Symposium 4: Positioning and applications

Organizer: Allison Kealy President of Commission 4
Co-organizer: Vassilis Gikas Vice-president of Commission 4

Abstract:
The opportunities and challenges for positioning technologies and applications are rapidly evolving as we fully embrace the multi-frequency, multi-constellation era. This landscape is made even more complex and exciting as we address increasing concerns around GNSS vulnerabilities; high performance positioning enabled by smartphones; enhanced capabilities for alternative technologies to GNSS; and the growing demands of safety and liability critical applications. These developments are key drivers for this symposium. We invite the submissions of papers dealing with, but not limited to: multi-sensor systems; seamless indoor/outdoor positioning applications; smartphone positioning; novel applications for high performance positioning; multi-constellation/multi-frequency positioning modes and models; GNSS integrity and quality control; and GNSS/Geodetic remote sensing techniques and applications.

Symposium 4, Session 1: Geodetic Remote Sensing

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Abstract:
In the context of this session the expression "Geodetic Remote Sensing" comprises atmosphere (including e.g. troposphere, ionosphere and plasmasphere) monitoring as well as GNSS reflectometry (GNSS-R). There will be a strong relation to the Session 6.3: Geodetic space weather research.

The Earth's atmosphere can be structured into various layers depending on physical parameters such as temperature or charge state. Today, from the geodetic point of view the atmosphere is not only seen as a disturbing quantity which has to be corrected but also as a target quantity, since almost all geodetic measurement techniques, such as GNSS, satellite altimetry, VLBI, SLR and DORIS provide valuable information about the state and the dynamics of the atmosphere.

Modern GNSS applications such as autonomous driving and precision farming require the use of high-precision and high-resolution atmospheric correction models in (near) real-time. In particular, real-time approaches are under development to monitor and forecast the ionospheric state or to optimize ultra-fast tropospheric products. Other interesting topics of this session are the vertical coupling processes between atmospheric layers and GNSS-R. After interacting with the neutral and ionized atmospheric layers, GNSS signals can be reflected off water, ice, and soil surface and exploited to derive geophysical properties such as surface roughness and snow height.

In this session, contributions on atmosphere – from troposphere to ionosphere and plasmasphere – monitoring (incl. post-processing, (near) real-time approaches) and modelling (incl. scintillations and TIDs), forecasting methods, the combination of observation techniques and the validation of atmosphere products are welcome. We furthermore appreciate studies on coupling processes, on empirical upper atmosphere models, on numerical weather models, on GNSS reflectometry and geophysical applications. In all these topics, we focus rather on short-term variations than on climatology.

This session solicits contributions focusing on aspects of:

- Atmosphere (from lower to upper) monitoring and modelling of atmosphere parameters (e.g. electron density and water vapour) including post-processing and (near) real-time approaches
- Studies on the combination of ground- and space-based geodetic observation techniques (including terrestrial GNSS, satellite altimetry, radio occultations, VLBI, DORIS)
- Studies on the validation of atmosphere parameters (e.g. ionosphere parameters such as VTEC and the electron density)
- Vertical coupling processes between atmosphere layers
- Improvement of empirical atmosphere models, e.g. for the troposphere, ionosphere and thermosphere
- Studies on GNSS-R and related geophysical applications
- Presentations on the estimation and forecast of atmospheric parameters (including atmospheric data assimilation) and on the usage of numerical weather models to improve GNSS positioning and navigation

Keywords: Atmosphere monitoring and modelling, Near real-time and real-time modelling, Validation of atmosphere products, Vertical coupling processes, Development of forecast models, Further development of empirical models, Modern GNSS applications such as autonomous driving and precision farming, Investigations and applications of GNSS-R

Symposium 4, Session 2: Next Generation Positioning

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Abstract:
The global availability of position, velocity and time information due to the maturation of Global Navigation Satellite Systems (GNSS) technologies is creating an increasing demand for more and more accurate and reliable solutions for navigation in also GNSS challenging areas.

At present, navigation is mainly based on the use of GNSS, providing good performance in open outdoor environments. However, navigation solution with sufficient accuracy and integrity is needed in urban canyons and indoors, where GNSS is significantly degraded or unavailable. For overcoming the aforementioned navigation challenges, research has been very active for decades for finding a suitable set of other methods for augmenting or replacing the use of GNSS in positioning. As well, safety critical applications such as navigation of autonomous systems require use of multiple technologies. This session focuses on research using next generation positioning methods for accurate and reliable navigation for demanding applications and challenging GNSS environments.

This session solicits contributions focusing on aspects of:

- Developing methods for multi-sensor navigation
- Developing computer vision technologies for navigation
- Localization in deep urban canyons or indoors

Keywords: navigation, multi-sensor, computer vision, indoor navigation, urban navigation

Symposium 4, Session 3: Techniques and Applications in High Precision GNSS

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Xiaoming Wang
Co-Convener: Suelynn Choy, RMIT University, Australia.

Abstract:
The year 2020 marks a new era of multi-constellation GNSS with an increased number of available satellites in different orbits, diverse signals/frequencies, and new correction products and services. This ongoing modernization offers exciting prospects for further improvement of high precision GNSS PNT algorithms and methods, as well as opens up new areas of research and innovation. For example, the increased number of satellites and signals-in-space improves the performance of precise positioning applications; the available of addition frequency signals beyond L1 and L2 enables new concepts for signal quality assessment and improved carrier phase ambiguity resolution techniques; integrity and quality control methods; multi-GNSS satellite metadata to allow determination of GNSS-based terrestrial reference frame scale, orbit determination; as well as new services such as Precise Point Positioning (PPP) and emergency warning services. At the same time, the number of applications enabled by high precision GNSS is increasing rapidly including but not limited to location-based services, autonomous navigation, Internet-of-Things (IoT), etc.

This session is a forum to discuss new developments in high precision GNSS algorithms and techniques, as well as to share novel, emerging and innovative applications of GNSS.

This session solicits contributions focusing on aspects of:

- High-precision GNSS algorithms, modelling and estimation strategies
- Multi-frequency multi-GNSS biases and calibrations
- PPP, RTK, PPP-RTK
- New or improved GNSS products for high precision applications such as orbits, clocks, etc.
- Ambiguity resolution and validation
- Cost-effective, smartphones high precision GNSS
- High-precision applications for geosciences, natural hazards prevention
- GNSS and LEO constellation

Keywords: GNSS, high precision, PPP, RTK, PPP-RTK, biases, calibration, ambiguity resolution, cost-effective, geosciences, natural hazards prevention