Multi-GNSS Receiver Antenna Calibration

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SUMMARY

Global Navigation Satellite Systems (GNSS) are not only widely used for precise positioning, navigation and timing but also for establishing of terrestrial reference frames for geospatial tasks, such as land and water management.

The quality of GNSS phase measurements depends on the knowledge about the location of the exact electrical reception point within the GNSS receiver antenna, also known as the phase center. Due to the fact that the location of this receiving point varies with the direction of the incoming satellite signal, phase center corrections (PCC), including a phase center offset (PCO) and phase center variations (PCV), have to be taken into account. These corrections are determined by a calibration of the antennas either in an anechoic chamber using artificial generated signals or in the field by use of a robot and real GNSS signals. The frequency dependent PCC are published in the IGS Antenna Exchange format (ANTEX). Here, currently only corrections for GPS and GLONASS L1 and L2 frequencies are officially available. Only some chamber calibrations are available in the European Permanent Network (EPN) whereas a mixture of different calibration types should be avoided as this leads to uncertainties in the calculation of a GNSS network.

In order to take the benefits from the higher quality of the newer frequencies (like GPS L5) and satellite systems (e.g. Galileo or Beidou) so that Multi-GNSS measurements can be processed, PCC have to be provided also for these signals.

In this contribution, the calibration procedure developed at the Institut für Erdmessung (IfE) is presented. To this end, the robot model as well as the data acquisition and analysis is shown. Furthermore, the estimation process of the PCC using spherical harmonics is explained in

details.

We show, that an absolute GNSS receiver antenna calibration using a robot and real signals can be carried successfully out at the IfE. The results underline an overall good repeatability with an RMS for the difference patterns of different calibrations smaller than two millimeters. It is shown that the L5 patterns significantly vary from L2, so that specific calibration values are needed. In addition, the concept of a joint estimation approach of same frequencies (like GPS L1 and Galileo L1) and its difference to the "classical" approach of frequency and system dependent pattern is presented.