Are Phase Center Corrections Identical for Identical Frequencies from Different GNSS?

Johannes Kröger, Yannick Breva, Tobias Kersten and Steffen Schön (Germany)

Key words: Positioning; antenna calibration; phase center corrections; Multi-GNSS; Beidou

SUMMARY

Global Navigation Satellite Systems (GNSS) are used for the realization of land and water management tasks since they provide an absolute and highly accurate position. Especially measurements for the reorganization of land parcels are often carried out in dense urban areas. In these situations, only multi-GNSS enables a reliable position solution. In less severe situations, it improves the accuracy of the position significantly. The quality of multi-GNSS carrier phase measurements depends, among other factors, on the knowledge of the exact electrical receiving point of the receiver antenna, known as phase center. This location varies with the direction of the incoming signal, so that phase center corrections (PCC), including a phase center offset (PCO) and phase center variations (PCV), have to be taken into account. These corrections are frequency and antenna type dependent with the result that PCC for each antenna type and frequency have to be determined separately. This is especially true for including newer frequencies (e.g. L5) or GNSS like Galileo or Beidou.

In this contribution, the theoretical background of PCC and a short description of our estimation process developed at the Institut für Erdmessung (IfE) are given. Next, the repeatability of different calibrations for the same antenna is assessed. The results underline an overall good repeatability for several GPS, Galileo and Beidou frequencies with differences at maximum of 2 mm at low elevations except for L2 frequencies of GPS. Here, the differences are maximal 3 mm, probably due to settings of the tracking loop parameters.

The comparison of PCC of identical frequencies from different GNSS shows a very good agreement between GPS and Galileo L1 and L5 frequencies. Here, the maximum difference is less than 1 mm. The differences between Galileo L7 (E5b) and Beidou L7 (B2b) are clearly larger, at maximum 2.3 mm. The significantly different number of observations for the PCC estimation could

explain these deviations.

In a joint estimation approach, the identical frequencies of different GNSS are combined at the normal equation level. The jointly estimated PCC are compared to the “classical” approach resulting in differences smaller than 1.5 mm. Moreover, it could be shown, that these differences are mainly linked to the number of observations from each individual frequency. Since other antenna-receiver combinations show higher differences, a bigger study with several, different combinations need to be carried out in near future.