

Title: Use of BeiDou in Operational Precise Positioning Service

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Abstract

In 2009 Fugro added GLONASS to its operational real-time Precise Point Positioning (PPP) service. Fugro's aim is to introduce additional Global Navigation Satellite System (GNSS) as they become operational. A few years back, the expectation was that the European Galileo system would be the third GNSS system to be introduced in the Fugro PPP service, and Galileo real-time PPP was demonstrated in 2013. Due to delays in both system deployment and declaration of Initial Operational Capability (IOC) for Galileo, this has been postponed in favor of introducing the Chinese BeiDou system.

China has now deployed 13 satellites in its BeiDou system. The current satellite constellation consists of 3 Medium Earth Orbit (MEO) satellites, 5 Inclined Geosynchronous Orbit (IGSO) satellites and 5 Geostationary Orbit (GEO) satellites. Since the IGSO and GEO satellites reside over the Far East region, it is possible to achieve 24 hour coverage for positioning using only BeiDou in that region, where typically 8-12 BeiDou satellites are seen at any time.

In the spring of 2013 Galileo had 4 In Orbit Validation satellites (IOV) transmitting valid signals. Fugro did provide the first Galileo only solution with decimetre level accuracy using its own orbit/clock data generated by its reference station network. This was within a week of the EU/ESA announcing their first Galileo only fix, at the few meter level.

In 2014 further developments were made and BeiDou satellites were introduced into the Fugro PPP processing chain. BeiDou is the first GNSS system to use GEO satellites, and this requires additional tuning in the processing. Examples of positioning with BeiDou will be given, including 24 hour plots of BeiDou only decimetre level positioning including GEO satellites.

Fugro Satellite Positioning is providing GNSS augmentation services for marine/offshore Dynamic Positioning (DP) applications worldwide. DP applications are safety critical and it is important to have access to two or more independent positioning reference systems in order to have high availability and robustness. Today GPS is the basis of most GNSS setups in DP applications, often together with GLONASS. It is accepted as use of two "independent" setups in DP as long as the augmentation data is provided via independent channels. In the future, with four GNSS systems, it will be possible to configure two truly independent setups, each with high availability and robustness, by using two GNSS systems in each setup (e.g. GPS and BeiDou in the first setup and GLONASS and Galileo in the second).

Fugro has now introduced BeiDou in the operational PPP service, and will include Galileo as soon as IOC has been declared for the Galileo system.