Quality description in GPS precise point positioning

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Abstract

GPS processing, like every processing method for geodetic applications, relies upon least-squares estimation. Quality measures must be defined to assure that the estimates are close to reality. These quality measures are reliable provided that, first, the covariance matrix of the observations (the stochastic model) is well defined and second, the systematic effects are completely removed (i.e., the functional model is good).

In the GPS precise point positioning (PPP) the stochastic and functional models are not as complicated as in the differential GPS processing. We will assess the quality of the GPS Precise Point Positioning in this thesis by trying to define more realistic standard deviations for the station position estimates.

To refine the functional model from systematic errors, we have 1) used the phase observations to prevent introducing any hardware bias to the observation equations, 2) corrected observations for all systematic effects with amplitudes of more than 1cm, 3) used undifferenced observations to prevent having complications (e.g. linearly related parameters) in the system of observation equations.

To have a realistic covariance matrix for the observations we have incorporated the ephemeris uncertainties into the system of observation equations.

Based on the above-mentioned issues a PPP processing method is designed and numerically tested on the real data of some of the International GNSS Service stations. The results confirm that undifferenced stochastic-related properties (e.g. degrees of freedom) can be reliable means to recognize the parameterization problem in differenced observation equations. These results also imply that incorporation of the satellite ephemeris uncertainties might improve the estimates of the station positions.

The effect of troposphere on the GPS data is also focused in this thesis. Of particular importance is the parameterization problem of the wet troposphere in the observation equations.

Keywords

GPS, PPP