

Analysis tool for multi-GNSS precise point positioning

Ján Hefty, Ľubomíra Gerháťová
Slovak University of Technology, Bratislava¹

Abstract: The Department of Theoretical Geodesy at the Slovak University of Technology in Bratislava is developing the software package ABSOLUTE aimed to Precise Point Positioning (PPP) using the precise clocks and orbits of GNSS satellites. The recent version of software enables individual analysis of GPS and GLONASS un-differenced observations as well as their combination. The inclusion the Galileo Giove-B satellite is anticipated. In the paper are presented the used models and algorithms completed by examples of numerical and graphical outputs. The GPS-only, GLONASS-only and GPS+GLONASS coordinates from ABSOLUTE application will be compared with standard double-differenced phase based network solution.

The applied PPP analysis strategy involves:

- Pre-processing of simultaneous dual frequency phase and code observations of individual satellites continuous observations resulting in the iono-free pseudoranges and approximate real valued phase ambiguities.
- Precise orbits and satellite clocks interpolation from global network solutions.
- Reduction of observed ranges for systematic phenomena according to models available and computation of o-c (observed minus calculated) values.
- Forming of adjustment model and estimation of parameters: site coordinates, receiver clocks, corrections to ambiguities, troposphere zenith delays and other relevant parameters separately for GPS and GLONASS.
- Combined solution of GPS and GLONASS with inclusion of additional parameters aimed to model the inter-system biases between the two GNSS.

The parameter estimation in the software package ABSOLUTE is performed after the execution of pre-processing and reduction procedures resulting to o-c values for each satellite and observation epoch. Two adjustment approaches are involved:

¹Department of Theoretical Geodesy, Faculty of Civil Engineering, SUT, Radlinského 11, 813 68 Bratislava, Slovakia, jan.hefty@stuba.sk, lubomira.gerhatova@stuba.sk

1. Sequential coordinate and receiver clocks adjustment from single epoch's observations and subsequent combination by Kalman filtering. The input values are the smoothed iono-free code and phase pseudoranges. This option is recently developed for GPS-only solution.
2. Complex least-squares simultaneous adjustment for all available code and phase GPS and GLONASS observations. Firstly they are treated as independent systems and then the multi-GNSS solution is performed. Besides the site coordinates, the troposphere parameters, receiver clocks also the real valued ambiguity increments are estimated. Alternatively the combination-related biases are adjusted.

Observations at EUREF GNSS permanent stations Modra-Piesok, Gánovce (Slovakia), Jozefoslaw (Poland) and Dresden (Germany) are used for demonstration of multi-GNSS PPP potential. These sites are equipped by various GNSS receivers and antennae which allows to estimate the effect of the instrumentation in the combined coordinate solutions.

Key words: PPP software, combination of GNSS observations, inter-system biases

References

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