

## PPP with smartphone GNSS data

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Precise Point Positioning (PPP) is one the most promising processing techniques for Global Navigation Satellite Systems (GNSS) data nowadays. With double-frequency observations of a single receiver in static mode coordinate accuracies at the centimetre/millimetre level can be achieved. However, PPP is not restricted to expensive geodetic multi-frequency receivers, also single-frequency observations from low-cost receivers can provide promising results. Precise orbit and clock information might be retrieved for post-processing or even in real-time from ground based service providers like IGS or geostationary satellites through Signal-in-Space (SIS). In 2020/21 a new SIS-service, the Galileo Commercial Service (Galileo HAS), will become available.

Within project GAL-CS the research group Higher Geodesy at TU Vienna explores the limitations in PPP-positioning with smartphones. The project is conducted in cooperation with the TeleConsult Austria company located in Graz. We make use of the fact that since 2016 the retrieval of raw Smartphone GNSS observation data is supported by a number of Android devices, which has multiple benefits. On the one hand, a realistic quality assessment of the data is now possible and on the other hand, more complex processing schemes (like PPP) can be applied to the raw observations of smartphones. In course of this project a smartphone application should be build up, providing the users position with meter or even sub-meter accuracy by means of multi-GNSS-observations (Galileo+GPS), HAS data, high-quality ionospheric corrections and PPP processing.

Here we present current project results gained by processing data obtained from a Huawei P10 smartphone. The calculations are performed with the software raPPPid, which is the PPP module of the Vienna VLBI and Satellite Software (VieVS PPP) and is continually developed from our research group. Until today, the analysis of the results focuses on the smartphone tracking performance, usability of smartphone phase data, and the benefits of Galileo observations. The influence of atmospheric delays is not analysed up to now but will be a major topic of future investigations.