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Rhea Joyce Zambra, Saurav Uprety, Raymond Lee, and Hongzhou Yang Peer Reviewed

A Semi-Cognitive Localization Approach with Always-On and On-Demand 5G Downlink Signals 1901 - 1910
Faezeh Mooseli, Sharbel Kozhaya, and Zaher M. Kassas Peer Reviewed

Deep Learning Multipath Error Estimation for 3DMA-Based Positioning Algorithm in High Dynamics Environments 1911 - 1926
Nesreen I. Ziedan Peer Reviewed

3DMA GNSS Positioning with Multipath Signals in Urban Areas: Methodology and Preliminary Results 1927 - 1938
Mingda Ye, Guohao Zhang, and Li-Ta Hsu Peer Reviewed

GNSS Measurement Performance in Vegetation Environments: Assessment and Analysis in Signal Processing Level 1939 - 1951
Di Hai, Chin Lok Tsang, Guohao Zhang, and Li-Ta Hsu Peer Reviewed

Enhanced Urban Localization Techniques Using GraphSLAM: Precision Improvements for Pedestrian and Underground Scenarios 1952 - 1960
Aicha Karite, Christian Gentner and Susanna Kaiser Peer Reviewed

Performance Evaluation of Kinematic Doppler Positioning with LEO Satellites in Urban Environments 1961 - 1970
Yoji Takayama and Takateru Urakubo Peer Reviewed

Indoor Localization Based on PDR and Signals of Opportunity from Ambient Generic BLE Devices 1971 - 1980
Masakatsu Kouroggi, Akihiro Sato, Ryosuke Ichikari, Satoki Ogiso, and Takashi Okuma

D6: Navigation Using Environmental Features

Validating a Star Tracker Algorithm and Measuring Its Accuracy Through Suburban Night Sky Observations 1981 - 1994
Wen-Chiao Chen Student Paper Award Peer Reviewed

Deep Space PNT Instrument (DESPINA) Sensor Design

Mel Nightingale, Dorcas Oseni, Kyle J. Houser, William Setterberg, Ragini Suttar, Lindsay Glesener, Demoz Gebre-Egziabher, 1995 - 2014 Marc Murbach, and Malachi Mooney-Rivkin	
<u>Measuring Gravitational Acceleration Using X-Ray Pulsars for Deep Space Navigation Algorithm Initialization</u>	2015 - 2030
Kyle J. Houser and Demoz Gebre-Egziabher Best Presentation	
<u>Navigation Augmentation for Landing on Vertipads Utilizing Optical Detection of Standard ICAO Circular Markings</u>	2031 - 2045
Finn Hübner, Robert Haupt, Ulf Bestmann, and Peter Hecker	
<u>Accuracy of Magnetic Field-Based Train Localization and the Impact of Unknown Calibration Parameters</u>	2046 - 2055
Benjamin Siebler, Stephan Sand, and Uwe D. Hanebeck	
<u>Map Outage Recovery: ICP Tolerance to Initialization Errors for Automotive Radar</u>	2056 - 2066
Emma Dawson, Paulo Ricardo Marques de Araujo, Mohamed Elhabiby, and Aboelmagd Noureldin Peer Reviewed	
<u>Neural City Maps for GNSS Shadow Matching</u>	2067 - 2079
Daniel Neamati, Mira Partha, Shubh Gupta, and Grace Gao Peer Reviewed	
<u>Robust 3D Map-Matching with Visual Environment Features for Neural City Maps</u>	2080 - 2095
Mira Partha, Daniel Neamati, Shubh Gupta, and Grace Gao	
<u>Extended LTE Based Fingerprinting Positioning for Emergency Applications by Utilizing Seq2seq Model with Beam-Search Inference</u>	2096 - 2101
Sun Sim Chun, Jung Ho Lee, Ju-II Jeon, Jin Ah Kang, and Young-Su Cho	
<u>GMRC-Aided LiDAR/GNSS/INS: Ground Map Registration Constrained LiDAR-GNSS/INS Navigation Solution in Urban Canyons</u>	2102 - 2110
Mengchi Ai, Mohamed Elhabiby, Mehad Haggag, Ilyar Asl Sabbaghian Hokmabadi, Mohamed Moussa, Hongzhou Yang, and Naser El-Sheimy	

E1: Advanced Technologies in High Precision GNSS Positioning

<u>Galileo High Accuracy Service Reference User Algorithm Formulation and Verification</u>	2111 - 2122
Paolo Zoccarato, Francesco Menzione, Ciro Gioia, Joaquim Fortuny-Guasch, Javier Ostolaza, Stefano Lagrasta, Dimitrios Vasileios Psychas, Matteo Paonni, Javier De Blas, Daniel Blonsk, and Ignacio Fernandez-Hernandez	
<u>Analysis of HAS Performance in Pedestrian Navigation with Different Grade Devices</u>	2123 - 2135
Antonio Angrisano, Milad Bagheri, Giovanni Cappello, Paolo Dabove, Silvio Del Pizzo, Salvatore Gaglione, Ciro Gioia, Gabriele Portelli, and Salvatore Troisi Peer Reviewed	
<u>A Cascading Approach for Multi-Frequency Widelanes and Extra-Widelanes Carrier Phase Integer Ambiguity Resolution</u>	2136 - 2150
Clément Gazzino and Nicolas Lelarge Peer Reviewed	
<u>Factor Graph Optimization Based Multi Epoch Ambiguity Resolution for GNSS RTK and its Evaluation in Hong Kong Urban Canyons</u>	2151 - 2162
Yuan Li, Xikun Liu, Weisong Wen, Li-Ta Hsu, Yilong Yuan, Guangyu Bian, and Qiaoyun Chen Peer Reviewed	
<u>Implementation of Ambiguity-Resolved Detector for High-Precision GNSS Fault Detection</u>	2163 - 2174
Chengyu Yin, P.J.G. Teunissen, and C.C.J.M. Tiberius	
<u>High-Accuracy Atmospheric Correction Generation Method for Compact RTK for Expanded Area (COREA)</u>	2175 - 2188
Bu-Gyeom Kim and Changdon Kee	
<u>The Effect of Different Receiver Types and Ionospheric Conditions on Multi-GNSS Observable-Specific Biases</u>	2189 - 2202
A. Hauschild and T. Mayer-Gürr	
<u>Meta-Signal Inspired Quad-Frequency GNSS Measurement Combinations</u>	2203 - 2217
Daniele Borio, Melania Susi, and Kinga Wezka Peer Reviewed	
<u>Comparative Analysis of Commercial PPP-RTK and Network RTK Services for Urban and Suburban Vehicle-Borne Kinematic Positioning in Central Italy</u>	2218 - 2227
Matteo Cutugno, Laura Marconi, Giovanni Pugliano, Fabio Radicioni, Umberto Robustelli, and Aurelio Stoppini Peer Reviewed	
<u>GNSS Positioning Safety: Probability of Positioning Failure and its Components</u>	2228 - 2249
Sebastian Ciuban, Peter J.G. Teunissen, and Christian C.J.M. Tiberius	

E2: LEO for Positioning, Navigation, and Timing

<u>Starlink for PNT: A Trick or Treat?</u>	3779 - 3788
Sharbel Kozhaya, Joe Saroufim, and Zaher M. Kassas	
<u>A New Paradigm of Commercial GNSS Services: The Case for LEO PNT at C-Band, Part 1</u>	2250 - 2271
Paul Anderson, George Schmitt, Furqan Ahmed, Patrick Shannon	
<u>A Systematic Approach to LEO-Based PNT Error Source and Performance Analysis</u>	

Ahmad Mouri Sardarabadi, Vincent van der Knaap, Eva Fernandez Rodriguez, Detmer A. Bosma, and Hanno Hildmann Peer Reviewed	2272 - 2286
<u>Exploring the Utility of Doppler Shift Measurements for Enhanced GNSS Positioning</u> Lennon Headlee, Sherman Lo, and Todd Walter	2287 - 2298
<u>Integrity Monitoring and Augmentation of GNSS from Low Earth Orbit Constellations</u> Omar Garcia Crespillo, Michael Meurer, Can Oezmaden, and Marius Brachvogel	2299 - 2307
<u>Mixing Real and Simulated Observables to Assess the Performance of Hybrid GNSS/LEO-PNT Precise Positioning</u> Raul Orus Perez, Miguel Cordero Limon, Pietro Giordano, and Roberto Prieto-Cerdeira	2308 - 2322
<u>HOOC-EM: Fast Beam Sweeping for LEO Mega-Constellation Customer Terminals</u> Samuel C. Morgan and Todd E. Humphreys	2323 - 2339
<u>Simulation Based Tropospheric Error Estimation Performance Analysis with Low Earth Orbit (LEO) Satellites</u> Yunho Cha, Yongrae Jo, Hyunwoo Kim, and Byungwoon Park	2340 - 2350
<u>Doppler Positioning with LEO Satellites Using Unscented Kalman Filter</u> Yoji Takayama and Takateru Urakubo Peer Reviewed	2351 - 2362
<u>Gaps in Real-Time GNSS Satellite Clocks and Their Impacts on LEO Satellite POD</u> Kan Wang, Hang Su, Ahmed El-Mowafy, and Xuhai Yang Peer Reviewed	2363 - 2378
<u>Proof of Concept of User Segments Technologies For Complementary Low Earth Orbit System</u> Rami Ali Ahmad, Romain Crapart, Lea Castel, Miguel Cordero Limon, and Enik Shytermeja	2379 - 2391

E3a: All-Source Intelligent PNT Methods

<u>Reinforcement Learning Framework for Robust Navigation in GNSS Receivers</u> David Contreras Franco, Iñigo Cortés, Georgios Kontes, Tobias Feigl, Christopher Mutschler, and Alexander Rügamer Peer Reviewed	2392 - 2408
<u>Seamless Positioning and Mapping Using an Adaptive GNSS/INS/LIDAR/Wheel Odometry Integration Based on Factor Graph Optimization</u> Eva Buchmayer, Fabian Theurl, Karin Mascher, Christoph Schmied, Franziska Huebl Peer Reviewed	2409 - 2423
<u>Improved Starlink Satellite Orbit Prediction via Machine Learning with Application to Opportunistic LEO PNT</u> Paul El Kouba, Samer Hayek, Joe Saroufim, Zaher M. Kassas, and Evan Fakhoury Best Presentation	2424 - 2433
<u>Multi-Sensor PVT Solution for Android Devices</u> Benon Gattis, Dong-Kyeong Lee, and Dennis Akos Peer Reviewed	2434 - 2447
<u>Surveying GNSS Carrier Offset Modulations: Investigating Gabor Uncertainty Principle for Precise Time Delay and Frequency Offsets Estimation</u> Luca Morichi, Alex Minetto, Andrea Nardin, and Fabio Dovis Peer Reviewed	2448 - 2460
<u>FE-GUT: Factor Graph Optimization Hybrid with Extended Kalman Filter for Tightly Coupled GNSS/UWB Integration</u> Qijia Zhao, Shaolin Lü, Jianan Lou, and Rong Zhang Peer Reviewed	2461 - 2473
<u>Vehicle Positioning and Integrity Monitoring Based on GNSS/5G/IMU Fusion System in Urban Environments</u> Lu Yin, Wenfang Guo, Yuan Sun, Tianzhu Song, and Qiang Zhang Peer Reviewed	2474 - 2486

E3b: Advanced Processing of Terrestrial Signals of Opportunity

<u>Sub-Meter Hybrid Positioning with Flying 5G Networks and Synchronization Corrections</u> José A. del Peral-Rosado, Susanne Schlötzer, Esat Ince, Patric Nolle, Florian Kaltenberger, Niilo Sirola, Stefano Garlaschi, Luca Canzian, Ivan Lapin, and Detlef Flachs Peer Reviewed	2487 - 2494
<u>Analyzing 5G NR Ranging capabilities for Aiding Multi-GNSS SPP</u> Kai-Niklas Baasch and Steffen Schön Peer Reviewed	2495 - 2508
<u>Commercial Radio Phase Difference of Arrival (PDOA) for GNSS-independent PNT – Carrier Phase</u> David W.A. Taylor Best Presentation	2509 - 2521
<u>Opportunistic Positioning with Beamformed 5G Signals</u> Shaghayegh Shahcheraghi, Justin Kuric, and Zaher M. Kassas Peer Reviewed	2522 - 2533
<u>Localization with Multidimensional Channel Fingerprints of Multiband Cellular Signals</u> Zhinan Hu, Xin Chen, Shande Du, and Qiming Yang	2534 - 2540

E4a: Accurate GNSS Navigation in Challenging Environments

<u>Why Some Cycle Slip Detection Methods do not Work for Smartphones: Investigation, Explanation and Solutions</u>	2541 - 2554
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Jiahuan Hu Student Paper Award Peer Reviewed	
<u>A Deep Learning Approach for the Classification of Multipath Ranging Errors in Challenging Urban Environments</u>	2555 - 2566
Christian Phillips, Ali Broumandan, and Kyle O'Keefe Peer Reviewed	
<u>Single Difference Code-Based Technique for Direct Position Estimation</u>	2567 - 2575
Shuo Tang, Haoqing Li, and Pau Closas Peer Reviewed	
<u>Application of Adaptive Kalman Filtering on Smartphone Positioning</u>	2576 - 2588
Naman Agarwal and Kyle O'Keefe Peer Reviewed	
<u>A State-Based Method to Jointly Estimate Code Delay and Carrier Phase of Short Segment GNSS Signals Using Complex Waveforms from Open-Loop Tracking: A Simulation Study</u>	2589 - 2599
Jiawei Xu and Y. Jade Morton Peer Reviewed	
<u>Data-Driven Stochastic Modeling of Dual-Frequency GNSS Measurements Using Cycle Slip Parameter Variance</u>	2600 - 2614
Brian J. Weaver Peer Reviewed	
<u>Real-Time Multipath Mitigation with Sensor-Aided Long Coherent Integration (SALI)</u>	
Zhenlan Cheng, Maxim Köhler, Alessandro Biason, Robert Lluís Garcia, Gregor Dumphart, Konstantinos Arkoudogiannis, Christian Bischof, Duarte Dias, Sebastian Carreno Best Presentation Peer Reviewed	2615 - 2629
<u>AutoW: Self-Supervision Learning for Weighting Estimation in GNSS Positioning</u>	2630 - 2644
Penghui Xu and Li-Ta Hsu Peer Reviewed	
<u>Improving GNSS Positioning Using Deep Reinforcement Learning with Self-Supervised Learning Based Data Augmentation</u>	2645 - 2658
Peili Li, Zhenni Li, Kexian Hou, Jianhao Tang, and Shengli Xie Peer Reviewed	

E4b: Smartphone Decimeter Challenge (Co-sponsored by Google)

<u>Enhanced Smartphone Positioning in Urban Environments: GNSS Fault Detection and Mitigation Through Integrated Navigation System</u>	2659 - 2666
Jeonghyeon Yun and Byungwoon Park Peer Reviewed	
<u>DGNSS Corrected Pseudorange and Time-Differenced Carrier Phase (TDCP) Measurements using Differentiable Factor Graph Optimization (DFGO)</u>	2667 - 2675
Hoi-Fung Ng, Penghui Xu, Yihan Zhong, Guohao Zhang, Weisong Wen, and Li-Ta Hsu Peer Reviewed	
<u>Empirical Error Modeling of Android GNSS Using Machine Learning for PVT Improvement</u>	2676 - 2683
Dong-Kyeong Lee, Dennis Akos, and Byungwoon Park Peer Reviewed	
<u>Optimal Robust Positioning Using Factor Graph</u>	
Akpojoto Siemuri, Elham Ahmadi, Mahmoud Elsanhoury, Kannan Selvan, Petri Välisuo, Heidi Kuusniemi, and Mohammed S. Elmusrati Peer Reviewed	2684 - 2690
<u>Third Place Winner of the Smartphone Decimeter Challenge: Improving Smartphone Accuracy with a Two-Step Accurate Velocity Estimation</u>	2691 - 2702
Jeonghyeon Yun, Suyeol Kim, Taejin Youn, Gyeongmin Kim, Wonwoo Park, and Byungwoon Park Best Presentation	
<u>Second Place Winner of the Smartphone Decimeter Challenge: An Open-Source Factor Graph Optimization Package for GNSS and IMU Integration in Smartphones</u>	2703 - 2713
Taro Suzuki Peer Reviewed	
<u>First Place Winner of the Smartphone Decimeter Challenge: Optimized GNSS/INS Integration Approach for Smartphone Positioning</u>	2714 - 2728
Norizumi Motooka Peer Reviewed	

E6: Sensor Network and Cooperative Navigation

<u>Proximity-Based Location with Robustness to Byzantine Failures</u>	2729 - 2737
Guillermo Hernandez, Shuo Tang, and Pau Closas Peer Reviewed	
<u>Deeply Integrated GNSS-INS with CRPA to Constrain Attitude Biases in Robust Navigators</u>	2738 - 2753
Daniel F. Sturdivant and Scott M. Martin	
<u>Robust Beampattern Synthesis for UAV-Swarm-Based Distributed Beamforming</u>	2754 - 2765
W. Jeremy Morrison, Todd E. Humphreys, and Dao A. Ton-Nu	
<u>Low-Cost Collaborative Positioning for Autonomous Agents Using Carrier Phase DGNSS</u>	2766 - 2779
Eva Buchmayer, Christoph Schmied, and Fabian Theurl Peer Reviewed	
<u>Multi-Agent Multi-Sensor Collaboration for Improved Positioning in Urban Environment</u>	2780 - 2792
Anat Schaper and Steffen Schön Peer Reviewed	
<u>Addressing Stochastic Consistency for Fusing Absolute and Relative Orbit Determination for Satellite Swarms</u>	2793 - 2806
Marvin B. Stucke, Paula Peitschat, Thomas Hobiger, and Kevin Gutsche, Stefan Winkler Peer Reviewed	

Autonomous Constellation Fault Monitoring with Inter-Satellite Links: A Rigidity-Based Approach	2807 - 2824
Keidai Iiyama, Daniel Neamati, and Grace Gao Best Presentation Peer Reviewed	
STAN: Spatial-Temporal Attention Based Inertial Navigation Transformer	2825 - 2836
Zhenqiang Fan, Peng Cheng, Huamei Chen, Yajie Bao, Khanh Pham, Erik Blasch, Hao Xu, and Genshe Chen Peer Reviewed	
A Superimposed Signal Separation Algorithm for Satellite Navigation Receivers in Complex Environments Based on Capsule Networks	2837 - 2846
Jiangyan Chen, Sicun Han, Chengjun Guo, Long Jin, and Yunhao Liu	

F1: Advanced Software and Hardware Technologies for GNSS Receivers

Exploiting Next-Generation Signals From Galileo in a Real Time Receiver	2847 - 2854
F.A. Pinto, F. Conde-Pumpido, G. Ortas, C. Moriana, E. Garbin, R. Romero, G. Cueto-Felgueroso, Enik Shytermeja, Jose. A. Garcia-Molina	
GNSS Signal Correlation and Measurement Datasets for Interference Classification	2855 - 2864
David Gómez-Casco, Xurxo Otero Villamide, Luciano Musumeci, and Paolo Crosta Best Presentation Peer Reviewed	
Analysis of Subcarrier-Assisted Acquisition Methods for Galileo E5 AltBOC(15,10)	2865 - 2876
Elek T. Kozma, Bryce J. Karlins, and Scott M. Martin	
Analysis of Direct Conversion Front-End Distortions for High-Fidelity Satnav Integrity Monitoring Applications	2877 - 2891
Mark Carroll and Sanjeev Gunawardena	
Multipath Parameter Estimation Based on Reinforcement Learning	2892 - 2903
Xin Qi and Bing Xu Peer Reviewed	
A General Multi-Dimensional GNSS Signal Processing Scheme Based on Multicomplex Numbers	2904 - 2925
Daniele Borio Peer Reviewed	
Implementation of GPS L1C in an Open-Source Software-Defined Receiver	2926 - 2939
Into Pääkkönen, M. Zahidul H. Bhuiyan, and Sanna Kaasalainen Peer Reviewed	
Approximation of Finite-Length Bound for Binary Three-State Fading Channels with Applications to GNSS	2940 - 2951
Nuwan J. G. Kankanamge, Nghi H. Tran, Khanh Pham, Dan Shen, and Genshe Chen Peer Reviewed	
Development of GNSS Multi-Constellation IF Signal Generator for SSV in Geostationary Orbit	2952 - 2959
Seung-Gyu Yang, Young-Jin Song, and Jong-Hoon Won	
Selective Coherent Integration-Based Optimal Acquisition to Enhance Anti-Jam for Low SWaP-C MGUE	2960 - 2969
Dan Shen, Genshe Chen, and Khanh Pham	
A GNSS Interference Signal Identification Scheme Based on Meta-Learning for Few-Shot Conditions	2970 - 2983
Yunhao Liu, Sicun Han, Chengjun Guo, and Jiangyan Chen	
Adaptive Notch Filter Based Interference Characterization and Mitigation for GNSS Receivers	2984 - 2994
Nabeel Ali Khan and Luis Enrique Aguado Peer Reviewed	

F2: Atmospheric Effects on GNSS

A Controlled Experiment of Ionospheric Effects on VHF Signals Transmitted from A NOAA Weather Satellite	2995 - 3006
Y. Jade Morton, Harrison Bourne, Steve Taylor, Chun Yang, and Madeleine Naudeau Peer Reviewed	
Ionospheric TEC Estimations Using Single-Frequency Wideband Low Elevation GNSS Signals	3007 - 3018
Madeline Evans, Brian Breitsch, and Y. Jade Morton Peer Reviewed	
Convolutional Neural Networks for Time Series Classification of Ionospheric Scintillation	3019 - 3028
Rubem Vasconcelos Pacelli, Angela Aragon-Angel, Adrià Rovira García, Andre Lima Ferrer de Almeida, and Felix Antreich Peer Reviewed	
Back Propagation Method for the Determination of the Vertical Location of Ionospheric Irregularities	3029 - 3037
Carles Quilis Alfonso, Vinícius Ludwig-Barbosa, Joel Rasch, Anders Carlström, Mats I. Pettersson, and Viet Thuy Vu Best Presentation Peer Reviewed	
Exploiting the Galileo High Accuracy Service Under Equatorial Ionospheric Scintillation	3038 - 3048
Haroldo Antonio Marques, Melania Susi, Daniele Borio, Joao Francisco Galera Monico, Jihye Park, and Kinga Wezka	
Maintaining High RTK Availability and Accuracy Throughout the Maximum of Solar Cycle 25	3049 - 3058
Frank Kleijer, Frank Boon, Masoud Arash, Cyrano Vasseur, and Stefan Söderholm	
Evaluating Amplitude Scintillation Severity in the Early Night Hours Using Fading Coefficients	3059 - 3070
Victor Di Santis, João Galera Monico, Renan Ruan Sarmento, Alison Moraes, and Jonas Sousasantos Peer Reviewed	
Analysis of GNSS Receiver Tracking During High-Latitude Ionospheric Scintillation	3071 - 3077
Andrew Ludwig and Xiaoqing Pi	
Ionospheric Modeling by Using Self-Organizing Map (SOM) Under the Disturbed Condition	

Kazue Murai, Yuki Sato, Seigo Fujita, Yuichiro Tsukamoto, Rui Hirokawa, and Shinichi Nakasuka	Peer Reviewed	3078 - 3091
<u>Model the Ionospheric Gradients Between Satellites in Network RTK</u>		3092 - 3100
Tong Liu, Xiaolong Mi, Yang Yang, Duojie Weng, and Wu Chen	Peer Reviewed	
<u>Research on GNSS-R Snow Depth Inversion Based on Deep Learning Method</u>		3101 - 3113
Sijia Li, Hang Guo, Hangfei Zhu, Min Yu, and Jian Xiong	Peer Reviewed	
<u>Research on Prediction of Heavy Rainfall Based on BDS-2/3</u>		3114 - 3124
Longfei Lv, Hang Guo, Min Yu, Jian Xiong, Qun Tian, Ting Ni, Sai Du, and Wenjing Kong	Peer Reviewed	

F3a: Lunar Positioning, Navigation, and Timing

<u>Multi-Sensor Fusion and Resilient PVT Techniques for Safe Lunar Landing Missions</u>		3125 - 3143
Giuseppe Tomasicchio, Luca Andolfi, Marco Brancati, Arsenio Maria Di Donna, Simone Giannattasio, Roberto Del Prete, Luca Ostrogovich, Alfredo Renga, Michele Grassi, Michele Ceresoli, Stefano Silvestrini, and Michèle Lavagna	Peer Reviewed	
<u>Enabling High Performance PNT in the Lunar Environment (LUPIN)</u>		3144 - 3155
Ramin Moradi, Steven Kay, Danilo Forte, Matteo De Benedetti, Karl Buckley, Angus Cameron, Jorge Eduardo Martínez Esmeral, Florin-Adrian Stancu, Daniel Betco, Floor Thomas Melman, Richard Dennis Swinden, Martin Azkarate, and Javier Ventura-Traveset		
<u>Autonomous Navigation of a Lunar Relay Using GNSS and Other Measurements</u>		3156 - 3173
Benjamin W. Ashman, Luke B. Winternitz, Nathan I. Stacey, Anne C. Long, Michael C. Schmidt, Grant A. Ryden, Andrew J. Liounis, Samuel R. Price, William A. Bamford, Sun H. Hur-Diaz, Munther A. Hassouneh, Liam A. Greenlee		
<u>Modular Power, PNT, and Communication Infrastructure Development Options for Cislunar Space Exploration</u>		3174 - 3192
Taehwan Kim, Theodore R. Jaeger, Michael S. Larsen, and Emmanuel Austin		
<u>Lunar Node - 1: Initial Flight Results and the Role of Surface Pseudolites in Lunar Navigation</u>		3193 - 3215
Evan J. Anzalone and Tamara L. Statham		
<u>Analysis of Orbit Perturbation and Atmospheric Effects for Advanced ODTs Services in Elliptical Lunar Frozen Orbits</u>		3216 - 3239
Eleonora Antonietti, Gabriele Lambiase, Andrea Sesta, Daniele Durante, Carlo Albanese, Luciano Iess, Filippo Rodriguez, Laura Testa, and Giuseppe Tomasicchio		
<u>Markov Decision Processes for Scheduling Lunar PNT Services</u>		3240 - 3249
Guillem Casadesus Vila and Grace Gao	Peer Reviewed	
<u>Single-Satellite Lunar Navigation via Doppler Shift Observables for the NASA Endurance Mission</u>		3250 - 3265
Kaila M. Y. Coimbra, Marta Cortinovis, Tara Mina, and Grace Gao	Peer Reviewed	
<u>Orbit Determination of Lunar Radio Navigation Satellites Using MEMS Accelerometers and Microwave Tracking</u>		3266 - 3276
Luciano Iess and Andrea Sesta		
<u>Advancing Autonomous Navigation: Near-Moon GNSS-Based Orbit Determination</u>		3277 - 3291
Oliviero Vouch, Andrea Nardin, Alex Minetto, Simone Zocca, Fabio Dovis, Lauren Konitzer, Joel J.K. Parker, Benjamin Ashman, Fabio Bernardi, Simone Tedesco, Samuele Fantinato, and Claudia Facchinetti	Peer Reviewed	

F3b: GNSS Robustness to Vulnerabilities 1

<u>Galileo Signal Authentication Service (SAS)</u>		3292 - 3307
Ignacio Fernandez-Hernandez, Jon Winkel, Cillian O'Driscoll, Gianluca Caparra, Rafael Terris-Gallego, José A. López-Salcedo, Gonzalo Seco-Granados, Tom Willems, Beatrice Motella, Daniel Blonski, and Javier de Blas		
<u>SBAS Data Authentication Scheme on Q-Channel Based on Digital Signatures</u>		3308 - 3324
Ivan Lapin, Jaron Samson, Gianluca Caparra, Matthew Dibb, Jean-Christophe Denis, Cyrille Boulanger, Mikael Mabilieu, and Ettore Canestri	Peer Reviewed	
<u>Comparison of Methods for the Mitigation of Spoofing Attacks in a Vector Tracking Based Software Receiver Architecture</u>		3325 - 3335
C. Anderson Givhan and Scott M. Martin		
<u>Dual-Stage Deep Learning Approach for Efficient Interference Detection and Classification in GNSS</u>		3336 - 3347
Iman Ebrahimi Mehr, Outi Savolainen, Laura Ruotsalainen, and Fabio Dovis	Peer Reviewed	
<u>GNSS RFI Detection and Impact Characterization in Various Interference Environments Using Low-Cost Receivers</u>		3348 - 3360
Argyris Kriezis, Yu-Hsuan Chen, Dennis Akos, Sherman Lo, and Todd Walter	Peer Reviewed	
<u>Simultaneous Classification and Searching Method for Jammer Localization in Urban Areas Using KNN-GSA and Ray-Tracing</u>		3361 - 3374
Zhe Yan, Outi Savolainen, Xinhua Tang, and Laura Ruotsalainen		
<u>A Novel GNSS RF Interference Detection and Geolocation Algorithm for LEO Satellites</u>		3375 - 3389
Tasneem Yousif, Ben Wadsworth, Peter Christopher, and Paul Blunt	Peer Reviewed	

<u>Radio Frequency Interference (RFI) Analysis on GNSS Signals and Effects on Positioning Errors</u>	3390 - 3396
Somkit Sophan, Pornchai Supnithi, Lin M. M. Myint, Jirapoom Budtho, and Susumu Saito Peer Reviewed	
<u>The In-Depth Investigation of Matched-Spectrum Jamming Signals</u>	3397 - 3405
Xinhua Tang, Kepeng Luan, Zhe Yan, and Laura Ruotsalainen	
<u>A Hybrid Method for Interference Mitigation in GNSS Signals</u>	3406 - 3413
Nabeel Ali Khan and Luis Enrique Aguado Peer Reviewed	
<u>Assessing GNSS Spoofing Impact on A Safety-Critical Land Transportation Localization Function Within a Cooperative Fleet: An End-Users Focused Experimental Study</u>	3414 - 3427
Zaynab El Mawas, Nourdine Ait Tmazirte, Cindy Cappelle, Maan El Badaoui El Najjar	
<u>Enhanced Tracking with Improved Code Autocorrelation Function via Fractional Fourier Domain</u>	3428 - 3439
Yiran Luo, Yi-Fen Tseng, and Naser El-Sheimy Peer Reviewed	
<u>Galileo Open Service Navigation Message Authentication (OSNMA) Benefits, Challenges, and Limitations</u>	3440 - 3454
Ali Pirsiavash, Ali Broumandan, and Sandy Kennedy Peer Reviewed	
<u>MFFNet: Multimodel Feature Fusion Networks for GNSS Interference Identification</u>	3455 - 3467
Qiongqiong Jia, Lixin Zhang and Renbiao Wu	

F3c: Beyond GNSS: Emerging Trends in LEO-Based and Terrestrial Signals of Opportunity for PNT

<u>Comprehensive Assessment of Tropospheric Effects at a Wide Range of Frequencies Transmitted from LEO Satellites</u>	3468 - 3480
Neeti Sonth, Jade Morton, and Scott Logan Peer Reviewed	
<u>On the Integration of Tone-Like Signals-of-Opportunity Within a Geodetic Grade GNSS SDR</u>	3481 - 3497
Christian A. Lichtenberger, Markel Arizabaleta, Florian Binder, Francis Soualle, and Thomas Pany Peer Reviewed	
<u>Analogue Beamforming Antenna for Tracking Starlink Constellation</u>	3498 - 3502
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