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Precise Point Positioning Based on BDS and GPS Observations

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BeiDou Navigation Satellite System (BDS) has obtained the ability applying initial navigation and precise point services for the Asian-Pacific regions at the end of 2012 with the constellation of 5 Geostationary Earth Orbit (GEO), 5 Inclined Geosynchronous Orbit (IGSO) and 4 Medium Earth Orbit (MEO). Till 2020, it will consist with 5 GEO, 3 IGSO and 27 MEO, and apply global navigation service similar to GPS and GLONASS.

As we known, GPS precise point positioning (PPP) is a powerful tool for crustal deformation monitoring, GPS meteorology, orbit determination of low earth orbit satellites, high accuracy kinematic positioning et al. However, it accuracy and convergence time are influenced by the quality of pseudo-range observations and the observing geometry between user and Global navigation satellites system (GNSS) satellites. Usually, it takes more than 30 minutes even hours to obtain centimeter level position accuracy for PPP while using GPS dual-frequency observations only. In recent years, many researches have been done to solve this problem. One of the approaches is smooth pseudo-range by carrier-phase observations to improve pseudo-range accuracy. By which can improve PPP initial position accuracy and shorten PPP convergence time. Another sachems is to change position dilution of precision (PDOP) with multi-GNSS observations. Now, BDS has the ability to service whole Asian-Pacific regions, which make it possible to use GPS and BDS for precise positioning. In addition, according to researches on GNSS PDOP distribution, BDS can improve PDOP obviously. Therefore, it necessary to do some researches on PPP performance using both GPS observations and BDS observations, especially in Asian-Pacific regions currently.

In this paper, we focus on the influences of BDS to GPS PPP mainly in three terms including BDS PPP accuracy, PDOP improvement and convergence time of PPP based on GPS and BDS observations. Here, the GPS and BDS two-constellation data are collected from BeiDou experimental tracking stations (BETS) built by Wuhan University. And BDS precise orbit and precise clock products are applied by GNSS center, Wuhan University. After an introduction about GPS+BDS PPP mathematical and the error correction modes, we analyze the influence of BDS to GPS PPP carefully with calculating results. The statistics results show that BDS PPP can reach centimeter level and BDS can improve PDOP obviously. Moreover, the convergence time and position stability of GPS+BDS PPP is better than that of GPS PPP.