**Ground-Based GPS Occultation Utilizing Modernized Signals**

**Erin Griggs**, Elliot Barlow, Dr. Dennis Akos, Dr. Staffan Backén, Dr. Penina Axelrad

*Aerospace Engineering Sciences, University of Colorado, Boulder, Colorado*

erin.griggs@colorado.edu

The mountain-based GPS Radio Occultation (RO) experiment was proposed to test algorithms in development for a space-based GPS RO receiver. Ground-based downward looking receivers have been suggested as a hybrid between the space and ground viewing geometries [Zuffada et al., 1999]. The mountaintop experiment provides the vertical profiling capability of a space based receiver as the geometry is similar to the GPS-LEO occultation event from space. Ground-based receivers also provide ample collection opportunities, as rising and setting occultations of GPS satellites are common and locations are known a-priori.

Successful mountaintop campaigns were conducted on Mt. Fuji in 2001 and Mt. Wuling in China in 2005. Refractivity profiles obtained from applying Abel inversions to the bending angle between the GPS satellite and ground receiver were consistent with radio sonde observations for both experiments [Aoyama et al., 2003; Hu et al., 2008]. Raw RF data from Block II-RM and Block II-F GPS satellites was taken from the summit of Pikes Peak, outside of Colorado Springs, Colorado on October 21, 2011. Two events were recorded, utilizing three frequencies broadcast by the GPS satellites. Signals were recorded from an L1/L5 occultation, as well as L1/L2 by a helix antenna pointed horizontally in the azimuthal direction of the setting occultation. The raw signals were processed using a software based receiver, utilizing both open and closed loop tracking techniques. Carrier frequency and code phase measurements were recorded at set intervals throughout the data set. Model-aided Open Loop (OL) tracking uses the predicted Doppler frequency shift from the satellite-receiver geometry to reduce the frequency search range in traditional acquisition algorithms. For RO observations from LEO, the mean Doppler frequency shift caused by all of Earth's atmospheric conditions can be predicted with very good accuracy to within 10-15 Hz, without feedback from the RO signal [Sokolovskiy et al., 2009]. OL tracking was demonstrated on GPS signals recorded from setting occultations during an airborne platform experiment by Lulich in 2008. Signals were successfully tracked using OL techniques to approximately -4.5$^{o}$ elevation relative to the local horizontal [Lulich et al., 2010]. Current tracking results from the Pikes Peak datasets show successful tracking to -2$^{o}$ elevation, with room for improvement on tracking techniques.The bending angle of the RF signal path is calculated by use of the measured Doppler shift of the carrier signal measurements, and the known position and velocity of the occulted satellite. An Abel inversion is applied to the bending angle, which then gives refractivity profiles. Although no truth metrics were available from radio sonde or space-based measurements, results were compared to standard atmospheric models as a first order test to verify the proof of concept. Preliminary results suggest that a mountain-based collection is a feasible technique for obtaining ground-based RO measurements.