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Potential of VLBI observations to satellites to estimate orbital elements

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Orbital elements define the shape, size, and orientation of a satellite's orbit, as well as the position of the orbiting satellite along the ellipse at a specific time. Currently, precise orbit determination relies solely on satellite observations. However, future plans involve equipping Genesis and Galileo satellites with Very Long Baseline Interferometry (VLBI) transmitters. This would enable to observe satellites with VLBI radio telescopes and allow to determine orbital elements from VLBI observations to satellites.

This study investigates the potential of VLBI observations to satellites to contribute to the determination of orbital elements. In a first step, schedules, including satellite and quasar observations, are created using VieSched++. The Vienna VLBI and Satellite Software (VieVS) is used to simulate and analyze these schedules. To introduce the orbital elements in the Least Squares Adjustment, the partial derivatives of the position vector with respect to the orbital elements are needed. There are different approaches available for computing these partials, including numerical, analytical, or using partials obtained from the ORBGEN module in the Bernese GNSS software. Next, the partials of the position vector are utilized to determine the partial derivative of the time delay tau with respect to the orbital elements.

This enables the estimation of orbital elements from simulated VLBI observations to satellites. The estimated parameters' quality is evaluated based on the mean formal errors and repeatabilities. Furthermore, the correlations between all orbital elements are examined.