



On the Error Sources in Absolute Individual Antenna Calibrations

Wim Aerts (1), Quentin Baire (1), Andria Bilich (2), Carine Bruyninx (1), and Juliette Legrand (1)

(1) Royal Observatory of Belgium, Ukkel, Belgium (wim.aerts@oma.be), (2) National Geodetic Survey, Boulder CO, United States of America

The two main methods for antenna calibration currently in use, are anechoic chamber measurements on the one hand and outdoor robot calibration on the other hand. Both techniques differ completely in approach, setup and data processing. Consequently, the error sources for both techniques are totally different as well. Except for the (near field) multi path error, caused by the antenna positioning device, that alters results for both calibration methods. But not necessarily with the same order of magnitude.

Literature states a (maximum deviation) repeatability for robot calibration of choke ring antennas of 0.5 mm on L1 and 1 mm on L2 [1]. For anechoic chamber calibration, a value of 1.5 mm on L2 for a resistive ground plane antenna can be found in [2]. Repeatability however masks systematic errors linked with the calibration technique. Hence, comparing an individual calibration obtained with a robot to a calibration of the same antenna in an anechoic chamber, may result in differences that surpass these repeatability thresholds. This was the case at least for all six choke ring antennas studied. The order of magnitude of the differences moreover corresponded well to the values given for a LEIAT504GG in [3].

For some error sources, such as the GNSS receiver measurement noise or the VNA measurement noise, estimates can be obtained from manufacturer specifications in data sheets. For other error sources, such as the finite distance between transmit and receive antenna, or the limited attenuation of reflections on wall absorber, back-of-the-envelope calculations can be made to estimate their order of magnitude. For the error due to (near field) multi path this is harder to do, if not impossible. The more because this strongly depends on the antenna type and its mount. Unfortunately it is, again, this (near field) multi path influence that might void the calibration once the antenna is installed at the station.

Hence it can be concluded that at present, due to (near field) multi path errors, both during calibration and later on at the station, absolute sub-millimeter positioning with GPS is not (yet) possible.

References

- [1] G. Wübbena, M. Schmitz, G. Boettcher, C. Schumann, "Absolute GNSS Antenna Calibration with a Robot: Repeatability of Phase Variations, Calibration of GLONASS and Determination of Carrier-to-Noise Pattern", *International GNSS Service: Analysis Center workshop*, 8-12 May 2006, Darmstadt, Germany.
- [2] P. Zeimetz, H. Kuhlmann, "On the Accuracy of Absolute GNSS Antenna Calibration and the Conception of a New Anechoic Chamber", *FIG Working Week 2008*, 14-19 June 2008, Stockholm, Sweden.
- [3] P. Zeimetz, H. Kuhlmann, L. Wanninger, V. Frevert, S. Schön and K. Strauch, "Ringversuch 2009", *7th GNSS-Antennen-Workshop*, 19-20 March 2009, Dresden, Germany.