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Real-time precise point positioning using ultra-rapid orbits and predicted clocks

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The current real-time precise point positioning (RT-PPP) service heavily relies on the network communication, as the real-time orbits and clocks are updated with seconds. However, the communication interruption cannot be avoided and thus degrades the RT-PPP performance. The new GNSS constellations such as Galileo and BDS or satellite types such as GPS III have stable satellite clock onboard, which facilitates the windows of using predicted orbits and clocks for RT PPP. In this study we investigate the performance of RT-PPP using half-hourly updated multi-GNSS orbits and clocks. An epoch-parallel processing strategy is proposed for efficient GNSS processing, which shortens the latency of multi-GNSS POD of 120 satellites and 90 stations from one-hour, state-of-the-art ultra-rapid POD solution of IGS, to 30-min. The orbits and clocks are further predicted for RT-PPP. We adopt a new weighting strategy based on the orbit and clock prediction precision to exploit the benefit of all satellites. Using this satellite-specific weighting strategy, the 3D accuracy of quad-constellation kinematic RT-PPP in 5-, 10-, 20-, and 30-min becomes 0.70 m, 0.49 m, 0.35 m and 0.29 m, respectively. The position accuracy after convergence, which is counted starting from three hours, is 0.10 m in horizontal and 0.14 m in vertical. The PPP performance without considering satellite-specific weighting strategy is about 45% worse. This study is serviceable for the real-time GNSS applications with dm-level accuracy requirement.