Senior Design Project Announcement – 2013-2014

Project title: GPS Spoofing Detection and Mitigation in a Software Receiver

Brief description of project goals:

Overview:

Overview: GPS and other Global Navigation Satellite System (GNSS) Position, Navigation, and Timing (PNT) services have become ubiquitous utilities. Beyond its obvious navigation use in cell phones, cars, ships, and aircraft, GPS is used for timing in cell-phone towers, in the electric power grid, in the financial industry, and in other places. Unfortunately, these signals are vulnerable to spoofing attacks and other disruptions. A spoofing attack overlays a false signal on top of the true signal and can spoof a receiver into giving out false position or time readings. The GPS group at Cornell University has significant experience in developing GPS spoofing detection systems and in designing and fabricating real-time software radio receivers for GPS signals. It is building on this experience to develop real-time receivers that detect GPS spoofing attacks and mitigate their effects.

A method has been developed that uses a moving antenna or a small phased-array antenna in order to detect spoofing. A prototype off-line version of the moving-antenna system has been tested in the field. The current project seeks to transition this technology into a real-time software radio and to develop and test a newer version that eliminates the need for antenna motion by using data from 2 or more closely-spaced antennas. These projects include development of exotic phase-lock loops to track the spoofed and non-spoofed phase variations (especially in a multi-antenna version of the system), development and test of a prototype multi-antenna system, and real-time implementation of the designs in a GPS software radio receiver.

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 PLL for tracking phase with phase jumps due to RF switching between closely-spaced antennas.
2) Development of a moving-antenna prototype system with motion sensor connection to a real-time software radio.
3) Development of multi-antenna prototype system with RF switching and connection of the RF switch to a real-time software radio.
4) Implementation of a real-time spoof-resistant system using a moving antenna or a phased-array antenna with implementation in C, C++, or some compatible code and incorporation of this implementation into a real-time GPS software radio receiver, which is similar to an embedded system.
5) Development of spoofing-attack recovery strategies.
6) Experimental testing of the new spoof-resistant receivers.
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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 5 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