
Northrop Grumman Navigation Systems

Track B:
Dr. Michael Meurer,
German Aerospace Centre (DLR), Germany

Track C:
Dr. Jacob Campbell,
U.S. Air Force Research Laboratory

Track D:
Dr. Sherman Lo,
Stanford University

Note that the photographing of sessions/presentations and/or the audio or video recording of sessions/presentations is prohibited. As a courtesy to others, please set all cell phones to vibrate.



Dr. Fariokh Ayazi,
Georgia Tech



Tony Radojevic,
C.S. Draper
Laboratory



Dr. Todd
Humphreys,
University of Texas



Jason Hamilton,
NovAtel Inc.,
Canada

Session A1: High-Performance Inertial Sensor Technologies — *Atlantic 6/7*

- 8:35 1. Curve Fitting Method for Time Domain Switched Inertial Devices: C.H. Tally, P.D. *Swanson*, R.L. Waters, *SSC Pacific*
- 9:05 2. Angular Motion and Attitude Estimation Using Fixed and Rotating Accelerometers Configuration: E. Edwan, J. Zhang, O. Loffeld, ZESS, *University of Siegen, Germany*
- 9:30 3. Breakthrough in High Performance Inertial Navigation Grade Sigma-delta MEMS Accelerometer: P. Zwahlen, Y. Dong, A-M. Nguyen, F. Rudolf, J-M. Stauffer, *Colibrys SA, Switzerland*

Break 10:05 a.m. – 10:25 a.m.

- 10:30 4. High Performance Gyro with Fast Startup Time, High Range, Wide Bandwidth, Low Noise and Excellent Vibration Immunity: S.G. Saraswathy, J. Geen, J. Chang, W. Chen, H. Tang, *Analogue Devices Inc.*
- 11:00 5. Milli-HRG Inertial Navigation System: D. Meyer, D. Rozelle, *Northrop Grumman Electronics Systems International Inc. -Navigation System Division*
- 11:30 6. Atom Interferometry: Next Generation Moving Base Gravity Gradiometer System: V. Beniscek, H. Rice, J. Lindell, *Lockheed Martin*; M. Kasevich, B. Young, *AOSENSE Inc.*; D. Brown, *SP 2401*; L. Mauser, *Sp2421*

Alternate

1. Nuclear Magnetic Resonance Gyroscope for DARPA MTO NGIMG Program: M.S. Larsen, M.D. Bulatowicz, R.C. Griffith, P.R. Clark, H. Abbink, *Northrop Grumman*

Session B1: Receiver & Antenna Technology I — *Oleander B (Lower Level)*

- 8:35 1. A High Sensitivity VDFLL Utilizing Precise Satellite Orbit/Clock and Ionospheric Products: E. Xu, Y. Gao, *University of Calgary, Canada*
- 9:05 2. Advanced Signal Processing Scheme for GNSS Receivers Under Ionospheric Scintillation: J-H. Won, B. Eissfeller, *University EAF Munich, Germany*; T. Pany, J. Winkel, *IFEN GmbH, Germany*
- 9:30 3. An Integrated Overlay Architecture Based Multi-GNSS Front-end: A. Ruegamer, S. Urquijo, M. Eppel, H. Milosiu, J. Goerner, G. Rohmer, *Fraunhofer IIS, Germany*

Break 10:05 a.m. – 10:25 a.m.

- 10:30 4. Combined Doppler and Time-Free Positioning Technique for Low Dynamics Receivers: N. Othieno, S. Gleason, *Concordia University*
- 11:00 5. E-textile Microstrip Patch Antennas for GPS: P.G. Elliot, E.N. Rosario, B. Rama Rao, R.J. Davis, N.M. Marcus, *The MITRE Corporation*
- 11:30 6. Generalization of the Code Tracking Performance Theory to Receivers Using Non-Standard Local Replicas: O. Julien, *Ecole Nationale de l'Aviation Civile, France*

Alternate

1. Implementation of a Multi-mode and Multi-constellation Receiver: L. Yang, Y. Sun, Y. Zhang, *Beijing Microelectronics Technology Institute, China*



Dr. Dorota Grejner-Brzezinska,
The Ohio State University



Steve Rounds,
L-3 Communications



Dr. Juan Blanch,
Stanford University



Rick Niles,
The MITRE Corporation

Session C1: Indoor Personal & First-Responder Navigation — *Tides*

- 8:35 1. Rapid Mesh Network Setup for Indoor RF Tracking: M. Hedley, T. Sathyan, *CSIRO ICT Centre, Australia*
- 9:05 2. GLANSER: Geospatial Location, Accountability, and Navigation System for Emergency Responders: P. Samanant, W. Hawkinson, R. McCroskey, A. Kulkarni, *Honeywell*; L. Haas, *Boeing/Argon ST*; B. English, *TRX Systems*
- 9:30 3. Scenario-based Evaluations of High-accuracy Personal Positioning Systems: J. Rantakokko, P. Stromback, J. Rydell, E. Emilsson, *Swedish Defence Research Agency (FOI), Sweden*

Break 10:05 a.m. – 10:25 a.m.

- 10:30 4. Maps-based Angular PDFs used as Prior Maps for FootSLAM: S. Kaiser, M. Garcia Puyol, P. Robertson, *German Aerospace Center (DLR), Germany*
- 11:00 5. Opportunistic Radio SLAM for Indoor Navigation using Smartphone Sensors: R. Faragher, C. Sarno, M. Newman, *BAE Systems Advanced Technology Centre, UK*
- 11:30 6. Unscented Kalman Filter and Magnetic Angular Rate Update (MARU) for an Improved Pedestrian Dead-Reckoning: F.J. Zampella, *Centre for Automation and Robotics, CSIC, Spain*; M. Khider, P. Robertson, *German Aerospace Center (DLR), Germany*; A.R. Jimenez, *Centre for Automation and Robotics CSIC, Spain*

Alternate

1. Foot-Mounted INS for Everybody — An Open-Source Embedded Implementation: J-O. Nilsson, I. Skog, P. Handel, *KTH Royal Institute of Technology, Sweden*; K.V.S. Hari, *Indian Institute of Science, India*

Session D1: Aviation Positioning & Navigation Applications I — *Atlantic 8*

- 8:35 1. Investigation of APNT Optimized DME/DME Network Using Current State-of-the-Art DMEs: Ground Station Network, Accuracy, and Capacity: E. Kim, *Selex Systems Integration*
- 9:05 2. Tropospheric Error Modeling for High Integrity Airborne GNSS Navigation: G.A. McGraw, *Rockwell Collins*
- 9:30 3. Testing of a Statistical Approach to Local Ionospheric Disturbances Detection: G. Giorgi, P. Henkel, *Technical University Munich, Germany*; C. Guenther, *Technical University Munich and German Aerospace Center (DLR), Germany*

Break 10:05 a.m. – 10:25 a.m.

- 10:30 4. Differential RAIM and Relative RAIM for Orbit Ephemeris Fault Detection: M. Joerger, S. Stevanovic, S. Khanafseh, B. Pervan, *Illinois Institute of Technology*
- 11:00 5. GNSS-based Curved Landing Approaches with a Virtual Receiver: F. Kube, S. Schön, *Leibniz Universität Hannover, Germany*; T. Feuerle, *Technische Universität Braunschweig, Germany*
- 11:30 6. Performance Study of a New Crosslink-aided User Range Accuracy (URA) Integrity Monitor Algorithm for LPV-200: B. Bian, D. O’Laughlin, R. Braff, C. Shively, *The MITRE Corporation*

Alternates

1. New Cascade Method for Detecting Multiple Outliers by Using Total Residuals of Observation Equations: Y. Zhang, *Shanghai Ocean University, China*; E. Wu, *Beijing University of Aeronautics and Astronautics, China*; H. Isshiki, *Institute of Mathematical Analysis, Japan*
2. Enhanced Low Visibility Operations — Increasing Flight Operations Services in the National Airspace Systems in Low Visibility Conditions: S.L. Frodge, C. Hope, *Federal Aviation Administration*; R. Houghton, *Houghton Associates*



Ken Marino,
Systron Donner



Bill Clark,
Analog Devices

Session A2: Low-Cost Inertial Sensor Technologies — *Atlantic 6/7*

- 2:05 1. High-Performance, Low Cost Inertial MEMS: A Market in Motion: M. Perlmutter, *Skylight Navigation Technology*; L. Robin, *YOLE Development, France*
- 2:35 2. Parameter Study of Loosely Coupled INS/GNSS Integrity Performance: A. Grosch, B. Belabbas, *German Aerospace Center (DLR), Germany*
- 3:05 3. Characterization and Control of a High-Q MEMS Inertial Sensor using Low-cost Hardware: J.A. Gregory, J.Y. Cho, K. Najafi, *University of Michigan WIMS*
- Break 3:35 p.m. – 3:55 p.m.**
- 4:00 4. A Novel Optimal Redundant Inertial Sensor Configuration in Strap down Inertial Navigation System: L. Fu, *Beihang University, China and Purdue University, USA*; X. Yang, L. Wang, *Beihang University, China*
- 4:30 5. High-Q and Wide Dynamic Range Inertial MEMS for North-Finding and Tracking Applications: A.A. Trusov, I.P. Prikhodko, S.A. Zotov, A.M. Shkel, *University of California, Irvine*
- 5:00 6. Novel Mismatch Compensation Methods for Rate-integrating Gyroscopes: J.A. Gregory, J.Y. Cho, K. Najafi, *University of Michigan WIMS*
- Alternate**
1. Miniature IMU/INS with Optimally Fused Low Drift MEMS Gyro and Accelerometers for Applications in GPS-denied Environments: M. Tanenhaus, *Tanenhaus and Associates*; D. Carhoun, Consultant; T. Geis, *Tanenhaus and Associates*; E. Wan, *Oregon Health & Science University*; A. Holland, *Eminent Micro Systems-consultant*



Dr. Attila Komjathy,
NASA Jet Propulsion
Laboratory

Session B2a: Atmospheric Effects & Modeling — *Oleander B (Lower Level)*

- 2:05 1. Evolution to Modernized GNSS Ionospheric Scintillation and TEC Monitoring: A. MacAulay, S. Shanmugam, *NovAtel, Inc., Canada*; A.J. Van Dierendonck, *AJ Systems/GPS Silicon Valley*
- 2:35 2. Time-Frequency Analysis of Ionosphere Scintillations Observed by a GNSS Receiver Array: J. Wang, J. Morton, Q. Zhou, *Miami University*; F. van Graas, W. Pelgrum, *Ohio University*



Dr. Richard Langley,
University of New
Brunswick, Canada

Session B2b: Receiver & Antenna Technology II — *Oleander B (Lower Level)*

- 4:00 1. Neural Network Based Architecture for Robust and Adaptive Tracking in GNSS Receivers: K. Sun, *Hefei University of Technology, China*
- 4:30 2. Towards a Robust Multi-Antenna Mass Market GNSS Receiver: G. Kappen, M. Cuntz, C. Haettich, M. Meurer, *German Aerospace Center (DLR), Germany*
- 5:00 3. Two-Channel Method for the Processing of Wide-band GNSS Signals, its Implementation and Verification: P. Kovar, P. Kacmarik, O. Jakubov, P. Roule, F. Vejrazka, *Czech University in Prague, Czech Republic*



Dr. Todd Humphreys,
University of Texas



Jason Hamilton,
NovAtel Inc.,
Canada



Dr. Maarten Uijt de Haag, *Ohio University*



John Del Colliano, *U.S. Army CERDEC*



Dr. Jason Rife, *Tufts University*



Dr. David Bevly, *Auburn University*

Session C2: Urban Personal & Vehicular Navigation — *Tides*

- 2:05 1. Particle Filter Based Positioning with 3GPP-LTE in Indoor Environments: C. Gentner, E. Munoz Diaz, M. Khider, E. Staudinger, S. Sand, A. Dammann, *German Aerospace Center (DLR), Germany*
- 2:35 2. System Parameters Testing Methodology for ITS Applications of GNSS Systems: V. Faltus, *Czech Technical University in Prague, Czech Republic*
- 3:05 3. Tracking in Dynamic Anchorless Wireless Networks Based on Manifold Flattening: D.C. Popescu, M. Hedley, T. Sathya, *CSIRO ICT Centre, Australia*

Break 3:35 p.m. – 3:55 p.m.

- 4:00 4. A Robust Pedestrian Dead-reckoning Positioning Based on Pedestrian Behavior and Sensor Validity: S. Asano, *The University of Tokyo, Japan*; Y. Wakuda, N. Koshizuka, K. Sakamura, *The University of Tokyo and YRP Ubiquitous Networking Laboratory, Japan*
- 4:30 5. Cooperative Navigation in Transitional Environments: D.A. Grejner-Brzezinska, C.K. Toth, J-K. Lee, A. Zaydak, O. Mora, *The Ohio State University*
- 5:00 6. A Near-Far Effect Canceller for GPS High Sensitivity Receiver: B. Lu, J. Zhong, M. Zhao, L. Li, *Zhejiang University, China*

Session D2: Aviation Positioning & Navigation Applications II — *Atlantic 8*

- 2:05 1. Interference Characteristics for the Civil Airport Environment using Time-Frequency Analysis: C-C. Sun, S-S. Jan, *National Cheng Kung University, Taiwan*
- 2:35 2. Multipath Study on the Airport Surface: A. Guilloton, J-P. Arethens, *Thales Avionics, France*; A-C. Escher, C. Macabiau, *ENAC, France*; D. Koenig, *Gipsa-Lab, France*
- 3:05 3. Matching-suitable Feature Construction for SAR Image Aided Navigation: Y. Bu, S. Han, G. Tang, *National Key Laboratory of Science and Technology on Aerospace Flight Dynamics, China*

Break 3:35 p.m. – 3:55 p.m.

- 4:00 4. Real-time Estimation of Projectile Roll Angle using Magnetometers: In-flight Experimental Validation: S. Changey, E. Pecheur, L. Bernard, E. Sommer, P. Wey, C. Berner, *ISL, France*
- 4:30 5. Radar Altimeter as a Navigation Aid Using Hierarchical Elevation Map Clustering: B. Akin, H.E. Bingol, *Tübitak Sage, Turkey*
- 5:00 6. The GNSS Signal Phase Measurement to Determine the Trajectory Disturbances for a Small Air Vehicle: P. Bojda, *University of Defence, Czech Republic*

Alternate

- 1. Algorithm for the Detection and Isolation of Systematic Measurement Errors in Vision Based/aided Navigation Systems: N.A. Baine, K.S. Rattan, *Wright State University*



Randall Jaffe, L-3 Communications



Tony Rios, Systron Donner



Lionel Ries, CNES, France



Dr. Christopher Hegarty, The MITRE Corporation

Session A3: Multisensor Integrated Systems & Sensor Fusion Technologies I — *Atlantic 6/7*

- 8:35 1. An Adaptive Unscented Kalman Filter For Tightly Coupled INS/GPS Integration: T. Akca, *Roketsan Missiles Industries Inc., Turkey*; M. Demirekler, *Middle East Technical University, Turkey*
- 9:05 2. Approaches to Evaluate and Improve Short-term Relative Accuracy of GPS/INS Systems: Q. Zhang, X. Niu, C. Liu, H. Zhang, C. Shi, *Wuhan University, China*
- 9:30 3. Indoor Positioning Through Integration of Optical Angles of Arrival and an Inertial Measurement Unit: S. Islam, R. Klukas, *University of British Columbia, Canada*

Break 10:05 a.m. – 10:25 a.m.

- 10:30 4. Robust Pedestrian Height Tracking by Proper Accounting of Nonlinearities in an Integrated GPS/MEMS-based-IMU/Baro System: M. Zhang, A. Vydhyathanan, H. Luinge, *Xsens Technologies B.V., The Netherlands*
- 11:00 5. Range Sensor Aided Inertial Navigation Using Cross Correlation on the Evidence Grid: Y. Ma, J.B. McKitterick, *Honeywell Aerospace*
- 11:30 6. The IMRE Kalman Filter — a New Kalman Filter Extension for Nonlinear Applications: S. Draganov, L. Haas, M. Harlacher, *Argon ST*

Alternate

- 1. SINS/GPS/CNS Information Fusion Algorithms Based on Huber Filter with Classified Adaptive Factors for High-speed UAV: R. Wang, Z. Xiong, J. Liu, R. Li, H. Peng, *Nanjing University of Aeronautics and Astronautics, China*

Session B3: Interference, Spectrum Issues & Robust Navigation — *Oleander B (Lower Level)*

- 8:35 1. Compatibility Analysis Between Light Squared and L1/E1 GNSS Signals: D. Borio, C. O'Driscoll, E. Cano, M. Rao, J. Fortuny, *EC Joint Research Centre, Institute for the Protection and Security of the Citizen, Italy*; F. Bastide, D. Hayes, *EC DG for Enterprise and Industry, EU Satellite Navigation Programmes, Belgium*
- 9:05 2. Development and Demonstration of a TDOA-based GNSS Interference Signal Localization System: J. Bhatti, T. Humphreys, *The University of Texas at Austin*; B. Ledvina, *Coherent Navigation*
- 9:30 3. A USRP-Based GNSS and Interference Signal Generator and Playback System: R. Di, Y. Morton, *Miami University*

Break 10:05 a.m. – 10:25 a.m.

- 10:30 4. GNSS Spoofing Detection in Handheld Receivers Based on Signal Spatial Correlation: A. Broumandan, J. Nielsen, A. Jafarnia, G. Lachapelle, *University of Calgary, Canada*
- 11:00 5. Multi-Satellite Time-Delay Estimation for Reliable High-Resolution GNSS Receivers: C. Enneking, M. Stein, M. Castaneda, *Technical University Munich, Germany*; F. Antreich, *German Aerospace Center, (DLR), Germany*; J.A. Nossek, *Technical University Munich, Germany*
- 11:30 6. A Multiple-frequency GPS Software Receiver Design Based on a Vector Tracking Loop: S. Peng, *Virginia Tech*; J. Morton, *Miami University*



Dr. Paul DeBitetto,
C.S. Draper
Laboratory

Session C3: Vision/Integrated Navigation Systems for Indoor Applications — *Tides*

- 8:35 1. Efficient Outlier Removal in Vision Based Navigation: Y. Ma, Honeywell Aerospace; S. Rao, *Honeywell Technology Solutions Lab., India*
- 9:05 2. Improved Fusion of Visual Measurements Through Explicit Modeling of Outliers: C. Taylor, *Sensors Directorate Air Force Research Laboratory*
- 9:30 3. Inertial and Imaging Sensor Fusion for Image Aided Navigation with Affine Distortion Prediction: J.D. Jurado, K.A. Fisher, M.J. Veth, *Air Force Institute of Technology*

Break 10:05 a.m. – 10:25 a.m.

- 10:30 4. Exploiting Ground Plane Constraints for Visual-aided Inertial Navigation: G. Panahandeh, D. Zachariah, M. Jansson, *KTH Royal Institute of Technology, Sweden*
- 11:00 5. Fusing Visual Tags and Inertial Information for Indoor Navigation: D. Zachariah, M. Jansson, *KTH Royal Institute of Technology, Sweden*
- 11:30 6. CHAMELEON: Visual-inertial Indoor Navigation: J. Rydell, E. Emilsson, *Swedish Defence Research Agency (FOI), Sweden*

Alternate

- 1. Optical Flow Measurement of Human Walking: Q. Liu, O. Osechas, J. Rife, *Tufts University*



Dr. Will Curtis,
U.S Air Force
Research
Laboratory

Session D3: Consumer Positioning & Smartphone Navigation Technology — *Atlantic 8*

- 8:35 1. Using Inertial Sensors of iPhone 4 for Car Navigation: X. Niu, Q. Zhang, Y. Li, C. Shi, *Wuhan University, China*
- 9:05 2. A Hybrid Map-matching Algorithm for Real Time Passenger Information Systems via Mobile Phones and Crowd-Sourcing: N.R. Velaga, D. Corsar, P. Edwards, J.D. Nelson, S. Sripatha, N. Sharma, M. Beecroft, J.Z. Pan, *University of Aberdeen, UK*
- 9:30 3. WiFi AP Position Estimation using Contribution from Heterogeneous Mobile Devices: Y. Cho, M. Ji, Y. Lee, S. Park, *ETRI, South Korea*

Break 10:05 a.m. – 10:25 a.m.

- 10:30 4. An Empirical Solar Radiation Pressure Model for Autonomous GNSS Orbit Prediction: J. Ala-Luhtala, M. Seppänen, R. Piché, *Tampere University of Technology, Finland*
- 11:00 5. Using Unlocated Fingerprints in Generation of WLAN Maps for Indoor Positioning: M. Raitoharju, T. Fadjuhoff, S. Ali-Löytty, R. Piché, *Tampere University of Technology, Finland*
- 11:30 6. 3D Personal Navigation in Smartphone using Geocoded Images: Y. Wang, *Aalto University, Finland*; R. Chen, L. Pei, Y. Chen, *Finnish Geodetic Institute Finland*; K. Verrantaus, *Aalto University, Finland*

Alternate

- 1. An Adaptive Map-Matching Based on Dynamic Time Warping for Pedestrian Positioning using Network Map: Y. Wakuda, S. Asano, N. Koshizuka, K. Sakamura, *University of Tokyo and YRP Ubiquitous Networking Lab, Japan*



Dr. Guttorm
Opshaug
Qualcomm



Dr. Richard Fuller,
Broadcom



Dr. Andrei Shkel,
DARPA



Dr. Michael Larsen,
Northrop Grumman



Dr. Sandra
Verhagen, Delft
University of
Technology, The
Netherlands



Dr. Liwen
Dai, NavCom
Technology Inc.

Session A4: Multisensor Integrated Systems & Sensor Fusion Technologies II — *Atlantic 6/7*

- 2:05 1. Performance Investigation of Barometer Aided GPS/MEMS-IMU Integration: J. Zhang, E. Edwan, J. Zhou, W. Chai, O. Loffeld, ZESS, *University of Siegen, Germany*
- 2:35 2. Use of Magnetic Quasi Static Field (QSF) Measurements for Pedestrian Navigation: J. Bancroft, G. Lachapelle, *University of Calgary, Canada*
- 3:05 3. A Quaternion-based Initial Orientation Estimation Method Suitable for One Special Dynamic State Using Low Cost Magnetometers and Accelerometers: C. Liu, J. Li, K. Huang, F. Liu, *Beijing Institute of Technology, China*

Break 3:35 p.m. – 3:55 p.m.

- 4:00 4. Loosely-Coupled GPS-INS State Estimation in Precision Projectiles: L. Fairfax, F. Fresconi, *U.S. Army Research Laboratory*
- 4:30 5. ARMA Modeling with Noises for Inertial Sensors: K. Wang, S. Xiong, *Beihang University, China*; Y. Li, *University of New South Wales, Australia*
- 5:00 6. Circular Data Processing Tools Applied to a Phase Open Loop Architecture for Multi-Channels Signals Tracking: G. Stienne, S. Reboul, J-B. Choquel, M. Benjelloun, *Université du Littoral Côte d'Opale, France*

Session B4: Precise Positioning, Multipath Mitigation & Advanced Processing Algorithms — *Oleander B (Lower Level)*

- 2:05 1. Fixed Ambiguity Precise Point Positioning (PPP) with FDE RAIM: A. Jokinen, S. Feng, C. Milner, W. Ochieng, *Imperial College London, UK*; C. Hide, T. Moore, C. Hill, *IEXG, University of Nottingham, UK*
- 2:35 2. High-precision GNSS Orbit, Clock and EOP Estimation at the United States Naval Observatory: S. Byram, C. Hackman, *US Naval Observatory*
- 3:05 3. Integrity Risk of Cycle Resolution in the Presence of Bounded Faults: S. Khanafseh, M. Joergler, B. Pervan, *Illinois Institute of Technology*

Break 3:35 p.m. – 3:55 p.m.

- 4:00 4. Synthetic Aperture Navigation Algorithms Applied to a Driving User in Multipath Environments: W. Leong, K. Patel, J. Weinfeld, D. Karnick, *Argon ST, Inc.*
- 4:30 5. Bounding Integrity Risk Subject to Structured Time Correlation Modeling Uncertainty: S. Langel, S. Khanafseh, B. Pervan, *Illinois Institute of Technology*
- 5:00 6. Urban Multipath Detection and Mitigation with Dynamic 3D Maps for Reliable Land Vehicle Localization: M. Obst, S. Bauer, R. Streiter, G. Wanieliik, *Chebmitz University of Technology, Germany*

Alternates

1. A Novel Bayesian Ambiguity Resolution Technique for GNSS High Precision Positioning: J.G. Garcia, P.A. Roncagliolo, C.H. Muravchik, *Universidad Nacional de La Plata, Argentina*
2. Trajectory Estimation Improvement Based on Time-series Constraint of GPS Doppler and INS in Urban Areas: K. Takeyama, Y. Kojima, E. Teramoto, *Toyota Central Research & Development Lab.,*
3. M-Epoch Ambiguity Resolution Technique for Single Frequency Receivers with INS Aid: T. Iwase, Y. Kojima, E. Teramoto, *Toyota Central R&D Labs, Japan*



Dr. Jeffrey Dickman, Northrop Grumman



Dr. Bernard Schnauffer, Rockwell Collins

Session C4: Vision/Integrated Navigation for Vehicular & Robotic Applications — *Tides*

- 2:05 1. Real-time Implementation of Visual-aided Inertial Navigation Using Epipolar Constraints: J.-O. Nilsson, D. Zachariah, M. Jansson, P. Handel, *KTH Royal Institute of Technology, Sweden*
- 2:35 2. Collaborative Image Navigation Simulation and Analysis for UAVs in GPS Challenged Conditions: B.A. Schnauffer, P. Hwang, G.A. McGraw, J. Nadke, *Rockwell Collins*; D. Venable, *Air Force Research Laboratory*
- 3:05 3. Filter-Based Calibration for an IMU and Multi-Camera System: K. Brink, A. Rutkowski, *Air Force Research Laboratory*; A. Soloviev, *University of Florida*
- Break 3:35 p.m. – 3:55 p.m.**
- 4:00 4. Lane Detection Based on a Visual-Aided Multiple Sensors Platform: Y. Chen, J. Liu, L. Ruotsalainen, T. Kroger, *Finnish Geodetic Institute, Finland*; Y. Wang, *Aalto University, Finland*; H. Kuusniemi, R. Chen, T. Tenhunen, L. Pei, *Finnish Geodetic Institute, Finland*
- 4:30 5. Bundle Adjustment Without Iterative Structure Estimation and its Application to Navigation: V. Indelman, *Georgia Institute of Technology*
- 5:00 6. An Efficient Refinement for Relative Pose Estimation with Unknown Focal Length from Two Views: X. Fu, X. Zhang, *Tokyo Institute of Technology, Japan*

Alternates

1. Graph-Based Cooperative Navigation Using Three-View Constraints: Method Validation: V. Indelman, *Georgia Institute of Technology, USA*; P. Gurfil, E. Rivlin, *Techion Israel Institute of Technology, Israel*; H. Rotstein, *RAFAEL - Advanced Defense Systems Limited, Israel*
2. High Accuracy 3D Localization of Mobile Multipath Environments using RFID Super tags: V. Ekambaram, K. Ramchandran, *University of California Berkeley*
3. Architecture for Asymmetric Collaborative Navigation: Z. Zhu, S. Roumeliotis, J. Hesck, H. Park, D. Venable, *Air Force Research Laboratory*



Dr. Arthur Helwig, UrsaNav, Inc.



Patricia Rittenhouse, Northrop Grumman

Session D4: Maritime Positioning & Navigation Applications — *Atlantic 8*

- 2:05 1. Ship Attitude Accuracy Trade Study for Aircraft Approach and Landing Operations: G. Johnson, M. Primm, J. Waid, R. Aggarwal, *CISI*
- 2:35 2. Precise Determination of Sediment Dynamics Using Low-cost GPS Floaters: M. Vennebusch, S. Schön, F. Kube, L. Albert, *Universität Hannover, Germany*; A. Wurpts, *NLWKN-Forschungstelle Kuste, Germany*; T. Schlurmann, N. Goseberg, *Universität Hannover, Germany*
- 3:05 3. Heading-determination using the sensor-fusion based maritime PNT Unit: Z. Dai, R. Ziebold, A. Born, E. Engler, *German Aerospace Center (DLR), Germany*

Break 3:35 p.m. – 3:55 p.m.

- 4:00 4. A New Method of Initial Alignment and Self-calibration Based on Dual-axis Rotating Strap down Inertial Navigation System: S. Feng, Q. Sun, Y. Ben, Y. Zhang, W. Gao, *Harbin Engineering University, China*
- 4:30 5. A New Method of Automatic Compensation During States Transforming Based on the Strap down Inertial Navigation System: W. Gao, Y. Zhang, Y. Ben, Q. Sun, *Harbin Engineering University, China*
- 5:00 6. Four-position Drift Measurement of SINS Based on Single-axis Rotation: F. Sun, J. Xia, Y. Ben, X. Zhang, *Harbin Engineering University, China*



Ralph Hopkins,
C.S. Draper
Laboratory

Session A5: Sensor Manufacturing, Error Modeling & Testing — Atlantic 6/7

- 8:35 1. Statistical Modeling of Rate Gyros and Accelerometers: R.J. Vaccaro, *The University of Rhode Island*; A.S. Zaki, *Naval Undersea Warfare Center*
- 9:05 2. Honeywell Micro Electro Mechanical Systems (MEMS) Inertial Measurement Unit (IMU): K. Froyum, J. Henrickson, S. Goepfert, J. Thorland, *Honeywell International Inc.*
- 9:35 3. Inertial Sensors- Further Developments in Low Cost Calibration and Testing: Z. Berman, *Berman Consulting and Training LTD, Israel*

Break 10:05 a.m. – 10:25 a.m.

- 10:30 4. A Framework for Inertial Sensor Calibration Using Complex Stochastic Error Models: Y. Stebler, S. Guerrier, J. Skaloud, M-P. Victoria-Feser, *Swiss Federal Institute of Technology, Switzerland*
- 11:00 5. Estimation of Deterministic and Stochastic IMU Error Parameters: D. Unsal, *Roketsan Missiles Industries Inc., Turkey*; K. Demirbas, *Middle East Technical University, Turkey*
- 11:30 6. Analysis of Coning Motion Cause by Turntable's Vibrations in Rotation Inertial Navigation System: J-Z. Lai, P. Lv, J-Y. Liu, L. Zhang, *Nanjing University of Aeronautics and Astronautics, China*
Alternate
 - 1. High-order Error Modeling and Analysis on POS for Motion Compensation of Airborne InSAR: L. Chen, J. Fang, X. Gong, *Beijing University of Aeronautics and Astronautics, China*



Chris Lund,
Honeywell

Session B5: Modernized GNSS — Oleander B (Lower Level)

- 8:35 1. Characterizing the GNSS Correlation Function Distortions using a High Gain Antenna and Long Coherent Integration: L. Lestarquit, L. Ries, Y. Gregoire, *CNES, France*
- 9:05 2. Spectral Compatibility of BOC(5,2) Modulation with Existing GNSS Signals: S.B. Sekar, S. Sengupta, K. Bandyopadhyay, *Indian Institute of Technology Kharagpur, India*
- 9:35 3. Range Domain Auto-regression Method on Generalized Multivariate Time-varying Series Analysis: S. Qian, Z. Jun, Z. Yanbo, *Beihang University, China*

Break 10:05 a.m. – 10:25 a.m.

- 10:30 4. FMT Signal Options and Associated Receiver Architectures for GNSS: A. Garcia-Peña, O. Julien, C. Macabiau, *ENAC, France*; J-H. Won, D. Fontanella, M. Paonni, B. Eissfeller, *University EAF Munich, Germany*; A. Emmanuele, M. Luise, *University of Pisa, Italy*; F. Zanier, G. Lopez-Risueno, *European Space Agency/ESTEC, The Netherlands*
- 11:00 5. Staggered Interplex: M. Vergara, F. Antreich, *German Aerospace Center (DLR), Germany*
- 11:30 6. On Generalized Multidimensional Geolocation Modulation Waveforms: I.F. Progni, *Giffet Inc.*



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



Dr. Thomas D.
Powell, *The
Aerospace
Corporation*



Dr. Andrey Soloviev, University of Florida



Dr. Jack Holmes, The Aerospace Corporation



Dr. Stewart Cobb, iKare



Scott Martin, Auburn University

Session C5: Weak Signal Processing — *Tides*

- 8:35 1. A Novel Quasi Open Loop Frequency Estimator for GNSS Signal Tracking: M. Tahir, *Politecnico di Torino, Italy*; M. Fantino, *Istituto Superiore Mario Boella, Italy*; L. Lo Presti, *Politecnico di Torino, Italy*
- 9:05 2. A Weighted Combining Method for GNSS Antenna Diversity: S.N. Sadrieh, A. Broumandan, G. Lachapelle, *University of Calgary, Canada*
- 9:35 3. Characterization of the Impact of Indoor Doppler Errors on Pedestrian Dead Reckoning: V. Renaudin, Z. He, M. Petovello, *University of Calgary, Canada*

Break 10:05 a.m. – 10:25 a.m.

- 10:30 4. MAT and TTF of P2P Collaborative Networks: N. Kassabian, L. Lo Presti, *Politecnico di Torino, Italy*
- 11:00 5. Non-Coherent, Differentially Coherent and Quasi-Coherent Integration on GNSS Pilot Signal Acquisition or Assisted Acquisition: J. Qiu, Y. Qian, R. Zheng, *Unicore Communications Inc., China*
- 11:30 6. The Use of High Sensitivity GPS for Initialization of a Foot Mounted Inertial Navigation System: J. Pinchin, C. Hide, T. Moore, *Nottingham University, UK*

Session D5: Terrestrial Positioning & Navigation Applications — *Atlantic 8*

- 8:35 1. A Location-Based Services System (LBSS) Designed for an Arboretum: J. Huang, P. Uys, M. Yeh, *California State University, Fullerton*
- 9:05 2. Increased Navigation System Capacity using Ultra-Wide band Direct-path Pulse Signal Strength with Dynamic Recalibration: B.S. Dewberry, W. Beeler, *Time Domain*
- 9:35 3. Unknown Source Localization using RSS in Open Areas in the Presence of Ground Reflections: R.J. R. Thompson, E. Cetin, A.G. Dempster, *University of New South Wales, Australia*

Break 10:05 a.m. – 10:25 a.m.

- 10:30 4. Performance Analysis of a Civilian GPS Position Authentication System: Z. Li, D. Gebre-Egziabher, *University of Minnesota*
- 11:00 5. Collaboration-Enhanced Receiver Integrity Monitoring with Common Residual Estimation: J. Rife, *Tufts University*
- 11:30 6. Using the Microsoft Kinect for 3D Map Building and Teleoperation: W. Woodall, D. Bevy, *Auburn University*

Alternate

- 1. Integrated INS/GPS for Camera Tracking in Large Scale Outdoor Cinematic Applications: T. Suita, *KVH Industries Inc.*



Doug Meyer,
Northrop Grumman



Gordon Rouse,
Honeywell

Session A6: Emerging & Alternative Sensor Technologies & Precision Timing Systems — *Atlantic 6/7*

- 2:05 1. A Consistent Zero-Configuration GPS-Like Indoor Positioning System Based on Signal Strength in IEEE 802.11 Networks: M.M. Atia, *Queen's University, Trusted Positioning Inc., Royal Military College of Canada*; A. Nouredin, *Royal Military College and Queen's University, Canada*; M. Korenberg, *Queen's University, Canada*
- 2:35 2. A Segmentation-based Radio Tomographic Imaging Approach for Interference Reduction in Hostile Industrial Environments: V. Köster, A. Lewandowski, C. Wietfeld, *CNI, TU Dortmund University, Germany*
- 3:05 3. Improvement of TERCOM Aided Inertial Navigation System by Velocity Correction: Y.M. Yoo, W.H. Lee, S.M. Lee, *Seoul National University, South Korea*; J.H. Kwon, *The University of Seoul, South Korea*; C.G. Park, *Seoul National University, South Korea*
- 3:35 4. Compact Atomic Magnetometer for Global Navigation: M. Bulatowicz, M. Larsen, *Northrop Grumman*
- 4:05 5. Cold Atom Micro Primary Standard (CAMPS): K.D. Nelson, J. Strabley, K. Salit, J. Kriz, *Honeywell Aerospace*
- 4:35 6. Factors Influencing the Noise Floor and Stability of a Time Domain Switched Inertial Device: R.L. Waters, M. Fralick, D. Jacobs, S. Abassi, R. Dao, D. Carbonari, G. Abramov, G. Maurer, *Lumedyne Technologies, Inc.*

Alternate

1. Development of a Test Bed for UWB Radio Indoor Localization of First Responders: A. De Angelis, S. Dwivedi, P. Händel, *KTH Royal Institute of Technology, Sweden*



Dr. Boris Pervan,
Illinois Institute of
Technology



Dr. Félix Torán,
European Space
Agency (ESA),
France

Session B6: GNSS Augmentation Systems — *Oleander B (Lower Level)*

- 2:05 1. Automated Verification of Potential GPS Signal-In-Space Anomalies Using Ground Observation Data: L. Heng, G.X. Gao, T. Walter, P. Enge, *Stanford University*
- 2:35 2. Assessment of Integrity Monitoring Test-bed Module for the Airport Environment: S-J. Yeh, S-S. Jan, *National Cheng Kung University, Taiwan*
- 3:05 3. Detecting Ionospheric Gradients for GBAS Using A Null Space Monitor: J. Jing, S. Khanafseh, F. C. Chan, S. Langel, B. Pervan, *Illinois Institute of Technology*
- 3:35 4. Determining and Measuring the True Impact of C/A Code Cross-correlation on Tracking: L. Lestarquit, Y. Gregoire, *CNES, France*; O. Nouvel, *M3S, France*
- 4:05 5. Automated Determination of Fault Detection Thresholds for Integrity Monitoring Algorithms of GNSS Augmentation Systems: Y. Yun, J. Cho, M-B. Heo, *Korea Aerospace Research Institute, South Korea*
- 4:35 6. The Application of the Time Series Theory to Processing Data from the SBAS Receiver with Safety of Life Service: M. Jonas, *University of Pardubice, Czech Republic*

Alternates

1. GPS-III L1C Signal Reception Demonstrated on QZSS: P.G. Mattos, *STMicroelectronics, UK*; F. Pisoni, *STMicroelectronics, Italy*
2. Evaluation of Positioning Accuracy with QZSS Enhanced Global Navigation Satellite Systems: Y. Li, C. Rizos, *University of New South Wales, Australia*



Dr. Wouter Pelgrum, *Ohio University*



Dr. David Cyganski, *Worcester Polytechnic Institute*



Dr. Shau-Shiun Jan, *National Cheng Kung University, Taiwan*



Dr. Demoz Gebre-Egziabher, *University of Minnesota*

Session C6: Terrestrial Radionavigation & RF-Positioning — *Tides*

- 2:05 1. ASF Surveying and Quality Assurance for eLoran: C. Hargreaves, P. Williams, M. Bransby, *GLA R&NAV, UK*
- 2:35 2. A Terrestrial Positioning and Timing System (TPTS): C. Bartone, *Ohio University*
- 3:05 3. Precision Personnel Locator: Inverse Synthetic Aperture Array Reconciliation Tomography: A. Cavanaugh, M. Lowe, D. Cyganski, R. J. Duckworth, *Worcester Polytechnic Institute*
- 3:35 4. Joint Location and Parameter Tracking of Mobile Nodes in Wireless Networks: T. Sathyan, M. Hedley, *CSIRO ICT Centre, Australia*
- 4:05 5. Accuracy Indicator for Fingerprinting Localization Systems: V. Moghtadaiee, A.G. Dempster, B. Li, *University of New South Wales, Australia*
- 4:35 6. Constructing a Continuous Phase Time History from TDMA Signals for Opportunistic Navigation: K. Pesyna, Z. Kassas, T. Humphreys, *The University of Texas at Austin*

Alternates

- 1. Next Generation Low Frequency Solutions for Alternative Positioning, Navigation, Timing, and Data (PNT&D) Services and Associated Receiver Technology: A. Helwig, C. Stout, G. Offermans, C. Schue, *UrsaNav, Inc.*
- 2. RSSI Ranging Model and 3D Indoor Positioning with ZigBee Network: Q. Chen, *Nanchang University, China*; H. Liu, *Beijing Institute of Technology, China*; M. Yu, *Jiangxi Normal University, China*; H. Guo, *Nanchang University, China*

Session D6: Robotic Positioning, Navigation, Control & Sensor Technology — *Atlantic 8*

- 2:05 1. Applying Observability-constrained Kalman Filtering to Vision-aided Navigation for Miniature Air Vehicles (MAVs): C. Taylor, *Sensors Directorate Air Force Research Laboratory*
- 2:35 2. Characterization of Non-Line-of-Sight (NLOS) Distance Measurement Errors via Analysis of Clutter Topology: M. Hussain, Y. Ayatar, A. Markham, N. Trigoni, *University of Oxford, UK*
- 3:05 3. In-Cabin Localization Solution for Optimizing Manufacturing and Maintenance Processes for Wide-Body Commercial Aircraft: A. Lewandowski, C. Wietfeld, *TU Dortmund University, Germany*; J. Klaue, *EADS Innovation Works, Germany*
- 3:35 4. Mobile ad-hoc Communication in Machine Swarms for Relative Positioning Based on GNSS-raw Data Exchange: J. Schattenberg, T. Lang, S. Batzdorfer, M. Becker, U. Bestmann, P. Hecker, *Technische Universität Braunschweig, Germany*
- 4:05 5. Low Cost IMU Based Indoor Mobile Robot Navigation with the Assist of Odometry and Wi-Fi Using Dynamic Constraints: C. Chen, W. Chai, H. Roth, *University of Siegen, Germany*
- 4:35 6. Study on the Use of Microsoft Kinect for Robotics Applications: M.J. Yeh, J. Huang, *California State University, Fullerton*

Alternates

- 1. Relative Navigation for Formation Flying Space crafts Using X-ray Pulsars: F. Wu, X. Sui, Y. Zhao, *Beihang University, China*
- 2. SAR Image Processing Using Super Resolution Spectral Estimation with Cadzow Denoising and Periodogram Method: B. Kim, S-H. Kong, *KALST, South Korea*

Exhibit Hall and Hours

Coffee and all conference refreshments will be served in the exhibit hall.

Tuesday, April 24 10:00 a.m. – 4:00 p.m. (Lunch from 12:00 p.m. – 1:00 p.m.) &
6:00 p.m. – 8:00 p.m. (Exhibitor Hosted Reception)

Wednesday, April 25 10:00 a.m. – 4:00 p.m. (Lunch from 12:00 p.m. – 1:00 p.m.)

Exhibit Hall: Atlantic Ballroom 1-5

