2020 International Conference on Localization and GNSS (ICL-GNSS)

Conference Proceedings

Editors: Jari Nurmi, Elena-Simona Lohan, Joaquin Torres Sospedra, Heidi Kuusniemi, Aleksandr Ometov

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Welcome by the General Chairs

Ladies and Gentlemen,

Welcome to the 10th International Conference on Navigation and GNSS to consider and discuss reliable navigation, ranging and positioning in indoor and outdoor, vehicular applications, wireless networks, wearables and consumer products.

Navigation and positioning are becoming essential when guaranteeing transparent, efficient and reliable workflows. A robust localization solution, which will be available continuously is needed regardless outdoor and indoor, and on different platforms. ICL-GNSS addresses the latest research on wireless and satellite-based positioning and ranging techniques to provide reliable and accurate position information with low latency. During the three conference days we will have an intensive look to GNSS technologies and applications, as well as an outlook to various wireless technologies as enabler for precise and real-time localization.

In the special circumstances of the COVID-19 pandemic affecting our life and work, we are still able to meet each other in the virtual world. Stay safe and enjoy this opportunity. We wish you a fruitful virtual conference and hope to meet you live next year again!

Prof. Jari Nurmi   Assoc.Prof. Elena-Simona Lohan
Tampere University   Tampere University

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TUESDAY, 2ND JUNE

10:00 Conference Opening
10:20 Technical Session Hybrid Positioning
11:00 Keynote GNSS-based 3D modelling of cities
12:20 Technical Session GNSS Receivers
14:20 Technical Session 5G Positioning
16:00 Technical Session Spoofing and Interference

WEDNESDAY, 3RD JUNE

10:00 Special session GNSS in Smartphones
11:00 Keynote Concurrent Transmissions: A New Paradigm for Ultra-wideband Ranging and Localization
12:20 Technical Session Indoor Positioning
14:20 Technical Session Modelling and Estimation
16:00 Technical Session Vehicle Applications

THURSDAY, 4TH JUNE

10:00 Special Session Collaborative Positioning
11:00 Keynote Sensory technology for medical wearables and rehabilitation robotics
12:20 Special Session Wearables (A-WEAR)
14:20 Technical Session GALILEO
16:00 Special Session Localization Techniques
17:00 Awards, ICL-GNSS 2021 and closing
TUESDAY, 2ND JUNE

10:00 Conference Opening
Prof. Jari Nurmi (Tampere University)

10:20 Technical Session Hybrid Positioning
10:20
Tight Integration of GNSS and WSN Ranging based on Spatial Map Data Enhancing Localization in Urban Environments
Paul Schwarzbach, Albrecht Michler, Oliver Michler, TU Dresden, Germany

10:40 A study on robust navigation by means of GNSS, network LTE and INS integration
Davide Imparato¹, Jean-Jacques Floch¹, Elena Simona Lohan², Martin Ruzicka³, Petr Casek⁴, Marketa Palenska⁴
¹Airbus Defense and Space, Germany; ²Tampered University, Finland; ³Evektor, Czech Republic; ⁴Honeywell, Czech Republic

11:00 Keynote GNSS-based 3D modelling of cities
Dr. Anahid Basiri
University College London

12:00 Break

12:20 Technical Session GNSS Receivers
12:20 – Best Paper Award Candidate
Solving Multi-GNSS Signal Biases from Undifferenced Observations
Niilo Sirola, Jussi Parviainen, Olli Särkkä, Juha Roström
Exafore Oy, Finland

12:40 Architecture, design and implementation of carrier phase vector tracking in GNSS RTK receiver
Nikolay Mikhaylov¹, Valery Chistyakov², David Oertel¹
¹Robert Bosch GmbH, Germany
²BORA Ltd., Russia

13:00 Performance and Complexity Comparison of Adaptive Loop-Bandwidth Tracking Techniques
Iñigo Cortés, Jon Ander Iñiguez de Gordoa, Johannes Rossouw van der Merwe, Alexander Rügamer, Wolfgang Felber
Fraunhofer IIS, Germany

13:20 Position Solution Sensitivity for Snapshot Receivers
Johannes Rossouw van der Merwe, Xabier Zubizarreta, Daniel Rubino, Alexander Rügamer, Wolfgang Felber
Fraunhofer IIS, Germany

13:40 Lunch break

14:20 Technical Session 5G Positioning
14:20 – Best Paper Award Candidate
Positioning Based on Noise-Limited Censored Path Loss Data
Aki Karttunen, Mikko Valkama, Jukka Talvitie
Tampere University, Finland

14:40 Radio-based Sensing and Indoor Mapping with Millimeter-Wave 5G NR Signals
Carlos Baquero Barneto, Taneli Riihonen, Matias Turunen, Mike Koivisto, Jukka Talvitie, Mikko Valkama
Tampere University, Finland
15:00
**Deep Learning Based Localization and Handover Optimization in 5G NR Networks**
Roman Klus, Lucie Klus, Dmitrii Solomnickii, Mikko Valkama, Jukka Talvitie
Tampere University, Finland

15:20
**A Primer on Real-world RSS-based Outdoor NB-IoT Localization**
Thomas Janssen, Maarten Weyn, Rafael Berkvens
Universiteit Antwerpen – IMEC, Belgium

15:40 Break

16:00 Technical Session *Spoofing and Interference*

16:00 – Best Paper Award Candidate

**Sub-Messages Scheduling In GNSS Packet Broadcasting By Message Splitting**
Francesco Ardizzon, Nicola Laurenti, Stefano Tomasin
University of Padova, Italy

16:20
**Simultaneous Jamming and Navigation Pseudolite System**
Johannes Rossouw van der Merwe, Alexander Rügamer, Wolfgang Felber
Fraunhofer IIS, Germany

16:40
**Hardware Implementation and Evaluation of the HDDM**
Fabio Garzia, J. Rossouw Van der Merwe, Alexander Rügamer, Wolfgang Felber
Fraunhofer IIS, Germany

17:00
**Analog Mitigation of Frequency-Modulated Interference for Improved GNSS Reception**
Karel Pärflin¹, Taneli Rihonen²
¹Rantelon, Estonia
²Tampere University, Finland

17:20
**Optimal compromise among security, availability and resources in the design of sequences for GNSS spreading code authentication**
Nicola Laurenti, Anna Poltronieri
University of Padova, Italy

17:40 End of Technical Session
WEDNESDAY, 3RD JUNE

10:00 Special session GNSS in Smartphones

10:00
Analyzing Android GNSS Raw Measurements Flags Detection Mechanisms for Collaborative Positioning in Urban Environment
Thomas Verheyde1,2, Antoine Blais2, Christophe Macabiau2, François-Xavier Marmet1
1Telecommunication for Space & Aeronautics (TéSA)
2École Nationale de l’Aviation Civile (ENAC); 3Centre National d’Études Spatiales (CNES)

10:20
Assessment of the Vulnerability to Spoofing Attacks of GNSS Receivers Integrated in Consumer Devices
Akmal Rustamov1,2, Alex Minetto1, Neil Gogoi1, Fabio Dovis1
1Politecnico di Torino
2Turin Polytechnic University in Tashkent

10:40
Precise Point Positioning with single and dual-frequency multi-GNSS Android smartphones
Umberto Robustelli1, Valerio Baiocchi2, Laura Marconi3, Fabio Radicioni3, Giovanni Pugliano1
1Department of Engineering, Parthenope University of Naples, Naples Italy
2Department of Civil Constructional and Environmental Engineering DICEA Sapienza University of Rome, Rome, Italy
3Department of Engineering, University of Perugia, Perugia Italy

11:00 Keynote
Concurrent Transmissions: A New Paradigm for Ultra-wideband Ranging and Localization
Prof. Gian Pietro Picco
University of Trento

12:00 Break

12:20 Technical Session Indoor Positioning

12:20
NLOS Detection using UWB Channel Impulse Responses and Convolutional Neural Networks
Maximilian Stahlke1, Sebastian Kram2, Christopher Mutschler2, Thomas Mahr1
1Nuremberg Institute of Technology Georg Simon Ohm
2Precise Localization and Analytics Department Fraunhofer Institute for Integrated Circuits IIS

12:40
Floor Plan-free Particle Filter for Indoor Positioning of Industrial Vehicles
Ivo Silva, Adriano Moreira, Maria João Nicolau, Cristiano Pendão
Algoritmi Research Center, University of Minho, Portugal

13:00
Versatile, low-cost indoor positioning combining Bluetooth and Ultra Wideband technologies
María D. Miñambres1, Víctor Rojo2, Antonio Román2, Pablo Renero3, Diego R. Llanos3
1Servicio Prevención de Riesgos Laborales, University of Valladolid, Spain
2RDNest SL, Spain; 3Departamento de Informática, University of Valladolid, Spain

13:20
Sensor Fusion and Well Condition Triangle Approach for BLE-based Indoor Positioning
Amrit Karmacharya1, German M. Mendoza Silva1, Joaquín Torres-Sospedra2
1Universitat Jaume I, Spain
2UBIK Geospatial Solutions, S.L, Spain

13:40 Lunch Break
14:20 Technical Session Modelling and Estimation

14:20

Modeling and Mitigating 5G Wireless Downlink Interferences for Low-altitude Aerial vehicles
Wenbo Wang¹, Thilo Fath², Mikko Valkama¹, Elena-Simona Lohan¹
¹Tampere University, Finland
²Airbus, Germany

14:40

Multipath Delay Estimation Using Signal Power Measurements from Multiple Carrier Frequencies
Simon Ollander¹,², Friedrich-Wilhelm Bode³, Marcus Baum¹
¹University of Goettingen, Germany; ²Robert Bosch Car Multimedia GmbH, Germany

15:00

On the performance of selected ionospheric modelling schemes in Precise Point Positioning
Jacek Paziewski, Rafał Sieradzki
University of Warmia and Mazury in Olsztyn, Poland

15:20

Support Vector Regression Machine Learning Tool to Predict GNSS Clock Corrections in Real-Time PPP Technique
Mutaz Wajeh Abdalmajid Qafisheh¹,², Angel Martin Furones¹, Joaquín Torres-Sospedra²
¹Departamento de Ingeniería Cartográfica, Geodesia y Fotogrametría, Universitat Politècnica de València. València, Spain
²Institute of New Imaging Technologies, Universitat Jaume I, Castellón, Spain

15:40 Break

16:00 Technical Session Vehicle Applications

16:00

GNSS-based Techniques for Accurate Height Component Estimation of Vessels in Finnish Waterways – A review
Afroza Khatun, Sarang Thombre, M. Zahidul H. Bhuiyan, Mirjam Bilker-Koivula, Hannu Koivula
Finnish Geospatial Research Institute (FGI), NLS, Finland

16:20

GNSS Positioning Aspects for the Intelligent Shipping Test Laboratory at Rauma Harbor
Simo Marila, Octavian Andrei, Hannu Koivula, Pasi Häkli, Mirjam Bilker-Koivula
National Land Survey of Finland, Finland

16:40

Comparative Study on GNSS Positioning Systems for Autonomous Vessels in the Arctic Region
Anastasia Yastrubova¹, Marko Höyhtyä², Sandrine Boumard¹, Aleksandr Ometov¹
¹Autonomous Connectivity Systems Research Group, VTT Technical Research Centre of Finland Ltd, Oulu, Finland
²Space Technology Research, VTT Technical Research Centre of Finland Ltd, Oulu, Finland
³Faculty of Information Technology and Communication Sciences, Tampere University, Tampere, Finland

17:00

Challenges in Characterization of GNSS Precise Positioning Systems for Automotive
Cristiano Pendão¹, André Ferreira¹, Adriano Moreira¹, César Martins¹, Hélder Silva¹
¹Algoritmi Research Center, University of Minho – Portugal
²Center for MicroElectromechanical Systems, University of Minho – Portugal
³Bosch Car Multimedia Portugal, S.A., Braga – Portugal

17:20

Hybridized GNSS and IMU Positioning for Train Infrastructure Asset Health Status Monitoring within the SIA-Project
Ramin Moradi, Michael Hutchinson
Nottingham Scientific Limited, United Kingdom

17:40 End of Technical Session
THURSDAY, 4TH JUNE

10:00 Special Session Collaborative Positioning
10:00
RFI Localization in a Collaborative Navigation Environment
Naveed Ahmed, Nadezda Sokolova
Norwegian University of Science and Technology, Trondheim, Norway

10:20
Autocalibration of a UWB Localization System for Dynamic and Ad-Hoc Deployments in GNSS-Denied Environments
Carmen Martínez Almansa, Wang Shule, Jorge Peña Queralta, Tomi Westerlund
University of Turku, Finland

10:40
Performance analysis of collaborative positioning method in automated car driving
Shuo Li, Nikolay Mikhaylov, Florian Schiegg, Yichen Liu
Robert Bosch GmbH, Germany

11:00 Keynote Sensory technology for medical wearables and rehabilitation robotics
Prof. Nirvana Popescu
Polytechnic University of Bucharest

12:00 Break

12:20 Special Session Wearables (A-WEAR)
12:20
Privacy versus Location Accuracy in Opportunistic Wearable Networks
Viktoria Shubina¹, Aleksandr Ometov¹, Sergey Andreev¹, Dragos Niculescu², Elena Simona Lohan²
¹Tampere University, Finland
²University “Politehnica” of Bucharest, Romania

12:40
Lossy Compression Methods for Performance-Restricted Wearable Devices
Lucie Klus¹, Elena Simona Lohan¹, Carlos Granell², Jari Nurmi²
¹Tampere University, Finland
²Universitat Jaume I, Spain

13:00
Privacy in Indoor Positioning Systems: a systematic review
Sylvia Holcer¹, Joaquín Torres-Sospedra¹,², Michael Gould¹, Inmaculada Remolar¹
¹Institute of New Imaging Technologies, UJI, Spain
²UBIK Geospatial Solutions S.L., Castellón, Spain

13:20
New Cluster Selection and Fine-grained Search for k-Means Clustering and Wi-Fi Fingerprinting
Joaquín Torres-Sospedra¹,², Darwin Quezada², Germán Martín Mendoza-Silva², Jari Nurmi³, Yevgeni Koucheryavy², Joaquin Huerta²
¹UBIK Geospatial Solutions S.L., Spain, ²Universitat Jaume I, Spain, ³Tampere University, Finland

13:40 Lunch Break
14:20 Technical Session GALILEO

14:20

Signal performance analysis of the latest quartet of Galileo satellites
Octavian Andrei¹, Jan Johansson², Hannu Koivula³, Markku Poutanen¹
¹National Land Survey of Finland, Finland
²Chalmers University of Technology, Sweden

14:40

Opportunities and challenges of Galileo E5 wideband real signals processing
Nicola Linty, Mohammad Zahidul H. Bhuiyan, Martti Kirkko-Jaakkola
Finnish Geospatial research Institute (FGI-NLS), Finland

15:00

On the Time-Delay Estimation Performance Limit of New GNSS Acquisition Codes
Lorenzo Ortega¹, Jordi Vilà-Valls², Eric Chaumette², François Vincent²
¹TeSA, France
²ISAE-SUPAERO/University of Toulouse

15:20

Galileo OSNMA: an implementation for ARM-based embedded platforms
Micaela Troglia Gamba, Mario Nicola, Beatrice Motella
LINKS Foundation, Italy

15:40 Break

16:00 Special Session Localization Techniques

16:00

GNSS Aided Non-Line-of-Sight Radio Localization via Dual Polarized Arrays
Marco Antonio Marques Marinho¹, Alexey Vinel¹, Felix Antreich², Per Gustafson³
¹Halmstad University, Sweden
²Aeronautics Institute of Technology (ITA), Brazil
³Gutec AB, Sweden

16:20

Audio Source Positioning Based on Angle of Arrival Measurements Using Particle Filter
Mikko Lager, Simo Ali-Löytty, Robert Piché
Tampere University, Finland

16:40

MAMPI – Multipath-assisted Device-free Localization with Magnitude and Phase Information
Marco Cimdins, Sven Ole Schmidt, Horst Hellbrück
Technische Hochschule Lübeck, Germany

17:00 Awards, ICL-GNSS 2021 and closing
Prof. Jari Nurmi

17:20 End of ICL-GNSS 2020