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GNSS PERFORMANCE MONITORING USING PUBLICLY AVAILABLE DATA AND TOOLS

Abstract

Global Navigation Satellite Systems (GNSS) provide services to billions of users around the world for various applications. Some of them, such as Civil Aviation applications, are safety critical. This has resulted in the need for monitoring the performance of GNSS in both real-time and post-processing modes.

GALILEO Programme needs and other users interests for performance monitoring

The European GNSS Agency (GSA) has established the Galileo Reference Centre (GRC) with a primary mission of providing independent means to monitor and evaluate the performance of the Galileo services and the quality of the signals in space. The GRC is the European hub for these kinds of activities, integrating contributions from European entities, such as research centers, timing laboratories, and national space agencies. In addition, the GRC provides GNSS service performance expertise to the Galileo Programme and European Aviation authorities in charge of different aspects, such as aviation network management and safety policies. With the use of GNSS in a growing number of applications in different sectors (e.g. different transportation domains), a number of organizations are now interested in monitoring GNSS performance. This interest is often triggered by specific recommendations and/or requirements. For example, for civil aviation application, the International Civil Aviation Organization (ICAO) recommends that a National Authority that approves GNSS-based operations should also ensure that GNSS data relevant to these operations are properly recorded and archived.

Publicly available data and tools

A number of publicly available data and tools can be used for the development of a GNSS monitoring solution. For example, open source (library) software (such as RTKLIB and the BKG NTRIP Client) are available for GNSS-data processing and can be used to retrieve publicly available data and reference products. Such data and products can be retrieved from several sources, including the International GNSS Service (IGS) and a number of national and international initiatives.

Methodology for performance monitoring

The performance of a GNSS system can be evaluated based on the performance in both the position and the ranging domains. In the position domain, this is normally done through the computation of the Position, Velocity, and Timing (PVT) solution at one or more reference stations, which are deployed at known locations. In the ranging domain, the common approach is the evaluation of the User Equivalent

Range Error (UERE) of each GNSS satellite. This is usually complemented by the Signal in Space (SIS) Range Error (SISE).

Paper outline The computation of the PVT solution, UERE, and SISE requires GNSS measurement data and reference products. This computation can be based on publicly available data and products, which are normally available with some latency. An alternative for the independent monitoring of GNSS performance requires the deployment of a network of reference stations and the autonomous computation of reference products. In this context, this paper will present a set of guidelines for the implementation of a solution able to monitor the Galileo system performance based on publicly available data, products, and tools. The guidelines will highlight possible limitations of the tools. A suitable way forward to deal with these limitations will be also indicated. Finally, the proposed solution will be validated with the corresponding results generated at the GRC, where a completely independent system for the monitoring of the Galileo system performance is in place.