Integrated VLBI (FWF P23143)

Very Long Baseline Interferometry (VLBI) is the only technique for the determination of the celestial reference frame (CRF) which is realized by positions of extragalactic radio sources, and it is the primary technique for monitoring the full set of Earth orientation parameters (EOP). In particular it is unique for observing Universal Time and precession/nutation over longer time spans. It also essentially contributes to a stable scale of the terrestrial reference frame (TRF). Moreover, VLBI observations contain information about a large variety of geodynamic, astronomical, and cosmological parameters which are determined within the project Integrated VLBI. We take advantage of the long history of VLBI observations of more than 30 years and use these data to estimate geodynamic and astronomical parameters in an integrated and consistent one-step approach. In this project a new software package called VieVS (Vienna VLBI Software) which has been developed recently for processing single VLBI sessions will be extended to analyse the whole set of existing geodetic VLBI data in a so-called global solution. VLBI global solutions are typically used to determine the TRF in terms of station positions and velocities, and the CRF in terms of radio source coordinates. In this project we additionally estimate global geodynamic and astronomical parameters like the Free Core Nutation (FCN) period, which shows up in frequency-dependent solid Earth tidal displacements as well as in the nutation model. Thus, in our integrated approach we treat the FCN period in both models as a single parameter to gain more reliable and accurate results. Other geodynamic parameters of interest are complex Love and Shida numbers, which describe the reaction of the anelastic Earth and its gravity field to the tidal forces caused by the largest bodies of the solar system, and to loading by the variable atmosphere and ocean masses. These effects give rise to station displacements and also to variations of the Earth orientation parameters, and for both effects amplitudes and phases of tidal harmonics are determined. In the CRF, a (true or apparent) velocity field or a multi-pole pattern in time series of estimated source coordinates would allow to derive information about astronomical effects, such as an un-modelled acceleration of the solar system towards the galactic centre or a rotation of our galaxy against a background of extragalactic sources. Further we estimate the post-Newtonian parameter γ in the model of gravitational deflection of radio waves according to general relativity. As preparatory work in the project Integrated VLBI, careful inspection of all available data has to be done to detect outliers and to identify poor station performance. After that, sophisticated simulations are carried out to assess all possible interactions between observational quantities and geodynamic or astronomical parameters. Real observations are then processed by VLBI global solutions to determine the parameters of interest that allow further interpretations and conclusions concerning many geophysical and astronomical effects.