Title: Peeling the Onion: Increasing GPS Accuracy using New Signals and Open Source Software

Abstract: Multiple initiatives have improved the accuracy associated with the Global Positioning System (GPS). A family of initiatives, broadly labeled *modernization* efforts, introduce new signals to the system in order to improve the diversity of range measurements available to users. New signals require new payloads, and therefore new satellites, so modernization spans a timescale of many years, even more than a decade. Another initiative, called Legacy Accuracy Improvement (L-AII), enhanced the Earth-bound assets of the GPS system. L-AII improved the orbit and clock models, collectively known as ephemeris, broadcast as part of the GPS signal. One metric of performance, the User Range Error (URE), improved by over 30% [Creel, et al, 2007].

In the near future, modernization will impact system accuracy. Receivers that track the modernized M-Code signal will be incorporated into the GPS ephemeris generation process. The potential impact of this system change is predicted and presented. Supporting models that predict receiver response to noise and multipath are explained. The model of signal reflection is general, so it can be applied to the new signals of Europe's Galileo and the revitalized Russian GLONASS.

Estimating the performance of a receiver, or of GPS as a whole, is necessarily a computationally intensive endeavor. Much of the effort involves software development. This is similarly true for using GPS in the context of navigation, surveying or ionosphere modeling. In order to reduce the effort spent on creating new analyses and developing new applications, ARL:UT has established the GPS Toolkit or GPSTk. The goal of the GPSTk project is to provide an open source library and suite of applications to the satellite navigation community--to free researchers to focus on research, not lower level coding. The GPSTk suite consists of a core library, auxiliary libraries, and a set of applications. The GPSTk provides a wide array of functions that solve processing problems associated with GPS such as solving the navigation problem or reading standard file formats such as RINEX. The libraries are the basis for the more advanced applications distributed as part of the software suite. Examples of GPSTk are presented. A basic summary of how to start using the GPSTk is presented as well.

Speaker Bio: Dr. Ben Harris is an Engineering Scientist at Applied Research Laboratories, The University of Texas at Austin (ARL:UT). He is a member of the team that provides life-cycle engineering for the National Geospatial-Intelligence Agency (NGA) GPS Monitor Station Network (MSN), where his role is the technical lead for data quality analysis efforts. Prior to this position, Ben developed ground control software at Hughes Space and Communications in El Segundo, California. There he led a team of ten software developers to create the software that interfaces the expert system G2 to the payloads of a satellite constellation. Ben is an advocate for open source, and has won prizes for embedded programming using Linux. He has helped establish and lead the open source GPS Toolkit.