GPS-VLBI Hybrid Observations for Geodesy (FWF M1592-N29)

Modern space geodetic techniques like Very Long Baseline Interferometry (VLBI) or the Global Navigation Satellite Systems (GNSS), such as the Global Positioning System (GPS), are used for the determination of the International Celestial Reference Frame (ICRF), the International Terrestrial Reference Frame (ITRF), and of the Earth Orientation Parameters (EOP) between those frames. In particular for the ITRF and the EOP, it is of utmost importance to combine the observations from the different techniques to fully exploit the strengths and unique characteristics of the techniques. So far, the combination has been carried out at the result, normal equation, and observation level. In future, the combination of techniques will be intensified also at the hardware level. This will be realized by observing GNSS satellites with VLBI radio telescopes, and dedicated satellites will be launched (e.g. GRASP or NanoGEM) which carry GNSS and DORIS (Doppler Orbitography and Radiopositioning Integrated by Satellite) receivers, a laser reflector, and a beacon to send VLBI-like signals.

Within the project proposed here, we are moving towards the rigorous combination by improving our approach of GPS-VLBI hybrid observations, which means that parts of the hardware at the sites including the clocks are shared for both, VLBI and GPS, observations. In particular, GPS signals are sampled, recorded, and correlated with the same devices which are already used for VLBI so that we finally get VLBI-like group delays for GNSS observations, too. First tests have already been carried out, but now we want to extend the network to more than one single baseline, and we want to improve the calibration system and the correlation model for the GPS signals.

Together with the VLBI group at the Vienna University of Technology, many simulations will be run with the Vienna VLBI Software (VieVS) to demonstrate the possible improvements for the TRF and CRF when applying globally distributed GPS-VLBI hybrid observations. In particular, we will assess the benefits for the link between the dynamical satellite orbits and the kinematically realized celestial reference frames. Thereafter, real observed VLBI-like observations to GPS satellites will be analyzed with VieVS allowing a rigorous test for VieVS in terms of satellite models, such as the light path difference model.

The enhanced reference frames and EOP attained by global GPS-VLBI hybrid observations will be beneficial for precisely observing the Earth system. Ultimately, they will contribute to monitoring global climate change processes.