GPS Calibration System for High-Accuracy Geodetic Measurements (G31A-08)

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Abstract

Site-specific GPS phase-measurement errors, such as antenna scattering and multipath, are cm level. These systematic errors affect the estimates of both the horizontal and vertical components of site position. The vertical errors, larger than the horizontal, amount to several cm, and are probably the limiting source of error for determining vertical signals at the level of accuracy of mm/yr and smaller. A calibration of such errors is essential for improvement in the determination of geophysical signals using GPS.

As part of a "GPS calibration system" effort to characterize these errors at a level of 1 mm, we are developing an Antenna and Multipath Calibration System (AMCS). This level represents an improvement in accuracy of one order of magnitude. The AMCS system consists of a high-gain, multipath-free parabolic antenna and two GPS receivers, and will be transportable. Site visits of the AMCS will be used to determine calibrations for a particular site. The AMCS is scheduled to be fully operational by mid-2000.

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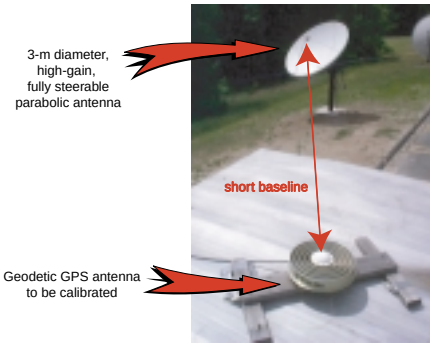
Elements of the AMCS System

The AMCS system consists of a:

- High-gain, "multipath-free" paraboloid antenna
- GPS receiver
- Short-baseline to GPS antenna to be calibrated for multipath, scattering, and phase-center variations



Activities undertaken

1- Performed extensive zero-baseline tests with several pairs of GPS receivers connected to the same antenna to understand their noise and operating characteristics relevant to the AMCS.

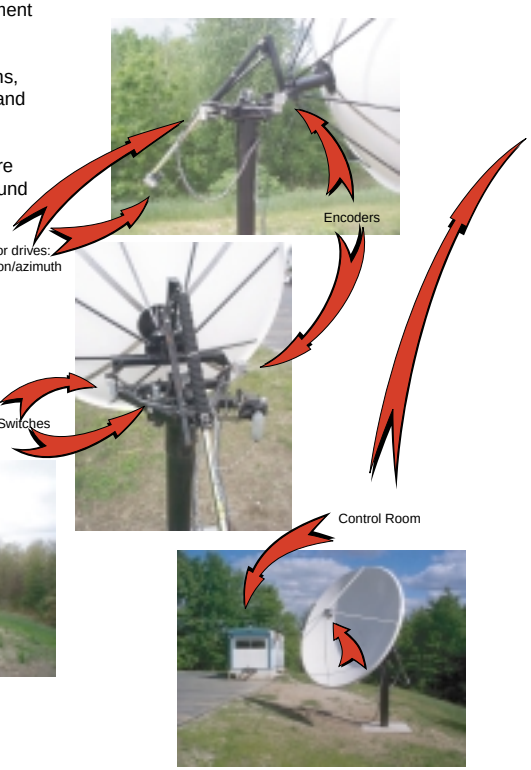
Preliminary Results (*Jarlemark et al.*, AGU, 1998):

- The performance of most receivers tested is sub-millimeter above 20° for L1, somewhat worse for L2.
- The elevation-angle dependence of the measurement noise is significantly larger for L2 than L1.
- All receivers are sensitive to temperature variations, which cause apparent clock drift. Clock drift on L1 and L2 differ for most receivers tested.
- The L2 measurements of some of the receivers are correlated in time. No significant time correlation found for L1 measurements.

Activities undertaken (cont.)

2- Assembled the antenna system, which consists of:

- Antenna mount and paraboloid reflector
- Positioner hardware (controller, antenna interface units, resolvers, motor drives, and travel limit switches)
- L-band feed

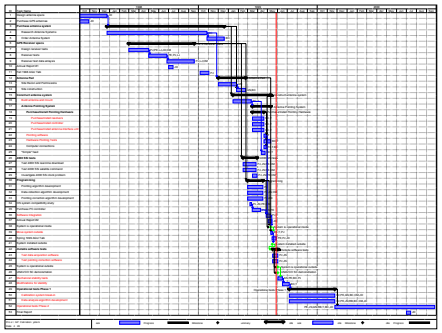


Activities undertaken (cont.)

3- Developed control and positioning software to:

- Communicate with the antenna controller
- Point and track a GPS satellite with the paraboloid antenna
- Acquire phase data from the GPS receivers
- Switch the AMCS GPS receiver between the paraboloid antenna and zero-baseline mode for calibration

Status of Development



Future Work

1- Tests at Haystack Observatory:
- Test antenna mechanical and electrical stability
- Calibrate temperature sensitivity of vital radiofrequency components of the system
- Develop software for multipath data analysis

2- Transfer the system to the UNAVCO facility

3- Work with UNAVCO and IGS to prioritize and coordinate site visits and develop a standarized site implementation scheme.