Real Time Precise Point Positioning: Preliminary Results for the Brazilian Region

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GNSS positioning can be carried out in relative or absolute approach. In the last years, more attention has been driven to the real time precise point positioning (PPP). To achieve centimeter accuracy with this method in real time it is necessary to have available the satellites precise coordinates as well as satellites clocks corrections. The coordinates can be used from the predicted IGU ephemeris, but the satellites clocks must be estimated in a real time. It can be made from a GNSS network as can be seen from EUREF Permanent Network. The infra-structure to realize the PPP in real time is being available in Brazil through the Brazilian Continuous Monitoring Network (RBMC) together with the Sao Paulo State GNSS network which are transmitting GNSS data using NTRIP (Networked Transport of RTCM via Internet Protocol) caster. Based on this information it was proposed a PhD thesis in the Univ. Estadual Paulista (UNESP) aiming to investigate and develop the methodology to estimate the satellites clocks and realize PPP in real time. Then, software is being developed to process GNSS data in the real time PPP mode. A preliminary version of the software was called PPP_RT and is able to process GNSS code and phase data using precise ephemeris and satellites clocks. The PPP processing can be accomplished considering the absolute satellite antenna Phase Center Variation (PCV), Ocean Tide Loading (OTL), Earth Body Tide, among others. The first order ionospheric effects can be eliminated or minimized by ion-free combination or parameterized in the receiver-satellite direction using a stochastic process, e.g. random walk or white noise. In the case of ionosphere estimation, a pseudo-observable is introduced in the mathematical model for each satellite and the initial value can be computed from Klobuchar model or from Global Ionospheric Map (GIM). The adjustment is realized in the recursive mode and the DIA (Detection Identification and Adaptation) is used for quality control. In this paper our proposition is to present the mathematical models implemented in the PPP_RT software and some proposal to accomplish the PPP in real time as for example using tropospheric model from Brazilian Numerical Weather Forecast Model (BNWFM) and estimating the ionosphere using stochastic process. GPS data sample from the Brazilian region was processed using the PPP_RT software considering periods under low and high ionospheric activities and the results estimating the ionosphere were compared with the ion-free combination. The PPP results also were analyzed considering the strategy of the troposphere estimation, Hopfield model or using the BNWFM. For the troposphere case, the values from BNWFM can reach similar results when estimating the troposphere. For the ionosphere case, the results have shown that ionosphere estimation can improve the time convergence of the PPP processing what is very important for PPP in real time.