

## SESSION 3.1 - HIGH INTEGRITY AND HIGH ACCURACY FOR INTELLIGENT TRANSPORTATION SYSTEMS

### Invited speech - GNSS HIGH PRECISION FOR ANYONE: DREAM OR REALITY?

Since the early GPS era, the relevance of GNSS carrier phase for High Precision and High Accuracy (using the correct metric parameter referred to the true value) satellite positioning has been recognised. Differential techniques came up suddenly, showing the possibility to eliminate common errors between a reference station and a rover receivers. The consequence of that was the possibility to solve the so called ambiguities (initial number of cycles in a satellite to user distance measurement), needed for dealing with carrier phase. This allowed achieving centimeter level positioning through long post processing (hours to tenths of minutes, depending on the relevant interdistance and level of measurements errors and noise). After that, RTK (Real-Time Kinematic) technique raised, allowing the same accuracy in tenths of seconds.

This led to the development of costly and dense Reference Station networks (being the maximum interdistance limited by the decorrelation of errors in the covered area) for allowing RTK on a local area.

Network-RTK allowed a modelling of errors in a wider area, reducing the need of Reference Stations (interdistance in the order of 70 km).

Nowadays, the technology is rapidly evolving and allows advantages in terms of costs, coverage and flexibility.

While high precision was limited in the past to professional use (e.g. geodesy, mapping, land surveying), today such requirement is becoming relevant for emerging applications, like autonomous driving.

PPP (Precise Point Positioning) is the ultimate objective of the Current GNSS Research. Such technique is based on the precise estimation of errors by a control centre (e.g. precise ephemeris and clock for each satellite). Such estimation requires a very sparse monitoring network of reference stations at global level and allows the implementation of High Precision for anyone. Unfortunately, a long convergence time is needed, but new techniques and the availability of multiple constellations and frequencies are very well promising.

The European Galileo programme is believing in that possibility and foresaw the broadcasting of such corrections directly from any satellite. This could lead to the possibility of having High Precision cm level positioning for anyone at low cost in a few years.

Furthermore, ubiquitous positioning is leading to the PNT (Positioning, Navigation and Timing) concept. The integration of other positioning means (mobile communication, Bluetooth, WiFi) will allow high accuracy positioning everywhere.

Receiver technology is rapidly evolving, through the availability of multi-frequency and multiconstellations GNSS chipsets within smartphones.

Integrity and reliability of high accuracy positioning are also important for the safety of life applications and standardization bodies are dealing with that point (e.g. new brand RTCM SC-134 Committee).

The present lecture will show the above steps of evolution of high precision positioning systems and how it could become a reality that will revolutionise our life in the incoming years.

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