

Ionospheric-Constrained PPP using Triple-GNSS Constellations

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SUMMARY

The technique of Precise Point Positioning (PPP) has wide-spread application in positioning, navigation, and timing (PNT) due to its improved accuracy and low cost. However, the technique continues to suffer from long convergence period in order to attain Real-Time Kinematic (RTK) comparable performance. The fusion of multi-GNSS constellations remains today's most probable remedy to the long convergence time with improved positioning accuracy, availability, redundancy and integrity. Besides, the Ionospheric and Hardware Delay (IHD) derived from Global Ionospheric Maps (GIM) generated by the International GNSS service (IGS) have proved significant in accelerating single-frequency PPP convergence time. Previous literature has a deficiency on triple constellation PPP incorporating both ionospheric-constrained single frequency PPP and dual-frequency PPP. In this paper, GPS+GLONASS+Galileo GNSS constellations are evaluated in kinematic mode over eleven (11) Multi-GNSS Experiment (MGEX) stations. Twenty-four (24) hour observations for the first week of February, 2017 are processed in four PPP scenarios (GPS-only, GLONASS-only, GPS+GLONASS, and triple-constellation of GPS+GLONASS+Galileo) at 7° elevation angle cut-off. To validate the findings, standard single-frequency PPP and dual-frequency PPP are analysed. Preliminary results show considerably longer convergence time (reaching up to 4-hours) for ionospheric-constrained GLONASS-only PPP than in its corresponding standard PPP solution. There is no meaningful difference in convergence time between the ionosphere-constrained GPS+GLONASS PPP is and standard GPS+GLONASS PPP. Similarly, augmenting GPS with GLONASS and Galileo, triple constellation, improves the overall convergence time in both the standard PPP and ionospheric-constrained PPP solutions than the GPS-only PPP. Thus, this study fills the gap in literature by unveiling the threshold of performance for the Ionospheric-Constrained PPP using Triple-GNSS Constellations.

Keywords: Triple-GNSS; PPP; Ionospheric-constrained; Standard PPP