Senior Design Project Announcement – 2013-2014

Project title: Multipath Mitigation in a GPS Software Receiver

Brief description of project goals:

Overview:

GPS and other Global Navigation Satellite System (GNSS) Position, Navigation, and Timing (PNT) devices rely on the precise measurement of radio wave observables that include pseudorange and beat carrier phase. The observables or supposed to be measured for the direct-path signal, but multipath reflections can act to corrupt the measured observables. The projects in this area seek to develop various techniques to estimate and mitigate the effects of multipath signals.

One project in this area involves the implementation of multipath mitigation techniques at the receiver tracking loop level. This includes development of exotic carrier-phase PLL discriminators and code-phase DLL discriminators, their implementation in real-time code, and the integration of that code into existing an existing GPS software radio receiver. Initial work on this project has already identified candidate discriminators and tested them in Matlab. The main focus of the project is to translate these theoretical developments into a practical working receiver.

Another project centers on a new method for detecting and estimating the effects of multipath. It involves a receiver with an antenna that undergoes small vibrations or a small phased-array antenna. The small vibrations or phased-array element displacements can be correlated with multipath effects on the received signals. It is believed that these correlations provide the means to develop improved estimates of the multipath effects, estimates that can be used to cancel out their impacts on the observables of the direct signal.

Specific Student Contribution:

Various areas of effort are open to senior design project participants, depending on their background and interests. These include:

1) Development of practical receiver DLL and PLL discriminators that are multipath resistant by developing simplified versions of MATLAB optimization-based discriminator calculations.

2) Implementation of practical multipath-resistant DLL and PLL discriminators in C, C++, or some compatible code and incorporation of these discriminators into a real-time GPS software radio receiver, which is similar to an embedded system.

3) Testing the new multipath-resistant receivers.

4) Collection and analysis of experimental multipath data from moving-antenna or phased-array systems.

5) Development and test of theoretical models of multipath effects on moving-antenna systems or phased-array systems.

6) Development and testing of moving-antenna multipath characterization and mitigation strategies.
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**Project Group Web Sites:** gps.mae.cornell.edu & gps.ece.cornell.edu

**Number of Senior or M.Eng. Students Needed:** Can accommodate up to 4 qualified students

**Required Skills:**

Participants must have taken or be co-registered in MAE 4150/5150 or ECE 4150 with a minimum grade of A- if this course has been completed. MATLAB experience is required. Communications signal processing experience is desirable but not required as is experience with C, C++, and real-time DSP programming. Signal processing principles, such as DLL and PLL discriminator and loop design, will be taught to participants as needed.

**Estimated Project Time Frame:**

Fall 2013 + Spring 2014 semesters