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Using residual stacking to mitigate site-specific errors in order to improve the quality of GNSS-based coordinate time series of CORS

Andreas Knöpfler, Michael Mayer, and Bernhard Heck
Karlsruhe Institute of Technology, Geodetic Institute, Karlsruhe, Germany (andreas.knoepfler@kit.edu)

Within the last decades, positioning using GNSS (Global Navigation Satellite Systems; e.g., GPS) has become a standard tool in many (geo-) sciences. The positioning methods Precise Point Positioning and differential point positioning based on carrier phase observations have been developed for a broad variety of applications with different demands for example on accuracy. In high precision applications, a lot of effort was invested to mitigate different error sources: the products for satellite orbits and satellite clocks were improved; the misbehaviour of satellite and receiver antennas compared to an ideal antenna is modelled by calibration values on absolute level, the modelling of the ionosphere and the troposphere is updated year by year. Therefore, within processing of data of CORS (continuously operating reference sites), equipped with geodetic hardware using a sophisticated strategy, the latest products and models nowadays enable positioning accuracies at low mm level.

Despite the considerable improvements that have been achieved within GNSS data processing, a generally valid multipath model is still lacking. Therefore, site specific multipath still represents a major error source in precise GNSS positioning. Furthermore, the calibration information of receiving GNSS antennas, which is for instance derived by a robot or chamber calibration, is valid strictly speaking only for the location of the calibration. The calibrated antenna can show a slightly different behaviour at the CORS due to near field multipath effects. One very promising strategy to mitigate multipath effects as well as imperfectly calibrated receiver antennas is to stack observation residuals of several days, thereby, multipath-loaded observation residuals are analysed for example with respect to signal direction, to find and reduce systematic constituents.

This presentation will give a short overview about existing stacking approaches. In addition, first results of the stacking approach developed at the Geodetic Institute of the Karlsruhe Institute of Technology (KIT) will be presented focussing on results of simulations as well as on experiences gained applying our stacking approach on real data of GURN (GNSS Upper Rhine graben Network) sites. Furthermore, the effect of wrong receiver antenna modelling and the improvement by taking into account stacking maps within the estimation process is illustrated in detail. The contribution will close with an outlook on further activities.