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マルチ GNSS 姿勢決定と GNSS 回転地震学について
Multi-GNSS Attitude Determination and GNSS Rotational Seismology

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High-rate GNSS positioning has been widely investigated and applied in science and engineering. We extend it to high-rate attitude determination under a multi-GNSS constellation. A series of experiments of high-rate GNSS attitude determination has been conducted on a platform with three 50 Hz geodetic receivers and two high-grade inertial measurement units (IMU). The high-rate attitude solutions are computed for each of the multi-GNSS systems and the combined constellation by either using short baselines with correct ambiguity resolution or precise point positioning (PPP) and compared with the IMU measurements. In the case of a single GNSS system, the experimental results have shown that GPS is of the best accuracy, followed by GLONASS. The results with Beidou are the noisiest. The combined multi-GNSS constellation can significantly improve the high-rate attitude solutions from any single GNSS system alone, which is, in particular, most suitable for applications to any platform in slow or quasi-static motion. However, the improvement rate could depend on proper weightings of measurements from different GNSS systems in the dynamical experiments. The accuracy of baseline-based high-rate GNSS attitude solutions remains stable over time, while that of PPP-based solutions substantially degrades with time, as theoretically expected. Within a short period of time, the PPP-based high-rate yaw solutions with the combined multi-GNSS constellation are comparable in accuracy with those computed from baselines with correct ambiguity resolution in the dynamical experiments. The attitude results from either static or dynamical experiments have shown that high-rate GNSS attitude determination is sufficiently precise to measure rotatory motions. GNSS rotational seismology is applied to the 2011 Tohoku Mw9.0 earthquake, illustrating the potential of multi-GNSS to precisely detect seismic rotatory motions.

For more information on this talk, the reader is referred to:

Xu PL, Shu YM, Niu XJ, Liu JN, Yao WQ, Chen Q (2019). High-rate multi-GNSS attitude determination: experiments, comparisons with inertial measurement units and applications of GNSS rotational seismology to the 2011 Tohoku Mw9.0 earthquake. **Measurement Science and Technology**, **30**, 024003, https://doi.org/10.1088/1361-6501/aaf987

Xu PL, Shi C, Fang RX, Liu JN, Niu XJ, Zhang Q, Yanagidani T (2013). High-rate precise point positioning (PPP) to measure seismic wave motions: An experimental comparison of GPS PPP with inertial measurement units. **Journal of Geodesy**, **87**, 361-372, DOI 10.1007/s00190-012-0606-z

Shu Y, Shi Y, **Xu PL**, Niu X, Liu JN (2017). Error analysis of high-rate GNSS precise point positioning for seismic wave measurement. **Advances in Space Research**, **59**, 2691-2713, DOI: 10.1016/j.asr.2017.02.006