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Study of behaviour of GNSS clock corrections in the face of prediction

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The accurate and reliable prediction of satellite clocks and orbits is an indispensable condition of all GNSS based positioning applications in real time. While the orbits are output to an integration of the well-known force field the clock corrections to GPS time have to be extrapolated by means of an experienced prediction model. The model used for predicting GPS and GLONASS satellite clocks within program GNSS-VC (GNSS-Vienna Clocks) contains basically the coefficients of a quadratic polynomial as well as an amplitude and phase shift of a periodic term. These parameters were initially determined in a least squares adjustment based on the observed part of the IGS (International GNSS Service) Ultra Rapid solutions.

To get rid of the three hours delay of the IGS Ultra Rapid Solution we developed a Kalman-filter approach which allows to issue clock predictions in near real-time. After an initial pre-determination of the model parameters the Kalman filter continuously updates the model parameters using real-time clock corrections calculated from the 1-sec data stream of the RealTime-IGS network (about 40 almost globally distributed stations). These 1-sec clock correction data are output of the programme RTR-Control developed by M. Opitz. Clock predictions are calculated every 15 minutes for the upcoming 6 hours period. Since October 2006 the programme GNSS-VC is operated in a fully automated test-mode.

To improve the clock predictions and to provide reliable accompanying accuracy estimates the stability of the various types of satellite clocks has to be studied carefully. Especially old Cesium clocks operated by BlockIIA satellites show a distinct periodic behaviour at the revolution period which is most likely caused by thermal effects. We

are able to present a clear connection between the varying amplitude of this 12-hours oscillation and the orientation of the satellite orbit with respect to the sun.