BENEFIT OF COMPLETE STATE MONITORING FOR GPS REALTIME APPLICATIONS WITH GEO++ GNSMART

G. Wübbena, M. Schmitz, A. Bagge

Geo++ GmbH, Garbsen, Germany, wuebbena@geopp.de/Fax: +49-5131-4689-99

Today, the demand for precise positioning at the cm-level in realtime is worldwide growing. An indication for this is the number of operational RTK network installations, which use permanent reference station networks to derive corrections for distance dependent GPS errors and to supply corrections to RTK users in realtime. Generally, the inter-station distances in RTK networks are selected at several tens of km in range and operational installations cover areas of up to 50000 km x km.

However, the separation of the permanent reference stations can be increased to several hundred km, while a correct modeling of all error components is applied. Such networks can be termed as sparse RTK networks, which cover larger areas with a reduced number of stations. The undifferenced GPS observable is best suited for this task estimating the complete state of a permanent GPS network in a dynamic recursive Kalman filter. A rigorous adjustment of all simultaneous reference station data is required. The sparse network design essentially supports the state estimation through its large spatial extension. The benefit of the approach and its state modeling of all GPS error components is a successful ambiguity resolution in realtime over long distances.

The above concepts are implemented in the operational GNSMART (GNSS State Monitoring and Representation Technique) software of Geo++. It performs a state monitoring of all error components at the mm-level, because for RTK networks this accuracy is required to sufficiently represent the distance dependent errors for kinematic applications. One key issue of the modeling is the estimation of clocks and hardware delays in the undifferenced approach. This pre-requisite subsequently allows for the precise separation and modeling of all other error components.

Generally most of the estimated parameters are considered as nuisance parameters with respect to pure positioning tasks. As the complete state vector of GPS errors is available in a GPS realtime network, additional information besides position can be derived e.g. regional precise satellite clocks, orbits, total ionospheric electron content, tropospheric water vapor distribution, and also dynamic reference station movements. The models of GNSMART are designed to work with regional, continental or even global data.

Results from GNSMART realtime networks with inter-station distances of several hundred km are presented to demonstrate the benefits of the operational implemented concepts.