Fast estimation of real-time high-frequency precise satellite clock offset using multi-frequency and multi-constellation GNSS observations

Yun Xiong, Xingxing Li, Jiaqi Wu , Yongqiang Yuan and Xin Li

School of Geodesy and Geomatics, Wuhan University, Wuhan, Hubei, China (xiongyun@whu.edu.cn)

Introduction

The real-time estimation of precise satellite clock and its rapid update are essential guarantee to realize real-time positioning with high precision. The rapid development of GNSS and IGS Multi-GNSS Experiment (MGEX) provides us a great opportunity to estimate high-accuracy Multi-GNSS satellite clocks. However, A great number of ambiguity parameters are estimated simultaneously with satellite clocks, which makes the estimation pretty time-consuming. In this study, we aim at improving the computational efficiency of precise Multi-GNSS satellite clock estimation (PCE) using the “Carrier-range” observations proposed by Blewitt et al. (2010).

Processing strategy

The wide-lane and narrow-lane un-calibrated phase delays (UPD) could be resolved in advance form the Melbourne-Wubennan (MW) combinations and ionosphere-free carrier-phase (LC) combinations observed by a network of stations. With the accurate wide-lane and narrow-lane UPD, both the wide-lane and narrow-lane ambiguities could be fixed, and the “Carrier-range” observations could be generated (Chen et al. 2014). Therefore, the pseudorange observations can be ignored in PCE processing and the satellite clocks estimated using the “Carrier-range” observations are referred to integer-recovery clocks (IRCs) (Geng et al. 2010).

Tracking network

The MGEX was set up by the International GNSS Service (IGS) to track, collect, and analyze all available GNSS signals. By October 2018, the MGEX network has grown to almost 240 stations, among which 31 stations are capable of tracking BDS-3 B1I and B3I signals. All the available MGEX stations are continuously tracking the GPS, GLONASS and Galileo, and 193 stations tracking BDS satellites. The distribution of the selected tracking stations and their supported constellations are shown in Fig. 1.

References


Fig. 3 shows the positioning performance of static PPP of IFC and float solutions at stations BRAZ and ROAP on DOY 106, 2017. From Fig. 3, we can see that after applying the IFC products, both the convergence time and positioning accuracy is significantly improved.

Conclusions
- The computational efficiency of precise clock estimation can be improved with the “Carrier-range” observations.
- When applying the inter-recovered satellite clock products, both the convergence time and positioning accuracy is significantly improved.