GNSS Group Dealy Variations - Potential for Improving GNSS based Time and Frequency Transfer ?

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Abstract

For time and frequency transfer as well as navigation applications, like e.g. precise guided landing approaches, GNSS code observables are widely used. In addition to the well known error bidget, code observables seem to be affected by Group Delay Variations (GDV), induced by the radiation pattern of the receiving antenna. The performance of the acquisition depends on the antenna and receiver ensemble. GDV degrade the precision of code observables and induce errors in timing and frequency applications.

In this contribution we analyzed the GDV for different antennas and receivers to quantify the net effect on the code observables and time and frequency transfer applications. The paper is divided into two parts:

GDV were estimated using the Hannover Concept of absolute antenna calibration with the current GNSS satellite signals in space. The GDV are parameterized using orthogonal base functions for L1(P) and L2(P) to describe variations in elevation and azimuth. Variations in elevation show magnitudes of 0.5 - 0.6 ns for the range of 90 to 30 degree and up to 1 - 2 ns at lower elevations. Azimuthal variations show smaller magnitudes, no larger than 0.6 ns for the tested sets of different GNSS antenna. The quality of the estimation process is about 0.15 ns.

Finally the impact on the time transfer links is investigated. A simulated time and frequency scenario with global coverage the impact and the noise contribution of the GDV are analyzed for long and short baselines equipped with different antennas. It is shown that the overall induced noise can be assigned as a white noise process with lower magnitude with respect to the existing P3 noise.

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