



Calibration of GPS Antenna Leica ATX1230

Deriving a GNPCV Type Mean from Absolute Calibrations with a Robot

(IGS Name: LEIATX1230*)

Calibration Method

The applied Geo++[®] calibration method of GPS antennas with a robot determines the absolute antenna offset in horizontal and vertical position as well as the absolute elevation and azimuth dependent phase center variations (PCV) for both frequencies. The resulting PCV are completely independent from the used reference antenna and allow the complete modeling of the receiving characteristic of the antenna.

Scope of the applied absolute GPS antenna calibration is:

- absolute offsets and absolute PCV
- special approach with inclined and rotated antenna (robot)
- elimination of multipath
- coverage of the complete elevation range from 0° to 90°
- coverage of complete antenna hemisphere
- precise determination of PCV using a large number of different antenna orientations
- simultaneous estimation of L1 and L2 PCV for GPS
- independent of weather
- at least two redundant calibrations per individual antenna

Basic concept of the calibration method is the separation between multipath and phase center variation. A special observation procedure with different antenna orientations is used for the determination of absolute PCV and for multipath elimination.

The processing is done in real-time. Primary result is a spherical harmonic expansion of the PCV as function of zenith distance and azimuth with complete variance-covariance data directly after the calibration. Finally absolute horizontal and vertical mean offsets as well as absolute elevation and azimuth dependent phase observation corrections for the calibrated antenna can be derived.

Calibration Procedure

A sample of individual LEIATX1230 calibrations conducted with the Geo++[®] calibration method with a robot is the basis for the calculation of the type mean. The individual calibrations are rigorously adjusted considering the full variance-covariance matrix.

Scope of the GNPCV type calibration:

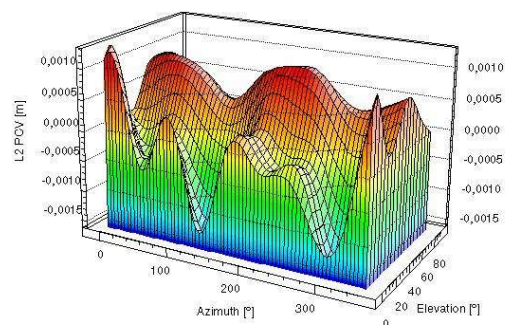
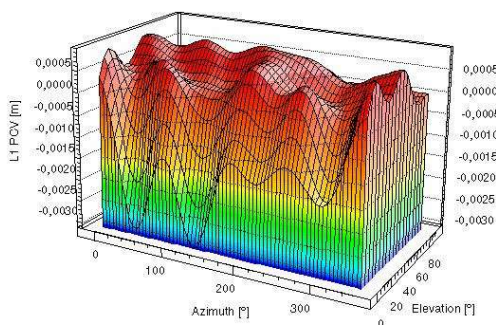
- individual calibrations of five antennas of same manufacturing series
- adjustment of a type mean using entire variance-covariance data

The type mean of the LEIATX1230 GPS antenna is derived from the individual antennas with serial numbers 155006, 155008, 155034, 155035 and 155036. Each antenna was calibrated twice, which gives ten individual calibrations.

* Naming is not officially included in the IGS naming convention at writing of this certificate. Check rcvr_ant.tab or gpp_rcvr_ant.tab for acceptance.

Calibration Result

The GNPCV type mean is the adjusted mean of the five individual LEIATX1230 GPS antennas. The absolute PCV excluding the mean phase center offsets for the L1 and L2 frequency are depicted below:



The Antenna Reference Point (ARP) is the reference point used in the calibration. The reference direction to north is defined by the cable connector pointing north. The height of the antenna has to be measured to the ARP, which is the lowest point of the antenna housing (i.e. bottom of 5/8" thread). As a numerical reference, the pure elevation dependent PCV are listed below in the international ANTEX format (see ANTEX format description for details). However, the complete model of the antenna consists of elevation and azimuth dependent PCV values.

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1.2      G      ANTEX VERSION / SYST
A        PCV TYPE / REFANT
        END OF HEADER
        START OF ANTENNA
LEIATX1230  Geo++ GmbH  5  2005-01-20METH / BY / # / DATE
ROBOT      5.0      DAZI
          0.0  90.0  5.0      ZEN1 / ZEN2 / DZEN
          2      # OF FREQUENCIES
          G01      START OF FREQUENCY
            1.65  0.15  88.82  NORTH / EAST / UP
          NOAZI  0.00  0.02  0.05  0.03  -0.07  -0.27  -0.51  -0.69  -0.75  -0.68  -0.52  -0.38  -0.33  -0.34  -0.31
          -0.10  0.35  0.97  1.50
          G01      END OF FREQUENCY
          G02      START OF FREQUENCY
            0.29  0.27  88.49  NORTH / EAST / UP
          NOAZI  0.00  0.00  -0.01  -0.04  -0.12  -0.26  -0.44  -0.62  -0.76  -0.79  -0.69  -0.47  -0.16  0.14  0.37
          0.45  0.41  0.32  0.28
          G02      END OF FREQUENCY
          END OF ANTENNA
    
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Garbsen, May 17, 2004

Dr.-Ing. G. Wübbena

Literature

- Wübbena, G., M. Schmitz, F. Menge, G. Seeber, C. Völksen (1997). A New Approach for Field Calibration of Absolute Antenna Phase Center Variations. *Navigation*, Journal of The Institute of Navigation, Vol. 44, No. 2, 247-256.
- Menge, F., G. Seeber, C. Völksen, G. Wübbena, M. Schmitz (1998). Results of Absolute Field Calibration of GPS Antenna PCV. Proceedings of International Technical Meeting, *ION GPS-98*, Nashville, Tennessee.
- Wübbena, G., M. Schmitz, F. Menge, V. Böder, G. Seeber (2000). Automated Absolute Field Calibration of GPS Antennas in Real-Time. Proceedings of International Technical Meeting, *ION GPS-00*, Salt Lake City, Utah.
- Schmitz, M., G. Wübbena, G. Boettcher (2002). Tests of phase center variations of various GPS antennas, and some results. *GPS Solutions*, Volume 6, Number 1-2, Springer, 18-27.