Ginan: Evaluating Multi-GNSS Precise Point Positioning for Surveying Applications

Simon McClusky, Eugene Du, Sebastien Allgeyer, Nathan Kelly and Ronald Maj (Australia)

Key words: Deformation measurement; Engineering survey; GNSS/GPS; Positioning

SUMMARY

Ginan is a multi-GNSS (Global Navigation Satellite System) Analysis Centre Software developed by Geoscience Australia, in collaboration with industry and academic partners. It is fully open-source and based on the State Space Representation (SSR) and Precise Point Positioning (PPP) models. Ginan is capable of computing and using precise positioning products, delivering real-time correction services, and functioning as a user-level PPP positioning engine. Ginan is a modern, multi-threaded C++ application that leverages industry-standard high-performance libraries. Configuration is managed through YAML Markup Language files, contributing to flexibility and ease of use. At its core, Ginan features a robust Kalman filter tightly coupled with a data pre-processor and orbit integrator. This architecture enables both real-time processing of industry-standard RTCM3 data streams and post-processing using International GNSS Service (IGS) positioning products. The software is versatile and supports various geodetic, positioning, navigation and timing applications, including daily coordinate solutions, kinematic tracking, precise satellite orbit determination and validation for GNSS and Low Earth Orbit (LEO) satellites, satellite clocks and biases estimation, atmospheric modelling, and data quality assurance and control (QA/QC). This paper focuses on Ginan's performance for general surveying applications, specifically highlighting its multi-GNSS PPP capabilities. We compare the static positioning performance when using a single GNSS satellite constellation (e.g., GPS-only) with multi-GNSS solutions that incorporate all four global constellations: GPS, Galileo, GLONASS, and BeiDou. The evaluation includes analyses of absolute positioning precision and accuracy over various data spans (1 hour to 24 hours) and positioning convergence time, i.e., the time required for solutions to meet specific accuracy thresholds. Finally, we benchmark Ginan's kinematic PPP capabilities against a traditional short-baseline Real-Time Kinematic (RTK) solution. This comparison highlights the advantages and limitations of Ginan in dynamic surveying applications.