

2016 European Navigation Conference (ENC 2016)

**Helsinki, Finland
30 May – 2 June 2016**



**IEEE Catalog Number: CFP16B81-POD
ISBN: 978-1-4799-8916-4**

**Copyright © 2016 by the Institute of Electrical and Electronics Engineers, Inc
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

******This publication is a representation of what appears in the IEEE Digital Libraries. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP16B81-POD
ISBN (Print-On-Demand):	978-1-4799-8916-4
ISBN (Online):	978-1-4799-8915-7

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) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

TABLE OF CONTENTS

STAMP-MAR BASED SAFETY MANAGEMENT OF MARITIME NAVIGATION IN THE GULF OF FINLAND (BALTIC SEA)	1
<i>R. Aps, M. Fetissov, F. Goerlandt, M. Kopti, P. Kujala</i>	
SWEPT GNSS JAMMING MITIGATION THROUGH PULSE BLANKING	9
<i>D. Borio</i>	
AN ANALYSIS OF A GYRO-FREE INERTIAL SYSTEM FOR INS/GNSS NAVIGATION	17
<i>D. Cucci, O. Crespillo, M. Khaghani</i>	
E-NAVIGATION BASED COOPERATIVE COLLISION AVOIDANCE AT SEA: THE MTCAS APPROACH	24
<i>C. Denker, M. Baldauf, S. Fischer, A. Hahn, R. Ziebold, E. Gehrmann, M. Semann</i>	
IMPROVEMENT OF THE STANDARD GNSS/IMU SOLUTION FOR UAVS USING ALREADH EXISTING REDUNDANT NAVIGATION SENSORS	32
<i>M. Dorn, R. Lesjak, M. Wieser</i>	
CONSTELLATION-AWARE METHOD FOR COMPUTING THE COVARIANCE MATRIX OF GNSS MEASUREMENTS	41
<i>G. Falco, M. Nicola, E. Falletti</i>	
A MULTI-FREQUENCY MULTI-CONSTELLATION GNSS DEVELOPMENT PLATFOR WITH AN OPEN INTERFACE	49
<i>F. Garzia, C. Strobel, M. Overbeck, N. Kumari, S. Joshi, F. Forster, W. Felber</i>	
THE SAPPART COST ACTION: TOWARDS POSITIONING INTEGRITY FOR ROAD TRANSPORT	56
<i>P.-Y. Gillieron, F. Peyret, L. Ruotsalainen, S. Feng, J. Engdahl</i>	
INDOOR NAVIGATION USING VIRTUAL ANCHOR POINTS	62
<i>E. Hoffmann, M. Werner, L. Schauer</i>	
AUTONOMOUS DRIVING POSITIONING USING BUILDING MODEL AND DGNS	70
<i>L.-T. Hsu, Y. Gu, S. Kamijo</i>	
RELIABILITY TESTING FOR MULTIPLE GNSS MEASUREMENT OUTLIER DETECTION	77
<i>A. Innac, M. Bhuiyan, S. Soderholm, H. Kuusniemi, S. Gaglione</i>	
MOBILE DEVICE ORIENTATION ESTIMATION USING VISIBLE LIGHT COMMUNICATION SYSTEM	85
<i>J. Yan, Y. He, B. Zhu, L. Chen</i>	
PRECISE ESTIMATION OF CLOCK BIAS DIFFERENCE BETWEEN MULTIPLE GNSS RECEIVERS FOR COOPERATIVE POSITIONING	90
<i>R. Kasaraneni, M. Sahmoudi, L. Ries</i>	
EFFECT OF ANTENNA LOCATION ON GNSS POSITIONING FOR ITS APPLICATIONS	99
<i>M. Kirkko-Jaakkola, S. Feng, Y. Xue, X. Zhang, S. Honkala, S. Soderholm, L. Ruotsalainen, W. Ochieng, H. Kuusniemi</i>	
BENEFITS OF GNSS IF DATA RECORDING	106
<i>G. Lachapelle, A. Broumandan</i>	
THE AALTO-1 NANOSATELLITE NAVIGATION SUBSYSTEM: DEVELOPMENT RESULTS AND PLANNED OPERATIONS	112
<i>H. Leppinen, A. Kestila, T. Tikka, J. Praks</i>	
IONOSPHERIC SCINTILLATION THREATS TO GNSS IN POLAR REGIONS: THE DEMOGRAPE CASE STUDY IN ANTARTICA	120
<i>N. Linty, R. Romero, M. Bavaro, J. Curran, J. Fortuny-Gausch, J. Ward, G. Lamprecht, E. Correia, L. Alfonsi</i>	
AMBIGUITY RESOLUTION ON IONOSPHERIC GRADIENT ESTIMATION AND DETECTION	127
<i>B. Lubbers</i>	
ENABLING CERTIFICATION OF SATELLITE BASED LOCALIZATION IN RAILWAYS BY COMBINATION OF REDUNDANT SENSORS AND MAP MATCHING	135
<i>H. Manzan, D. Spiegel, U. Becker</i>	
PERFORMANCE COMPARISON OF DIFFERENTIAL GNSS, EGNOS AND SDCM IN DIFFERENT USER SCENARIOS IN FINLAND	140
<i>S. Marila, M. Bhuiyan, J. Kuokkanen, H. Koivula, H. Kuusniemi</i>	
INERTIAL SENSOR ARRAYS – A LITERATURE REVIEW	147
<i>J.-O. Nilsson, I. Skog</i>	

ASSESSMENT OF END-TO-END PERFORMANCES OF A GNSS-BASED ROAD USER CHARGING SYSTEM	157
<i>M. Ortiz, D. Betaille, F. Peyret, O. Lykkja, S.-P. Oseth</i>	
PERFORMANCE EVALUATION OF THE AMBIGUITY FILTER AS AN ALTERNATIVE OF USING DUAL-FREQUENCY MEASUREMENTS FOR GPS HEADING AND PITCH ESTIMATION	165
<i>R. Pereira, J. Sanguino</i>	
SKYLINE POSITIONING IN URBAN AREAS USING A LOW-COST INFRARED CAMERA	175
<i>M. Petovello, Z. He</i>	
OBTAINING REAL-TIME SUB-METER ACCURACY USING A LOW COST GNSS DEVICE	183
<i>E. Rademakers, P. De Bakker, C. Tiberius, K. Janssen, R. Kleihorst, N. El Ghouti</i>	
THE PERFORMANCE OF BEIDOU SIGNALS IN HIGH LATITUDE AREA IN NORDIC COUNTRIES	191
<i>R. Zou, Y. Chen, H. Koivula, S. Lahtinen, M. Poutanen, J. Tang, C. Shi</i>	
FREQUENCY DIVIDED ADAPTIVE KALMAN FILTER IN GUIDANCE LAW RECOGNITION	197
<i>R.-L. Du, J.-Q. Liu, Z. F. Li, Z.-H. Niu</i>	
ENHANCED CARRIER PHASE TRACKING IN FADING ENVIRONMENTS USING FREQUENCY DIVERSITY	203
<i>R. Siddakatte, A. Broumandan, G. Lachapelle</i>	
TERRAIN NAVIGATION IN THE MAGNETIC LANDSCAPE: PARTICLE FILTERING FOR INDOOR POSITIONING	209
<i>A. Solin, S. Sarkka, J. Kannala, E. Rahtu</i>	
INDOOR POSITION DETERMINATION USING LOCATION FINGERPRINTING AND VEHICLE SENSOR DATA	218
<i>R. Wilfinger, T. Moder, M. Wieser, B. Grosswindhager</i>	
GNSS-BASED VEHICLE STATE DETERMINATION TAILORED TO COOPERATIVE DRIVING AND COLLISION AVOIDANCE	227
<i>K. Wisiol, M. Wieser, R. Lesjak</i>	
3-DIMENSIONAL FORWARD LOOKING SONAR: OFFSHORE WIND FARM APPLICATIONS	235
<i>G. Wright, R. Mehdi, M. Baldauf</i>	
IONOSPHERIC SPATIAL AND TEMPORAL GRADIENTS FOR DISTURBANCE CHARACTERIZATION	243
<i>J. Vukovic, T. Kos</i>	
QUALITY ASSESSMENT METHOD OF GNSS SIGNALS BASE ON MULTIVARIATE DILUTION OF PRECISION	247
<i>L. Yin, Z. Deng, D. Zhu, E. Hu</i>	
Author Index	