Real-Time Kinematic GPS Positioning Supported by Predicted Ionosphere Model

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Precise real-time kinematic positioning (RTK) requires finding the integer carrier phase ambiguities; therefore, ambiguity resolution (AR) is of the highest importance in RTK applications. Although this task may be relatively easy over short distances (< 10 km), it becomes increasingly difficult when the separation between the rover and the reference station grows. This is due to decorrelation of the atmospheric errors with the growing distance, when ionospheric and tropospheric delays do not cancel out even in the double difference (DD) mode. Hence, application of RTK technique over longer distances (10-100 km) requires using dual-frequency receivers and special handling of the ionospheric errors in order to make the initialization time as short as possible. Recently, many techniques were developed to provide the ionospheric delay corrections that support fast on-the-fly (OTF) AR over longer distances. Most of these techniques can be divided into two groups. The first group consists of Network-RTK approach (or VRS), where the ionospheric corrections are derived by the reference network in real-time. The second group consists of techniques that use external ionosphere information, e.g., from ionospheric models, to form ionospheric corrections. However most of the quality ionospheric models are derived in postprocessing, therefore they cannot support real-time application. Hence, the desired solution is to use ionosphere models capable of predicting the ionospheric corrections. Recently, such a model was developed at the Institute of Geodesy of the University of Warmia and Mazury in Olsztyn (UWM). The model (UWM-IPM) is based on several prediction techniques, such as autocovariance, autoregression moving average (ARMA) and Neural Networks, and uses the high accuracy regional ionosphere model (UWM-IM) as an input for the prediction algorithm. The UWM-IM model was developed in cooperation with West Department of the Institute of Ionosphere and Radio-Wave Propagation of the Russian Academy of Sciences (WD IZMIRAN) in Kaliningrad, Russia.

This paper presents the test results of the performance assessment of the predicted UWM-IPM model in medium-range RTK positioning. The rover data collected within 40 to 60 km from the closest reference station were processed in kinematic mode with the support of the ionospheric corrections derived from the UWM-IPM model. The RTK solution was derived in single- and multi-baseline modes. All numerical tests were carried out using the MPGPS software developed in cooperation with The Ohio State University. The recent extension to the software developed at UWM allows for using external (predicted) ionosphere information. The test results are very promising, and indicate that the predicted ionosphere model can effectively support medium to long range RTK positioning, and allows for fast AR over distances of several tens of kilometers.