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Development of the GFZ Real-Time Precise Point Positioning Service

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Motivated by the IGS Real-Time Pilot Project (RTPP) and the increasing requirements on (real-time) precise kinematic positioning from a number of ongoing projects in geosciences, GFZ has been working on the development of the EPOS-RT (Earth Parameter and Orbit determination Software – Real Time) software since years. As one of the IGS RTPP Analysis Centers, GFZ is now running the software operationally using streaming data from about 80 global stations to generate the real-time products including GPS satellite orbits and clocks and information for resolving integer ambiguity as well. The products are contributed to IGS RTPP for comparison and combination. They are also disseminated via internet protocol to provide global Precise Point Positioning (PPP) services. An embeddable client software piece developed recently is also available for end-users. Concurrently, the EPOS-RT software is also set up and running in real-time for regional deformation monitoring for various applications.

In order to improve the accuracy and to shorten the convergence time of PPP, we implemented the real-time ambiguity resolution for PPP by providing the Uncalibrated Phase Delays (UPD) estimated from the reference network at the server side. We also try to accelerate the convergence and to improve ambiguity resolution by using observations at L1 and L2 directly with help of a priori ionospheric delay model instead of their ionosphere-free combination. The discontinuity in phase observations which is inevitable in practice could cause severe accuracy degradation and may request a convergence process in order to obtain reasonable result. To overcome such limitation, a sophisticated approach is developed to precisely estimate the cycle slips based on the short-term stability of the atmosphere. A new strategy to augment the global PPP services with regional networks is also developed for instantaneous ambiguity resolution and consequently can achieve similar performance as the Network Real-Time Kinematic (NRTK) service for users within the coverage of the regional networks.

After a brief introduction of the software package and its configurations for various applications, we concentrate on the PPP based precise positioning services. We present the above mentioned new approaches and their implementation into EPOS-RT in detail. Based on the GFZ real-time products, we demonstrate their improvements on the performance of real-time PPP in terms of accuracy and convergence time.