Absolute orientation of Galileo orbits from simulated VLBI and GNSS observations

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Abstract

Mounting a dedicated Very Long Baseline Interferometry (VLBI) transmitter on one or more Galileo satellites would expand space and science applications due to the possibility of observing these satellites with VLBI radio telescopes. The combination of VLBI observations to satellites and extragalactic radio sources enables to determine the satellite orbit in the terrestrial but also in the celestial reference frame as VLBI is uniquely capable to determine the Universal Time UT1.

This simulation study investigates the quality of estimating orbit arcs based on combined VLBI observations and GNSS measurements. The aim of this study is the estimation of the absolute orientation of the orbital plane, which is equated to the estimation of the right ascension of the ascending node RAAN. To achieve this, GNSS measurements from Bernese are introduced in VieVS as partial derivatives of the state vector of the satellite with respect to RAAN during the analysis process of a schedule including satellite and quasar observations. In VieVS these measurements are used for the final computation of the sensitivity of the time delay with respect to RAAN, which further enables the estimation of the right ascension of the ascending node from simulated VLBI observations. In addition, at a further stage, the results from VieVS and Bernese could be combined at the normal equation (NEQ) level using the module ADDNEQ2. This would allow to retrieve a fully consistent result for the orbital parameter RAAN based on VLBI and GNSS observations.

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