

**23rd International Technical
Meeting of the Satellite Division
of the Institute of Navigation 2010**

(ION GNSS 2010)

**Portland, Oregon, USA
21-24 September 2010**

Volume 1 of 4

ISBN: 978-1-61782-735-8

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2010) by the Institute of Navigation
All rights reserved.

Printed by Curran Associates, Inc. (2011)

For permission requests, please contact the Institute of Navigation
at the address below.

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

Phone: (703) 366-2723
Fax: (703) 366-2724

membership@ion.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

Volume 1

PLENARY

Looking Ahead for GPts	1
<i>Bradford Parkinson</i>	
GNSS Sustainment: The Challenge of Availability	46
<i>Paul D. Massatt</i>	
GNSS Robustness: The Interference Challenge	69
<i>Phillip W. Ward</i>	
GNSS Interoperability Through International Cooperation	98
<i>David A. Turner</i>	
The Impact of GNSS on PNT Applications Around the World	125
<i>Mikel M. Miller</i>	

B1: GNSS ALGORITHMS & METHODS 1

Novel Multipath Mitigation Methods Using a Dual-Polarization Antenna	140
<i>Paul D Groves, Ziyi Jiang, Benjamin Skelton, Paul A Cross, Lawrence Lau, Yacine Adane, Izett Kale</i>	
An Efficient Algorithm for Short Delay Time Multipath Estimation and Mitigation	152
<i>Matthew Brenneman, Yu Morton</i>	
Kalman-Filter-Based Integer Ambiguity Resolution Strategy for Long-Baseline RTK with Ionosphere and Troposphere Estimation	161
<i>Tomoji Takasu, Akio Yasuda</i>	
ADIBEAM: Adaptive Digital Beamforming for Galileo Reference Ground Stations	172
<i>Jose Lopez-Vicario, Felix Antreich, Marc Barcelo, Nikola Basta, Joan M. Cebrian, Manuel Cuntz, Oscar Gago, Laura Gonzales, Marcos V. T. Heckler, Cristina Lavin, Marti Manosas, Joan Picanyol, Gonzalo Secon-Granados, Matteo Sgammini, Francisco Amarillo</i>	
Reliable Integer Ambiguity Resolution with Multi-Frequency Code Carrier Linear Combinations	185
<i>P. Henkel, C. Günther</i>	
Long Baseline Relative Positioning with Estimating Ionosphere and Troposphere Gradients	196
<i>Tomohiro Yanase, Hisaya Tanaka, Masaharu Ohashi, Yukihiko Kubo, Sueo Sugimoto</i>	
Positioning Techniques with Two GNSS Satellites Over Time	207
<i>Yong Khigh Tan</i>	
On Hilbert Huang Transform and its Application to GNSS Signal Multipath Characterization	217
<i>Angelika Hirrle, Evelin Engler</i>	
A Compensation Filter Design for Accurate GPS Attitude Determination	224
<i>Romeo Ahohe</i>	

C1A: AUTONOMOUS VEHICLES

Optimization of Vehicle Positioning System Architectures for Future Automotive Applications	231
<i>Hans-Georg Büsing, Andreas Sasse, Tobias Scheide, Peter Hecker</i>	
Detection of Stationarity in an Inertial Navigation System	238
<i>Arvind Ramanandan, Anning Chen, Jay A. Farrell, Sarah Suvarna</i>	
Integrity Monitoring of Vision-Based Automotive Lane Detection Methods	245
<i>Courtney Mario, Jason Rife</i>	
Terrain Characterization and Feature Extraction for Automated Convoys	256
<i>Scott M. Martin, Jeremy J. Dawkins, William E. Travis, David M. Bevly</i>	
High Performance RTK for Small UAVs	266
<i>M. R. Phillips, K. L. Johnson, T. D. Arthur, M. S. Braasch, K. M. Scheff</i>	

C1B: RAIM AND/OR MULTI-CONSTELLATION RAIM

Advanced RAIM Based on Inter-Constellation Comparisons to Detect Consistent Faults for LPV-200	272
<i>Young C. Lee, Tim Cashin</i>	
Prototyping Advanced RAIM for Vertical Guidance	285
<i>Juan Blanch, Myung Jun Choi, Todd Walter, Per Enge, Kazushi Suzuki</i>	
Advanced RAIM Scheme and its Evaluation for Non-Aeronautical Users in Different Environments	292
<i>J. Simon, J. Vázquez, A. Madrazo, A. Cezañ, W. Enderle</i>	

D1: ATMOSPHERIC SCIENCES

Local Ionosphere Model Estimation from Dual-Frequency GNSS Observables	301
<i>Ryan Mitch, Mark Psiaki</i>	
Observing Traveling Ionospheric Disturbances Caused by Tsunamis Using GPS TEC Measurements	313
<i>David A. Galvan, Attila Komjathy, Michael Hickey, James Foster, Anthony J. Mannucci</i>	
Time Frequency Analysis of Tropospheric Wet Delay Series Monitored by GPS Network PPP Technique During Extreme Rainfalls	328
<i>Wei-Chih Peng, Kun-Yao Peng, Kai-Wei Chiang</i>	
Using Ionospheric Imaging Combined with Feature Tracking to Automate Identification and Tracking of Polar-cap Plasma Patches	343
<i>Robert Burston, Kevin Hodges, Ivan Astin, Nicolas Bergeot, Carine Bruyninx, Jean-Marie Chevalier</i>	
Investigation of High Latitude Ionospheric Scintillation Observed in the Canadian Region	349
<i>R. Tiwari, F. Ghafoori, O. Al-Fanek, O. Haddad, S. Skone</i>	
Temporal Decorrelation of GPS Satellite Signals due to Multiple Scattering from Ionospheric Irregularities	361
<i>Charles S. Carrano, Keith M. Groves</i>	
Ionospheric Depletion Detection Over the Indian Region Using a Single Frequency Detection Algorithm	375
<i>M. Cueto, I. Hidalgo, E. Sardon, G. Um, M. Bailey</i>	
Elimination of Superimposed Multipath Effects on Scintillations Index on Solar Quiet Ionosphere at Low Latitude Over the Kenyan Airspace from a Lone Positioned SCINDA System	386
<i>O. J. Olwendo, P. Baki, C. Mito, P. Doherty</i>	

E1: URBAN & INDOOR NAVIGATION TECHNOLOGY 1

Spatial/Temporal Characterization of the GNSS Multipath Fading Channels	393
<i>Seyed Nima Sadrieh, Ali Broumandan, Gérard Lachapelle</i>	
Power Levels and Second Order Statistics for Indoor Fading Using a Calibrated A-GPS Software Receiver	402
<i>Shashank Satyanarayana, Daniele Borio, Gérard Lachapelle</i>	
Satellite to Indoor Channel Characterization with Implementation in a GNSS Software Simulator	415
<i>Iva Bartunkova, Matteo Paonni, Bernd Eissfeller</i>	
Signal Simulations in Urban Environments	425
<i>A. Steingass, B. Krach, F. Schubert, M. Crisci, R. Prieto-Cerdeira</i>	
Snapshot Software Receiver for GNSS in Weak Signal Environments: An Innovative Approach for Galileo E5	435
<i>Sergio Carrasco-Martos, Gustavo López-Risueño, David Jimenez-Baños, Eberhard Gill</i>	
An Ultra-Sensitive Software GPS Receiver for Timing and Positioning	448
<i>Nobuhiro Kishimoto, Jon Vavrus, Lawrence R. Weill</i>	
A New Approach for Deep Integration of GNSS and Vision-Aided MEMS IMU	464
<i>Valentin Barreau, Benoit Priot, Mohamed Sahmoudi, Vincent Calmettes</i>	
Stationary, Cyclostationary and Nonstationary Analysis of GNSS Signal Propagation Channel	476
<i>Shashank Satyanarayana</i>	
Implementation of Receiver of Indoor Positioning System Based on UWB	489
<i>Jinsong Xu, Xiaochun Lu, Yan Bai, Jing Wang</i>	
Research of Nonlinearity Effects Based on Indoor-Pseudolite Positioning System	496
<i>Xiaoguang Wan, Xinqun Zhan, Chuanrun Zhai, Jingjing Dou</i>	

F1: PEDESTRIAN NAVIGATION

New Pedestrian Trajectory Simulator to Study Innovative Yaw Angle Constraints	504
<i>C. Ascher, C. Kessler, A. Maier, P. Crocoll, G. F. Trommer</i>	
In-Situ Step Size Estimation Using a Kinetic Model of Human Gait	511
<i>Christopher J. Mathews, Yohannes Ketema, Demoz Gebre-Egziabher, Michael Schwartz</i>	
Assessment of Indoor Magnetic Field Anomalies Using Multiple Magnetometers	525
<i>Muhammad Haris Afzal, Valérie Renaudin, Gérard Lachapelle</i>	
Vision-aided IMU for Handheld Pedestrian Navigation	534
<i>C. Hide, T. Botterill, M. Andreotti</i>	
Non-Conventional INS/GNSS Integration for Qualitative Motion Analysis in Caregiving Applications	542
<i>P. Molina, I. Colomina, M. Troger, B. Hofmann-Wellenhof, C. Aguilera</i>	
Towards Arbitrary Placement of Multi-sensors	556
<i>X. Zhao, S. Saeedi, N. El-Sheimy, Z. Syed, C. Goodall</i>	
Test Results for Indoor Positioning Solution Using MEMS Sensor Enabled GPS Receiver	565
<i>Mahesh Chowdhary, Mahaveer Jain, Rajeev Kumar Srivastava</i>	
A Novel EMG-Based Stride Length Estimation Method for Pedestrian Dead Reckoning	569
<i>Wei Chen, Xu Zhang</i>	
Integrated Particle Swarm Optimization and Kalman Filter for Navigation Applications	577
<i>A. S. Ali, N. El-Sheimy</i>	
Adaptive Methods of Kalman Filtering for Personal Positioning Systems	584
<i>E. Pulido Herrera, H. Kaufmann</i>	

PANEL 1: PROGRAM UPDATES: GPS, GLONASS, GALILEO, IRNSS, QZSS

Global Positioning Systems Wing	590
<i>Bernard Gruber</i>	
GLONASS Status and Progress	609
<i>Sergey Revniviykh</i>	
Galileo Programme Status	634
<i>René Oosterlinck</i>	
QZSS The Japanese Quasi-Zenith Satellite System: Program Updates and Current Status	660
<i>Hiroaki Maeda</i>	

A2. GNSS IIF: FROM INCEPTION TO LAUNCH

Operations Readiness to Support GPS IFF	709
<i>Thomas Duffy, Jack Taylor</i>	
GPSI IIF Processing at the Eastern Launch Site	721
<i>Harry Brown, Eric Watts</i>	
GPSW IIF Test Methodology and Selected Results for SVN62 (PRN 25)	738
<i>John Buckreis, Rommel Villanueva, Eric Watts, Avram Tetewsky</i>	
GPS IFF Satellite Overview	753
<i>Michael Braschak, Harry Brown Jr., Joseph Carberry, Tim Grant, Gregory Hatten, Robert Patocka, Eric Watts</i>	
Control Segment Implementation of SAASM: A Programmatic Perspective	771
<i>Candace J. Hoecker</i>	
Rubidium Frequency Standard for the GPS IIF Program and Modifications for the RAFSMOD Program	781
<i>Ryan T. Dupuis, Thomas J. Lynch, John R. Vaccaro, Eric Watts</i>	
GPS IIF L5 Transmitter Design and Performance	789
<i>David Curnutte, Frank Czopek, Paul Dahlgren, Eric Watts, Karl Kovach</i>	
GPS Block IIF Rubidium Frequency Standard Life Test	812
<i>F. Vannicola, R. Beard, J. White, K. Senior, A. Kubik, D. Wilson</i>	
Space-Qualified Microprocessor-Controlled Cesium Atomic Clock	820
<i>Peter Cash, Peter Vlitas, Donald Emmons, Robert Lutwak, Eric Watts</i>	

B2: GNSS SIMULATION AND TESTING

End-to-End GPS Multi-Platform Integrated System Testing for MGUE	826
<i>Angelo Trunzo, Paul Benshoof, Ray Diesposti, Mitch Markota, Joe Hewlett, Sultan Mahmood</i>	
GNSS Receiver Performance: Dependency on Receiver Make, Model, & Sky View	835
<i>Chaminda Basnayake</i>	
A New GNSS Multi Constellation Simulator: NAVYS	845
<i>Geraldine Artaud, Antoine De Latour, Joël Danepal, Lionel Ries, Nicolas Maury, Jean-Christophe Denis, Eirc Senant, Thomas Bany</i>	
Fluctuation: A Novel Approach to GNSS Receiver Testing	858
<i>Alexander Mitelman</i>	

Volume 2

Modifications to GPS Reference Station Antennas to Reduce Multipath	866
<i>Aaron Kerkhoff, R. Benjamin Harris, Colin P. Petersen, Alex Pickard</i>	
Wideband Dual-Channel RF Record and Playback for Multi-Constellation Analysis	879
<i>Marc-Antoine Fortin, Iurie Ilie, Dominique Fortin, Kaveh Mollaiyan, René Jr. Landry</i>	
Development of a Software-Based Multi-GNSS Observable Simulator	892
<i>Sunil Bisnath, Alexander Dolgansky, Anthony Szeto</i>	
Global Navigation Satellite System of Systems Implications for Civil Users	900
<i>Janaki Potukuchi, Peter Bauer, Jonathan Rios</i>	

C2: ENHANCED AND DEVELOPING SYSTEMS

Robust Time Transfer From Space to Backup GPS	907
<i>David Whelan, Per Enge, Gregory Gutt</i>	
Effect of SVN49 (PRN01) on Position and Time Accuracy for Single-and Dual-Frequency Users	915
<i>M. Bakry El-Arini, Robert S. Conker, Daniel G. O'Laughlin, Christopher J. Hegarty</i>	
Potentials for GNSS Signal Enhancements – An Assessment of the Impact of Satellite Imperfections on the Navigation Performance of Today's and Future GNSS	924
<i>Michael Meurer, Steffen Thoelert, Stefan Erker, Oliver Montenbruck</i>	
Initial Results on Nominal GPS L5 Signal Quality	935
<i>Christopher J. Hegarty, Jeffry T. Ross</i>	

A Comprehensive Methodology for Assessing Radio Frequency Compatibility for GPS, Galileo and Compass	943
<i>Wei Liu, Li Liu, Mancang Niu, Xingqun Zhan</i>	
Radio Frequency Compatibility Assessment of COMPASS New Signals	955
<i>Liang Zhu, Xiaowei Cui, Mingquan Lu, Zhenming Feng</i>	
Next Generation GPS Ground Control Segment (OCX) Navigation Design	964
<i>Willy Bertiger, Yoaz Bar-Sever, Nate Harvey, Kevin Miller, Larry Romans, Jan Weiss, Larry Doyle, Tara Solorzano, John Petzinger, Al Stell</i>	

D2: REMOTE SENSING WITH GNSS & INTEGRATED SENSORS

The Calibration Methodology of a Low Cost Land Vehicle Mobile Mapping System	978
<i>Yu-Hua Li</i>	
Low-Cost Post-Mission Positioning and Orientation Solution for Land-Based Mobile Mapping Using Nonlinear Filtering	991
<i>Jacques Georgy, Aboelmagd Noureldin</i>	
Testing Sub-decimeter, Kinematic Wide-Area Positioning for Airborne Lidar Surveys Using the CORSnet-NSW Network	1004
<i>Oscar L. Colombo, Shane Brunker, Glenn Jones, Volker Janssen, Chris Rizos</i>	
The ROSA Radio-Occultation Receiver: Missions and Next Generation Evolution	1019
<i>L. Marradi, A. Zin, E. Mangolini, F. Belgiavone, L. Scaciga, S. Zago, S. Landenna, V. Decosmo, V. Catalano</i>	
Soil Moisture Estimation Using Land-Reflected GPS L2C Bi-Static Radar Measurements	1031
<i>A. Azmani, S. Reboul, J. B. Choquel, M. Benjelloun</i>	
Error Propagation in Ionospheric Image-Based Parameter Estimation	1039
<i>Seebany Datta-Barua, Gary S. Bust, Geoff Crowley</i>	
Open Loop Tracking of Radio Occultation Signals from an Airborne Platform	1049
<i>Tyler D. Lulich, James L. Garrison, Jennifer S. Haase, Yu-Ming Yang, Justin Voo, Feiqin Xi, Paytsar Muradyan</i>	
The SGR-ReSI – A New Generation of Space GNSS Receiver for Remote Sensing	1061
<i>M. Unwin, R. De Vos Van Steenwijk, C. Gommenginger, C. Mitchell, S. Gao</i>	

E2A: CONSUMER APPLICATIONS

Robust First Fix Performance in Urban Areas	1068
<i>Y. C. Chien, W. G. Yau, C. T. Weng</i>	
GNSS Hybridisation for Indoor Positioning	1073
<i>Jose F. M. Lorga, Pedro F. Silva, João S. Silva, Tiago F. Rocha Da Silva, Mario S. Nunes, Fernando D. Nunes, Fernando M. G. Sousa</i>	
Off-Board Positioning Using an Efficient GNSS SNAP Processing Algorithm	1088
<i>Dvir Rosenfeld, Eiran Duchovny</i>	
GNSS Position Computation without Ephemeris "Single Shot MS Based"	1094
<i>Javier De Salas, Frank Van Diggelen</i>	
Sources and Impact of GNSS Signal Degradation within a Vehicle Environment	1100
<i>Brian Weinstein, Martin Czerep, Dennis Akos</i>	

E2B: REGULATORY SERVICE APPLICATIONS (ROAD USER CHARGING, ETC.)

The Possibility and Added-value of Authentication in Future Galileo Open Signal	1112
<i>H. V. De Castro, G. Van Der Maarel, E. Safipour</i>	
Quantifying and Demonstrating GNSS and EGNOS Benefits in Regulated Road Pricing Applications	1124
<i>Fiammetta Diani, Philippe Hamet, Gian Gherardo Calini</i>	
Groundwork for GNSS Integrity Monitoring in Urban Road Applications. The Road User Charging Case	1130
<i>D. Saló, A. Martineau, C. Macabiau, D. Kubrak, B. Bonhoure</i>	
Detection and Mitigation of GNSS Deception by Combination of Odometric Dead Reckoning and GNSS Observations for Vehicles	1145
<i>H. Niedermeier, H. Beckmann, B. Eissfeller, O. Pozzobon, R. Grzeszczyk, T. Przybyla</i>	
Performance Aspects of Navigation Systems for GNSS-Based Road User Charging	1157
<i>Rafael Toledo-Moreo, José Santa, Benito Ubeda, Carolina Pinana, Miguel A. Zamora-Izquierdo, Antonio F. Gómez-Skarmeta</i>	

F2: LBS TECHNOLOGY AND APPLICATIONS

A Network Selection and Optimization Approach for Ground-Based Positioning Systems	1166
<i>Fazole Sadi, Richard Klukas, Abbas S. Milani</i>	
Development of a Real Time Indoor Location Based Service Test Bed	1175
<i>Li-Ta Hsu, Wen-Ming Tsai, Shau-Shiun Jan</i>	
Results of IMES (Indoor Messaging System) Implementation for Seamless Indoor Navigation and Social Infrastructure Platform	1184
<i>Dinesh Manandhar, Seiya Kawaguchi, Hideyuki Torimoto</i>	
Reference for Indoor Location Systems Using Gyroscope and Quadrature Incremental Encoder	1192
<i>Olli Pekkalin, Helena Leppakoski, Lucian Iozan, Jani Hautamaki, Jussi Collin, Jarmo Takala</i>	

Demonstration of Inter-Vehicle UWB Ranging to Augment DGPS for Improved Relative Positioning	1198
<i>Mark G. Petovello, Kyle O'Keefe, Billy Chan, Stephanie Spiller, Cyril Pedrosa, Chaminda Basnayake</i>	
Positioning Enhancement with Double Differencing and DSRC	1210
<i>Nima Alam, Asghar Tabatabaei Balaei, Andrew G. Dempster</i>	
Innovative Localization System for the Soldier/Fire-fighter Based on the IR-UWB	1219
<i>Seong Yun Cho, Young Woo Choi, Joo Young Kim, Munkhzul Enkhtur</i>	
Coordinate-Free Radio Navigation and Guidance Using Location-Dependent Signals and Propagation Channel Parameters	1224
<i>Di Qiu, Mikel Miller, Stew Devilbiss, Thao Nguyen, Chun Yang</i>	
Dynamic Indoor positioning with the Handover Algorithm	1233
<i>F. Alsehly, R. Mohd Sabri, Z. Sevak, T. Arslan</i>	

PANEL 2: PROGRAM UPDATES: HIGH INTEGRITY SYSTEMS

Wide Area Augmentation Systems (WAAS) Status	1243
<i>Deborah Lawrence</i>	
European Geostationary Navigation Overlay Service EGNOS Status Update	1270
<i>Cedric Seynat, Didier Flament</i>	
Ground Based Augmentation System	1300
<i>Carlos Rodriguez</i>	
Integrity Challenges Resulting from Fragmentation of GNSS Navigation Services	1316
<i>Tim Murphy</i>	

A3. INTEGRATING SYSTEM CAPABILITIES AT THE GPS WING (INVITED PAPERS ONLY)

System Engineering Approach for GPS Civil Signal Monitoring	1341
<i>Nori Shohara, Aaron Hale</i>	
Enterprise Information Assurance Integration	1345
<i>George A. Johnson, Martin H. Lopez</i>	
A Novel Approach to GPS System-Level Testing	1350
<i>Edward Weston, Glenn A. Schroeder, Bob Chadil, Phillip A. Herre</i>	
GPS Capability Delivery Planning and Analysis	1355
<i>John P. Silvas, John C. McCanless, Christopher J. Williams</i>	
GPS Integrated System Test Panel	1362
<i>Mark Fish</i>	

B3: NEW PRODUCTS ANNOUNCEMENTS

Super-Sensitive Software GNSS Receiver	1365
<i>Ruslan Budnik, Bladimir Sviridenko</i>	
GNSS Absolute Antenna Calibration at the National Geodetic Survey	1369
<i>Andria Bilich, Gerald L. Mader</i>	
Digital GNSS Signal Recorder, Generator, and Simulator for Receiver Test, Qualification, and Certification	1378
<i>Alexander Ruegamer, Matthias Overbeck, Stefan Koehler, Guenter Rohmer, Philipp Berglez, Elmar Wasle, Juergen Seybold</i>	
The New Leica Viva GNSS Receivers	1386
<i>Peter Fairhurst, Ulf Glueckert, Bernhard Richter</i>	
SX-NSR 2.0 – A Multi-frequency and Multi-sensor Software Receiver with a Quad-band RF Front End	1395
<i>N. Falk, T. Hartmann, H. Kern, B. Riedl, T. Pany, R. Wolf, J. Winkel</i>	
An Innovative EGNOS/EDAS-Based Platform to Generate Advanced Solutions in the Winter Service Technology	1402
<i>Gianluca Marucco, Fabrizio Dominici, Paolo Mulassano, Antonio Defina, Khalid Charqane, Gianluca Falco</i>	
Positioning Platform for Low-Cost, Accurate, Infrastructure-free Machine Control	1411
<i>Z. Syed, A. Noureddin, N. El-Sheimy</i>	
Next Generation Software-based GPS Receiver for Real-World Applications	1420
<i>Francis Yuen, Zhe Liu</i>	
Nexteq Precise Low-Cost GPS/GIS Handhelds	1424
<i>Yufeng Zhang, Suen Lee, Chang Chen</i>	

C3: AVIATION APPLICATIONS

The Multivariate Constrained LAMBDA Method for Single-Epoch, Single-Frequency GNSS-Based Full Attitude Determination	1429
<i>Gabriele Giorgi</i>	
Operational Implementation of EGNOS and LPV Approaches in Aviation in Europe	1440
<i>Javier Murcia, Luis Chocano, Pablo Haro, Richard Farnworth, Hans De With</i>	
Multi SBAS Interoperability Flight Trials with A380	1449
<i>Laurent Azoulai, Sébastien Virag, Romain Leinekugel Le Cocq, Cyril Germa, Bernard Charlot</i>	

Validation of the WAAS RNAV and VNAV Approach Precision by Using Category A and B Aircraft with Commercial WAAS Receiver	1465
<i>Yih-Ru P. Huang, R. Xiao, John Fagan</i>	
Feasibility Analysis of GPS III Integrated with an Inertial System to Provide CAT IIIB Services	1472
<i>Young C. Lee, Curtis A. Shively</i>	
Protection Level Calculation for Least Squares GPS Attitude Determination	1482
<i>Teng-Yao Yang, Shau-Shiun Jan</i>	
Containment Limits for Free-Inertial Coast	1490
<i>James L. Farrell, Frank Van Graas</i>	
The Performance Improvement of a Low Cost GPS/INS Integration System Using a Single-Antenna GPS Based Attitude	1498
<i>Am Cho, Heekwon No, Changdon Kee</i>	

D3: SURVEYING & GEODESY

GNSS/INS Integration in Vehicular Urban Navigation	1505
<i>A. Angrisano, M. Petovello, G. Pugliano</i>	
Operational Performance of RTK Positioning when Accounting for the Time Correlated Nature of GNSS Phase Errors	1513
<i>Charles Miller, Kyle O'Keefe, Yang Gao</i>	
Professional Care of GNSS Handheld with Internal Antenna: What Position Accuracy One Can Expect	1525
<i>Gleb Zyryanov, Igor Artushkin, Dmitry Ivanov, Evgeny Sunitsky</i>	
Concepts to Limit Convergence Time of GPS-Based Precise Point Positioning (PPP)	1533
<i>Ana Karabatic, Robert Weber, Katrin Huber, Christoph Abart, Florian Heuberger, Philipp Berglez, Jürgen Seybold, Christian Klug</i>	
Detection of Millimetric Periodic Displacement Amplitude Using One GPS Receiver	1540
<i>Ricardo E. Schaal, Ana P. C. Larocca</i>	
The Development of a Tightly-coupled INS/GPS Sensors Fusion Scheme Using Adaptive Kalman Filter	1545
<i>Guan-Yu Yao, Kuan-Yun Chen, Yu-Wen Huang, Kai-Wei Chiang</i>	

E3: GPS AND GLONASS MODERNIZATION AND OTHER EMERGING GNSS (GALILEO, QZSS, IRNSS, COMPASS)

Impact of GPS Block IIR Space Vehicle Lifetime on Constellation Sustainment	1554
<i>Willard Marquis, J. David Riggs</i>	
GLONASS Developing Strategy	1566
<i>Y. Urlichich, V. Subbotin, G. Stupak, V. Dvorkin, A. Povaliae, S. Karutin</i>	
ETS-VIII Precise Orbit and Clock Estimation Experiments	1572
<i>R. Nakamura, T. Inoue, S. Nakamura, S. Katagiri, S. Noppanakepong, Y. Feng</i>	
Evaluation and Calibration of Receiver Inter-channel Biases for RTK-GPS/GLONASS	1580
<i>Hideki Yamada, Tomoji Takasu, Nobuaki Kubo, Akio Yasuda</i>	
Modified Binary Coded Symbol Modulation and Its Application for Compass	1588
<i>Wei Liu, Chuanrun Zhai, Yanhua Zhang, Xingqun Zhan</i>	
GPS in Mid-life with an International Team of Doctors Analyzing IIF-1 Satellite Performance and Backward-Compatibility	1597
<i>Grace Xingxin Gao, Liang Heng, Gabriel Wong, Eric Phelts, Juan Blanch, Todd Walter, Per Enge, Stefan Erker, Steffen Thöelert, Michael Meurer</i>	
Assisted GNSS – Traditional and Vectorized: Implementation and Performance Results	1605
<i>Tianxing Chu, Dennis Akos</i>	
New Signals in the Sky - A High Gain Antenna Analysis of GPS IIF and COMPASS	1615
<i>Steffen Thöelert, Stefan Erker, Michael Meurer, Johann Furthner</i>	

F3: LAND BASED APPLICATIONS

High Precision Positioning in Difficult GPS Environments for Cooperative Vehicle Safety Applications	1622
<i>Andrey Soloviev, Zeljko Popovic, Yutaka Mochizuki</i>	
Performance Evaluation of Range Information Provided by Dedicated Short Range Communication (DSRC) Radios	1631
<i>John W. Allen, David M. Bevly</i>	
Performance Evaluation of Compact MEMS IMU/GPS Tight Coupling with IMU-Aided Tracking Loop	1636
<i>Ping Ye, Gang Du, Xingqun Zhan, Chuanrun Zhai</i>	
Low-Cost Sensor Fusion Dead Reckoning Using a Single-Frequency GNSS Receiver Combined with Gyroscope and Wheel Tick Measurements	1645
<i>A. Somieski, Ch. Hollenstein, E. Favey, C. Schmid</i>	
Application of Particle Filters for Vehicle Positioning Using Road Maps	1653
<i>Pavel Davidson, Jussi Collin, John Raquet, Jarmo Takala</i>	

GPS-Aided Land-Based Navigation and Precision Farming Applications: Improving GPS Solutions by Means of MEMS-IMU and Low-Cost Sensors.....	1662
<i>Cristina Castagnetti, Ludovico Biagi, Alessandro Capra</i>	
Estimation of Spatially Correlated Errors in Vehicular Collaborative Navigation with Shared GNSS and Road-Boundary Measurements.....	1667
<i>Jason Rife, Xuan Xiao</i>	
Validation of an Affordable Real Time Lane-Level Positioning System for Cooperative Vehicle-Infrastructure Systems.....	1678
<i>Pedro Rodriguez De Andres, David Betaille, Rafael Toledo-Moreo</i>	
Dynamic Modeling for Land Mobile Navigation Using Low-Cost Inertial Sensors and Least Squares Support Vector Machine Learning.....	1687
<i>Kyriakos Frangos, Allison Kealy, Vassilis Gikas, Azmir Hasnur</i>	
Bridging Integrated GPS/INS Systems with Geospatial Models for Car Navigation Applications.....	1697
<i>M. Attia, A. Moussa, N. El-Sheimy</i>	

PANEL 3: DEEP INDOOR NAVIGATION —WHICH TECHNOLOGY WILL PREVAIL?

Deep Indoor Navigation - The End of the Beginning	1704
<i>Frank Van Diggelen</i>	
Pseudolite Concepts for Deep Indoor Navigation	1724
<i>H. Stewart Cobb</i>	

Volume 3

MOSAIC: Enabling Technology for Deep Indoor Navigation	1739
<i>Changdon Kee</i>	
WiFi Localization - Market, Technology, and Future	1761
<i>Farshid Alizadeh-Shabdz</i>	
IMES (Indoor Messaging System) The Solution for Deep Indoor Navigation	1779
<i>Kiyoshi Yajima</i>	

A4A: NATO MILITARY PNT & NAVWAR (INVITED PAPERS ONLY)

Overview of NATO Navigation Sub-Committee and its PNT and NAVWAR Activities	1800
<i>Jean-Philippe Saulay</i>	
GPS Precise Positioning Service Equipment Certification Office (PECO) and Military Standard Order (MSO) Certification	1830
<i>James Tomaszewski, Karl Kovach, Xuandzung Tran, Joan Stripling</i>	
Galileo, the Public Regulated Service and PRS/GPS Dual Mode Operations	1863
<i>N. C. Davies, G. Black, P. Campagne</i>	

B4: SOFTWARE RECEIVERS

A Multi-Purpose Software GNSS Receiver for Automotive Applications	1869
<i>Ulrich Haak, Hans-Georg Büsing, Peter Hecker</i>	
Channel Context Detection and Signal Quality Monitoring for Vector-based Tracking Loops	1875
<i>Tao Lin, Cillian O'Driscoll, Gerard Lachapelle</i>	
Efficient GNSS Signal Acquisition with Massive Parallel Algorithms Using GPUs	1889
<i>T. Pany, B. Riedl, J. Winkel</i>	
Tracking AltBOC with the ipexSR Software Receiver	1896
<i>Dominik Dötterböck, Carsten Stöber, Felix Kneissl, Bernd Eissfeller</i>	
A Direct-Sampling Digital-Downconversion Technique for a Flexible, Low-Bias GNSS RF Front-end	1905
<i>Johnathan York, Jon Little, David Muntan</i>	
Fast Direct Acquisition of the L2 CL Code Through Utilizing the Code Properties and Wiener Filtering Techniques	1919
<i>Nesreen I. Ziedan</i>	
Real-Time Software Receiver for GPS Controlled Reception Pattern Antenna Array Processing	1932
<i>Yu-Hsuan Chen, Jyh-Ching Juang, David S. De Lorenzo, Jiwon Seo, Sherman Lo, Per Enge, Dennis M. Akos</i>	
The GPS Assimilator: A Method for Upgrading Existing GPS User Equipment to Improve Accuracy, Robustness, and Resistance to Spoofing	1942
<i>Todd E. Humphreys, Jahshan A. Bhatti, Brent M. Ledvina</i>	
Batch Processing for Efficient Base-Band Operations in Real-time GNSS Software Receivers	1953
<i>G. Waelchli, C. Botteron, P.-A. Farine, M. Baracchi-Frei</i>	
Design and Capability Analyze of High Dynamic Carrier Tracking Loop Based on UKF	1960
<i>Shuai Han, Wenjing Wang, Xi Chen, Weixiao Meng</i>	
Development of a Dual Frequency Software-based GNSS Receiver	1967
<i>P. Berglez, J. Seybold, B. Geiger, M. Soudan, C. Vogel, C. Abart, A. P. Singh, B. Hofmann-Wellenhof</i>	

C4: GNSS SPACE BASED AUGMENTATION SYSTEMS (SBAS)

PRN1/SVN049 L5 Payload Drawback and PRN27 Outage on the 30th of June 2009: GNSS Receiver Reactions and Lessons Learnt	1975
<i>N. Suard</i>	
The EGNOS Services Provision within the Single European Sky – The Start of the Safety-of-Life Service	1984
<i>F. Javier De Blas, Miguel A. Sánchez</i>	
The EGNOS Service to Provide Ground Based Access to EGNOS – EDAS Beta Test Findings	1994
<i>Reinhard Blasi, Gian Gherardo Calini, Rafael Cardoso-Herce, Didier De Greef, Jose Ramón López-Pérez, Francisco J. Jiménez-Roncero, Ángel Gavin-Alarcón, Monica Pesce</i>	
SACCSA - SBAS in the CAR/SAM Regions: Feasibility Analysis	2002
<i>A. Cezón, M. Cueto, I. Hidalgo, L. Andrade</i>	
Kriging as a Means of Improving WAAS Availability	2013
<i>Lawrence Sparks, Juan Blanch, Nitin Pandya</i>	
WAAS Offline Monitoring	2021
<i>Stephen Gordon, Chad Sherrell, B. J. Potter</i>	
Vertical Protection Level Equations for Dual Frequency SBAS	2031
<i>Todd Walter, Juan Blanch, Per Enge</i>	
Computing SBAS Protection Levels with Consideration of All Active Messages	2042
<i>Takeyasu Sakai, Keisuke Matsuaga, Kazuaki Hoshino, Todd Walter</i>	
The Role of the ESSP in Monitoring EGNOS Performances	2051
<i>Elisabet Lacarra, Sofía Cilla, Roberto Roldán</i>	
Prediction of SBAS Integrity Performance Using PORIMA Algorithm	2056
<i>Hua Su</i>	

D4A: MARINE NAVIGATION

Seabed Mapping on an Earth Centered Earth Fixed (ECEF) Geocentric Reference Frame. Cooperative Validation with US Navy and Brazilian Navy in Guanabara Bay, Rio de Janeiro	2064
<i>Aluizio M. Oliveira Jr., Elliot N. Arroyo-Suarez, Alexandre M. Ramos, Maria Fernanda R. Arentz</i>	
Tidal Datum Determination and VDatum Evaluation with a GNSS Buoy	2076
<i>Ben Hocker, Nathan Wardwell</i>	
A Primary Research and Practice to Determine Tide Height Using PPP and Satellite Altimeter	2087
<i>Xiaowen Luo, Jinyao Gao, Xianglong Jin, Jiabiao Li, Fengyou Chu, Zhaocai Wu</i>	

D4B: TIMING & SCIENTIFIC APPLICATIONS

Four Dimensional Real Time Kinematic State Estimation and Analysis of Relative Clock Solutions	2092
<i>Yanming Feng, Bofeng Li</i>	
A Flexible Low-Cost Time Synchronizer for GNSS/INS Integration	2100
<i>Gang Du, Liduan Wang, Chuanrun Zhai, Xingqun Zhan</i>	
The WAAS/L5 Signal for Robust Time Transfer: Adaptive Beamsteering Antennas for Satellite Time Synchronization	2106
<i>David S. De Lorenzo, Sherman C. Lo, Jiwon Seo, Yu-Hsuan Chen, Per Enge</i>	
Orbit Determination for the Canx-2 Nanosatellite Using Intermittent GPS Data	2117
<i>Erin Kahr, Susan Skone, Kyle O'Keefe</i>	
Analysis of Timing Errors Under Limited Sky View Conditions	2126
<i>N. S. Sudhir, G. Vyasaraj, B. S. Nandini, B. Srinivasa</i>	

E4: INTEGRITY MONITORING FOR NEXT GENERATION APPLICATIONS

Autonomous Isotropy-Based Integrity Using GPS and GLONASS	2135
<i>M. Azaola, D. Calle, A. Mozo, R. Piriz</i>	
Integrity Monitoring for Carrier Phase Ambiguities	2148
<i>Shaojun Feng, Washington Ochieng, Jaron Samson, Michel Tossaint, Manuel Hernandez-Pajares, J. Miguel Juan, Jaume Sanz, Ángela Aragón-Ángel, Pere Ramos, Martí Jofre</i>	
Integrity Assessment of a Maritime Carrier Phase Based GNSS Augmentation System	2160
<i>David Minkwitz, Stefan M. Schlüter, Jamila Beckheinrich</i>	
Receiver Autonomous Integrity Monitoring for GPS Attitude Determination with Carrier Phase FD/FDE Algorithms	2168
<i>Xian-Li Su, Xingqun Zhan, Hui Fang</i>	
Optimization of Position Domain Relative RAIM for Weak Geometries	2182
<i>Yiping Jiang, Jinling Wang, Nathan Knight, Weidong Ding</i>	
A Non-Traditional Approach to Analysis of Signal Structure Anomalies Observed in PRN 21	2190
<i>Jon Little, Johnathan York, Allen Farris, David Munton</i>	
Reliability Estimation for Analyzing and Improving Multi-sensor Multi-network Positioning	2199
<i>Heidi Kuusniemi, Jingbin Liu, Ling Pei, Yuwei Chen, Ruizhi Chen</i>	

Real-Time Spoofing Detection in a Narrow-Band Civil GPS Receiver	2211
<i>Brady W. O'Hanlon, Mark L. Psiaki, Todd E. Humphreys, Jahshan A. Bhatti</i>	

F4: URBAN & INDOOR NAVIGATION TECHNOLOGIES 2

GNSS Positioning Enhancement Based on Statistical Modeling in Urban Environment	2221
<i>Ignace Mendooume, Maurice Charbit, Baptiste Godefroy, Jean-Baptiste Prost</i>	
Estimation of Multipath Range Error for Detection of Erroneous Satellites	2228
<i>Tatsuya Iwase, Noriyoshi Suzuki, Yusuke Watanabe</i>	
An OFDM Based Indoor GPS Retransmission System	2236
<i>Yongtao Guo, Robert Horton, Phillip Coiner</i>	
Study of Sferic Position Location Mechanisms	2241
<i>Di Qiu, Thao Nguyen, Chun Yang</i>	
Monocular Vision Localization Using a Gimbaled Laser Range Sensor	2251
<i>Don J. Yates, Michael J. Veth</i>	
Computer Mouse-Based Odometry and Heading for Indoor Navigation.....	2262
<i>Christopher Lomanno, Kenneth A. Fisher</i>	
Modeling Residual Errors of GPS Pseudoranges by Augmenting Kalman Filter with PCI for Tightly-Coupled RISS/GPS Integration	2271
<i>Umar Iqbal, Jacques Georgy, Michael J. Korenberg, Aboelmagd Noureldin</i>	
Evaluation of a Pedestrian Walking Status Awareness Algorithm for a Pedestrian Dead Reckoning	2280
<i>M. S. Lee, S. H. Shin, C. G. Park</i>	
Error Analysis of a Vision-Based Navigation System Using a GPS DOP Concept.....	2285
<i>Dae Hee Won, Sebum Chen, Sangkyung Sung, Young Jae Lee</i>	

PANEL 4: 50TH ANNIVERSARY OF KALMAN FILTER

Applications of Kalman Filtering to Aerospace: 1960 to Present	2290
<i>Angus Andrews</i>	
The GPS Operational Control System Kalman Filter Description and History	2329
<i>Jack Taylor</i>	
Kalman Filtering: A Multi-faceted Tool in Integrated Navigation.....	2367
<i>Jay A. Farrell, A. Chen, A. Ramanandan, M. Barth, L. Huang, B. Suierwala, A. Vu</i>	
Adaptability of the Kalman Filter in GNSS/MEMS Inertial Navigation and its Emerging Role in GNSS Receivers.....	2393
<i>Mark Petovello</i>	
Navigation System for a Precision Guided Artillery Projectile.....	2430
<i>M. Vaujin, J. Kyle, T. Caylor</i>	

A5: MILITARY GPS & HOST APPLICATIONS INTEGRATIONS FOR ROBUST PNT SOLUTIONS

Simulation Study of UWB-OFDM SAR for Navigation Using an Extended Kalman Filter	2443
<i>Kyle Kauffman, John Raquet, Yu Morton, Dmitriy Garmatyuk</i>	
PPS Positioning in Weak Signal GPS Environments Using a TIDGET Sensor	2452
<i>Alison K. Brown, Stephen Stankevich, Bruce G. Johnson</i>	
Self-Calibration Algorithm for Precision GNSS Antennas on Moving Platforms	2457
<i>Andrew J. O'Brien, Inder J. Gupta</i>	
Antenna Configurations for a C-Band Global Navigation Satellite System	2465
<i>Chris Bartone, Tom Stansell</i>	
The Double IMU Measurement for the Precise UXO Geolocation System	2477
<i>Jong Ki Lee, Christopher Jekeli</i>	
NavFire™ Guidance System – Integrated GPS and Mission Computer for Future Navigation Systems.....	2483
<i>Walter Trach Jr.</i>	
Performance of a Next Generation Integrated Multi-Sensor Time-Space Position Information (TSPI) System.....	2489
<i>Mark A. Smearcheck, Michael J. Veth</i>	
Combining Multiple FRPA for AJ Functionality in GPS Receivers	2500
<i>Inder J. Gupta, Teh-Hong Lee</i>	
Precision RF Ranging as an Aid to Integrated Navigation Systems	2508
<i>David W. A. Taylor, W. Todd Faulkner, Bradley D. Farnsworth</i>	

B5: PRECISE POINT POSITIONING & NETWORK RTK

Functional Models of Ordinary Kriging for Medium Range Real-Time Kinematic Positioning Based on the Virtual Reference Station Technique.....	2513
<i>Ali Al-Shaery, Samsung Lim, Chris Rizos</i>	
Implementation of Wide Area Broadcast NRTK on a Communication Satellite Platform.....	2522
<i>Lei Yang, Chris Hill, Terry Moore</i>	

Real-Time PPP with Undifferenced Integer Ambiguity Resolution, Experimental Results	2534
<i>D. Laurichesse, F. Mercier, J. P. Berthias</i>	
Antenna Rotation and its Effects on Kinematic Precise Point Positioning	2545
<i>Simon Banville, Hui Tang</i>	
Analysis of the Integer Property of Ambiguity and Characteristics of Code and Phase Clocks in PPP Using a Decoupled Clock Model	2553
<i>Junbo Shi, Yang Gao</i>	
Absolute Precise Kinematic Positioning with GPS and GLONASS	2565
<i>Brian W. Tolman, Aaron Kerkhoff, David Rainwater, David Munton, Joel Banks</i>	
A New Method to Design Broadcasting Schedules for Compact-RTK Corrections: Reducing GNSS Temporal Decorrelation Error	2577
<i>Inmo Jang, Byungwoon Park, Junesol Song, Changdon Kee</i>	

C5: GNSS GROUND BASED AUGMENTATION SYSTEMS (GBAS)

Equatorial Plasma Depletions Observed over Brazil - Impact on Safety Critical GNSS Navigation	2583
<i>Thomas Dautermann, Christoph Mayer</i>	
Evaluation of Dual-Frequency GBAS Performance Using Data from Public Receiver Networks	2592
<i>Kazushi Suzuki, Sam Pullen, Per Enge, Takeshi Ono</i>	
Carrier Phase Ionospheric Gradient Monitor for GBAS with Experimental Validation	2603
<i>Samer Khanafseh, Fan Yang, Boris Pervan, Sam Pullen, John Warburton</i>	

Volume 4

Effects of External Ionosphere Anomaly Monitors on GNSS Augmentation Systems Studied with a Three-dimensional Ionospheric Delay Model - A Study for GBAS	2611
<i>Susumu Saito, Naoki Fujii</i>	
Ranging Source Fault Detection Performance for Category III GBAS	2618
<i>Mats Brenner, Fan Liu</i>	
Fault Modeling for GBAS Airworthiness Assessments	2633
<i>Tim Murphy, Matt Harris, Curt Shively, Laurent Azoulai, Mats Brenner</i>	
Long Term Monitoring of Ionospheric Anomalies to Support the Local Area Augmentation System	2651
<i>Jiyun Lee, Sungwook Jung, Eugene Bang, Sam Pullen, Per Enge</i>	
A Study of Severe Multipath Errors for the Proposed GBAS Airport Surface Movement Application	2661
<i>Young Shin Park, Sam Pullen, Per Enge</i>	
LAAS Integrity Study Based on Internal Reliability Theory	2672
<i>Zhipeng Wang, Jun Zhang, Yanbo Zhu, Rui Xue</i>	
GBAS Algorithm Performance in the Implementation of the Integrity Monitor Testbed in Taipei Flight Information Region	2681
<i>Shuo-Ju Yeh, Hui-Chieh Hsu, An-Lin Tao, Yao-Cheng Lin, Shau-Shiun Jan</i>	
A Study of Nominal Ionospheric Gradient for GBAS (Ground-based Augmentation Systems) in Japan	2689
<i>Takayuki Yoshihara, Susumu Saito, Naoki Fujii</i>	

D5: SPACE APPLICATIONS

Near Real-Time Precise Orbit Determination for Radio Occultation and Altimetry Missions	2695
<i>Y. Andrés, P. L. Righetti, C. Marquardt</i>	
GEO Satellite Positioning Using GPS Collective Detection	2706
<i>Penina Axelrad, Ben K. Bradley, Jill Tombasco, Shan Mohiuddin, James Donna</i>	
GNSS Sensor for Autonomous Orbit Determination	2717
<i>José F. M. Lorga, Pedro F. Silva, Andrea Di Cintio, Fabio Dovis, Steeve Kowalschek, David Jimenez, Roger Jansson</i>	
Comparing the Extended and the Sigma Point Kalman Filters for Orbit Determination Modeling Using GPS Measurements	2732
<i>P. C. P. M. Pardal, H. K. Kuga, R. Vilhena De Moraes</i>	
Study of GPS Reflections and Multipath During Hubble Servicing Mission 4 (STS-125)	2743
<i>Rashmi Shah, Michael A. Walker, Justin Voo, James L. Garrison, Phillip Stout, Katie Pekkarinen, Daniel Lejeune</i>	
Optimizing Tracking and Acquisition Capabilities for the CanX-2 Nanosatellite's COTS GPS Receiver in Orbit	2750
<i>Erin Kahr, Kyle O'Keefe, Susan Skone</i>	
GNSS-Reflectometry: Techniques for Scatterometric Remote Sensing	2761
<i>P. J. Jales</i>	
Near Real Time Precise Orbit and Clock Determination for GLONASS	2771
<i>Jan P. Weiss, Yoaz Bar-Sever, Willy Bertiger, Larry J. Romans</i>	
Precise Orbit Determination for LEO Spacecraft Using GNSS Tracking Data from Multiple Antennas	2778
<i>Da Kuang, William Bertiger, Shailesh Desai, Bruce Haines</i>	
Constrained GPS Precise Orbit Determination for Low Earth Orbiters	2789
<i>Amandeep Mander, Sunil Bisnath</i>	
GPS Based Relative Navigation for the TanDEM-X Mission - First Flight Results	2797
<i>O. Montenbruck, M. Wermuth, R. Kahle</i>	

E5: MULTI-CONSTELLATION USER RECEIVERS

Development and Integration of a Robust Signal Tracking Module for the Triple-Frequency Dual-Constellation GAMMA-A Receiver.....	2808
<i>Cécile Mongrédiens, Matthias Overbeck, Guenter Rohmer</i>	
Results from an Analytical Model for GNSS Receiver Implementation Losses.....	2820
<i>Christopher J. Hegarty, Alessandro P. Cerruti</i>	
Adding GLONASS to the GPS/Galileo Consumer Receiver, with Hooks for COMPASS.....	2835
<i>Philip G. Mattos</i>	
Investigation of the Benefits of Combined GPS/GLONASS for High Sensitivity Receivers	2840
<i>C. O'Driscoll, M. E. Tamazin, D. Borio, G. Lachapelle</i>	
Lessons Learnt: The Development of a Robust Multi-Antenna GNSS Receiver	2852
<i>M. Cuntz, L. Greda, M. Heckler, A. Konovaltsev, M. Meurer, L. Kurz, G. Kappen, T. G. Noll</i>	
GPS L1C: Enhanced Performance, Receiver Design Suggestions, and Key Contributions	2860
<i>Thomas A. Stansell, Kenneth W. Hudnut, Richard G. Keegan</i>	
Comparison of Massive-Parallel and FFT-Based Acquisition Architectures for GNSS Receivers.....	2874
<i>L. Kurz, G. Kappen, T. Coenen, T. G. Noll</i>	
The Optimization of Algorithm and Implementation for Dual-Constellation Navigation Receiver.....	2884
<i>Tianyi Ma, Xiaowei Cui, Mingquan Lu, Zhenming Feng</i>	
Design Methodology for a Dual Frequency Configurable GPS Receiver	2892
<i>Muhammad Haris Afzal, Gérard Lachapelle</i>	

F5: PORTABLE NAVIGATION DEVICES

GLANSER - An Emergency Responder Locator System for Indoor and GPS-Denied Applications	2901
<i>R. McCroskey, P. Samanant, W. Hawkinson, S. Huseth, R. Hartman</i>	
Using EGNOS with Standard GPS-Equipped Mobile Phones	2910
<i>François Boullete, Boris Kennes, Michaël Mastier, Lee Banfield</i>	
Reliable Real-Time Recognition of Motion Related Human Activities Using MEMS Inertial Sensors	2919
<i>Korbinian Frank, María Josefa Vera, Patrick Robertson, Michael Angermann</i>	
Block Floating Point Arithmetic for Low-Energy GNSS-Receiver PVT-Estimation	2933
<i>E. Tasdemir, G. Kappen, T. G. Noll</i>	
GPS Observability and Availability for Various Antenna Locations on the Human Body	2941
<i>Jared B. Bancroft, Gerard Lachapelle, Thomas Williams, John Garrett</i>	
Thermal Vibration's Impacts on a GNSS Receiver in a Wireless Combo Chip.....	2952
<i>T-Y. Chiou, C-Y. Lo, S-Y. Huang, S-T. Wu, C-T. Weng</i>	
Opportunistic Frequency Stability Transfer for Extending the Coherence Time of GNSS Receiver Clocks.....	2959
<i>Kyle D. Wesson, Kenneth M. Pesyna Jr., Jahshan A. Bhatti, Todd E. Humphreys</i>	
A Truly Portable, Low-Cost, and Accurate Mobile Navigator for Urban and Indoor Usage	2969
<i>C. Goodall, Z. Syed, N. El-Sheimy</i>	
Time Signal Assisted GPS Receiver for Mobile Devices	2977
<i>Christoph Kandziora, Robert Weigel</i>	
An Innovative Self-Generated Assistance Technology for a High Sensitivity GPS Mobile Phone	2981
<i>K. S. Huang, C. T. Weng</i>	
Development and Investigation of Real-time Hybrid Navigation System Using a DCM Based Integration Method	2986
<i>Jieying Zhang, Ezzaldeen Edwan, Junchuan Zhou, Ottmar Loffeld</i>	

PANEL 5: COMMON FREQUENCIES VS. FREQUENCY DIVERSITY IN CIVIL SIGNALS —WHAT IS THE RIGHT CHOICE?

Common Frequencies vs. Frequency Diversity in Civil Signals-What is the Right Choice?	2995
<i>Ron Hatch</i>	
Modernized GNSS Receiver System Issues	3005
<i>Gary A. McGraw</i>	
New Signals, Signal Diversity - The GNSS Engineer Full-employment Program	3012
<i>Bruce Peetz</i>	
Frequency Diversity or No Frequency Diversity	3021
<i>Tony Pratt</i>	

B6: STATISTICAL SIGNAL PROCESSING

Performance Analysis of Collective Detection of Weak GPS Signals	3041
<i>Ben K. Bradley, Penina Axelrad, James Donna, Shan Mohiuddin</i>	
A High Performance Code and Carrier Tracking Architecture for Ground-Based Mobile GNSS Receivers	3054
<i>Lawrence R. Weill</i>	
Indoor Doppler Measurement and Velocity Characterization Using a Reference-Rover Receiver.....	3069
<i>Behnam Aminian, Valérie Renaudin, Daniele Borio, Gérard Lachapelle</i>	

Generalized Differential Signal Processing for Combined L1/L2C Acquisition	3080
<i>Tung Hai Ta, Marco Pini, Letizia Lo Presti</i>	
Use of Neural Network for the Improvement of Particle Filter Performance in INS/GPS Integrated Navigation System during GPS Signal Outages	3090
<i>Albert Lee</i>	
A Variable Gain Adaptive Kalman Filter-Based GPS Carrier Tracking Algorithm for Ionosphere Scintillation Signals	3107
<i>Lei Zhang, Yu T. Morton, Mikel M. Miller</i>	

C6: NEXT GENERATION GNSS INTEGRITY FOR AVIATION

GPS Signal-in-Space Anomalies in the Last Decade: Data Mining of 400,000,000 GPS Navigation Messages	3115
<i>Liang Heng, Grace Xinxin Gao, Todd Walter, Per Enge</i>	
Independent Control Segment URA Monitor for GPS IIIC with Application to LPV200	3123
<i>Ronald Braff, Brian Bian, Curtis A. Shively</i>	
Characterization of Signal Deformations for GPS and WAAS Satellites	3143
<i>Gabriel Wong, R. Eric Phelts, Todd Walter, Per Enge</i>	
Integrity Analysis of Vector Tracking Architecture	3152
<i>Susmita Bhattacharyya, Demoz Gebre-Egziabher</i>	
Sequential Residual-Based RAIM	3167
<i>Mathieu Joerger, Boris Pervan</i>	
A Practical Approach to RAIM-based Fault-Tolerant Position Estimation	3181
<i>Fang-Cheng Chan, Boris Pervan</i>	
RAIM for LPV-200: The Ideal Protection Level	3191
<i>Carl Milner, Washington Ochieng</i>	
On-Board Signal Integrity for GPS	3199
<i>Marc Weiss, Pradipta Shome, Ron Beard</i>	
Development of a Portable WAAS Data Acquisition Tool for Fixed and Rotary Wing Data Gathering	3213
<i>Yih-Ru P. Huang, B. Douglas, John Fagan</i>	

D6: GNSS ALGORITHMS & METHODS 2

A Modelled Eigenstructure Based Antenna Array Calibration Algorithm for GPS	3220
<i>Zili Xu, Matthew Trinkle, Douglas A. Gray</i>	
Novel Calibration of Adaptive GNSS Antenna	3229
<i>A. Konovaltsev, M. Cuntz, M. Meurer</i>	
Design and Testing of an Intelligent GPS Tracking Loop for Noise Reduction and High Dynamics Applications	3235
<i>Ahmed M. Kamel</i>	
PLL Phase Jitter Analysis and Minimisation	3244
<i>F. A. Khan, A. G. Dempster, C. Rizos</i>	
Generalized Discriminator and its Applications in GNSS Signal Tracking	3251
<i>Jyh-Ching Juang, Tsai-Ling Kao</i>	
GNSS Signal Tracking Using a Bank of Correlators	3258
<i>Karen Q. Z. Chiang, Mark L. Psiaki</i>	
A Novel Decision Directed Kalman Filter to Improve RTK Performance	3268
<i>G. Van Meerbergen, A. Simsky, F. Boon</i>	
GPS Carrier Signal Parameters Estimation Under Ionosphere Scintillation	3277
<i>Xiaolei Mao, Yu T. Morton, Lei Zhang, Yanhong Kou</i>	
On the Averaging Correlation for Satellite Acquisition in Software Defined Radio Receivers	3284
<i>Michael Soudan, Bernhard C. Geiger</i>	
A FFT-based Space-Differential Cooperative Algorithm for In-Phase and Orthogonal Data/Pilot Signal Acquisition	3290
<i>Qing Wan, Weixiao Meng, Shuai Han</i>	
New Threshold Setting Method of GNSS Signal Acquisition Under Near-Far Situation	3298
<i>Yang Liu, Tian Jin, Honglei Qin</i>	

E6: GALILEO SYSTEM DESIGN & SERVICES, GPS/GALILEO INTEROPERABILITY

Long Term and Multi-Receiver GPS/GIOVE Mixed PVT Experimentation	3309
<i>Bernard Bonhoure, Cyrille Boulanger, Jean Marechal</i>	
Testing the TUR - A Performance Report on Septentrio's Galileo Test User Receiver	3320
<i>R. J. P. Van Bree, C. C. J. M. Tiberius, A. Van Den Berg, J. M. Sleevaegen, R. Morgan-Owen, P. Giordano</i>	
Performance Evaluation of Single Antenna Interference Suppression Techniques on Galileo Signals Using Real-time GNSS Software Receiver	3330
<i>Ayse Sicramaz Ayaz, Roland Bauernfeind, Jaegyu Jang, Isabelle Kraemer, Dominik Dötterböck, Björn Ott, Thomas Pany, Bernd Eissfeller</i>	
In-Orbit Analysis of Antenna Pattern Anomalies of GNSS Satellites	3339
<i>Stefan Erker, Steffen Thoelert, Michael Meurer</i>	

S-Band Signal Design Considering Interoperability and Spectral Separation.....	3349
<i>Jean-Jacques Floch, Felix Antreich, Michael Meurer, Jean-Luc Issler</i>	

F6: URBAN & INDOOR NAVIGATION TECHNOLOGY 3

Dead-reckoning Aided RSSI Based Positioning System for Dynamic Indoor Environments	3359
<i>Wei-Wen Kao, Shih-Hong Lin</i>	
Motion Recognition Assisted Indoor Wireless Navigation on a Mobile Phone	3366
<i>Ling Pei, Ruizhi Chen, Jingbin Liu, Wei Chen, Heidi Kuusniemi, Tomi Tenhunen, Tuomo Kröger, Yuwei Chen, Helena Leppäkoski, Jarmo Takala</i>	
Accurate Mapping of Wi-Fi Access Point Location for Indoor Positioning	3376
<i>R. Mohd Sabri, T. Arslan</i>	
Network-Based Collaborative Navigation for Ground-Based Users in GPS-Challenged Environments	3380
<i>Jong Ki Lee, Dorota A. Grejner-Brzezinska, Charles Toth</i>	
Active RFID Indoor Positioning and Navigation Based on Probability Method	3388
<i>Hui Tang, Don Kim</i>	
Development of a Tightly Coupled Wireless Acoustic Sensor Network Aided Inertial Navigation System for Indoor Navigation.....	3398
<i>Nicholas Baine, Pratik Desai, Kuldip Rattan</i>	

PANEL 6: THE USE OF GNSS IN EMERGENCY SERVICES

Exploring New Applications for GPS in Emergency Management	3407
<i>Jeff Waters</i>	
Patton Visuality™ Platform - Mobile Communication Systems for Situational Awareness	3425
<i>Gun Akkor</i>	
The Use of GNSS in Emergency Services	3445
<i>Terry Eby</i>	
IC.NET (Incident Command Net)	3461
<i>Don McGarry</i>	
Author Index	