



INTERNATIONAL CONFERENCE
ON LOCALIZATION AND GNSS

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
Tampere University

Assoc.Prof. Elena-Simona Lohan
Tampere University

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Conference Program

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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; ²Tampere 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 Gordo, 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 [◆IEEE](#)

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 [◆IEEE](#)

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 [◆IEEE](#)

Francesco Ardizzon, Nicola Laurenti, Stefano Tomasin
University of Padova, Italy

16:20

Simultaneous Jamming and Navigation Pseudolite System [◆IEEE](#)

Johannes Rossouw van der Merwe, Alexander Rügamer, Wolfgang Felber
Fraunhofer IIS, Germany

16:40

Hardware Implementation and Evaluation of the HDDM [◆IEEE](#)

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 [◆IEEE](#)

Karel Pärlin¹, Taneli Riihonen²
¹Rantelon, Estonia
²Tampere University, Finland

17:20

Optimal compromise among security, availability and resources in the design of sequences for GNSS spreading code authentication [◆IEEE](#)

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 Verheyde^{1,2}, Antoine Blais², Christophe Macabiau², François-Xavier Marmet³

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 Rustamov^{1,2}, 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, Victor 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 Ollander^{1,2}, Friedrich-Wilhelm Bode², 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, Rafal 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 Abdlamajud Qafisheh^{1,2}, Angel Martín 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 Yastrebova¹, Marko Höyhty², Sandrine Boumard¹, Aleksandr Ometov³

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 Martins³, Hélder Silva²

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 Martinez Almansa, Wang Shule, Jorge Peña Queraltá, 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

Viktoriiia Shubina¹, Aleksandr Ometov¹, Sergey Andreev¹, Dragos Niculescu², Elena Simona Lohan¹

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 Nurmi¹

¹Tampere University, Finland

²Universitat Jaume I, Spain

13:00

Privacy in Indoor Positioning Systems: a systematic review

Sylvia Holcer¹, Joaquín Torres-Sospedra^{1,2}, 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-Sospedra^{1,2}, Darwin Quezada², Germán Martín Mendoza-Silva², Jari Nurmi³, Yevgeni Koucheryavy³, Joaquín 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 Koivula¹, 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 Vine¹, 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