GPS Signal Simulator:
Senior Project Functional Description

By Anthony Hoehne and Benjamin Herreid
Advisor: Dr. In Soo Ahn

Overview

The purpose of this project is to develop a system that will generate a simulated Global Positioning System (GPS) signal. An arbitrary trajectory can be loaded into the system and a signal will be produced that can drive a GPS receiver so it will track the intended trajectory. A high-level block diagram of the system is shown in Fig. 1.
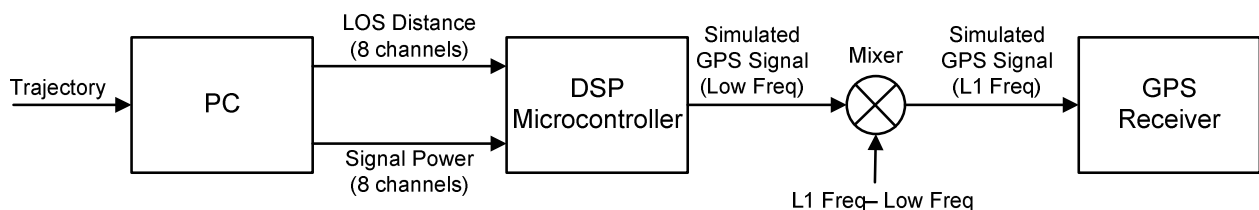

Figure 1 – System Block Diagram

PC

The primary input to the PC is a trajectory file that specifies the motion of the receiver in terms of duration of jerk (derivative of acceleration) in 4 axes: thrust, roll, pitch, and yaw. This data is used to generate a position file, which contains data for position, velocity, acceleration, and jerk (PVAJ), as well as attitude, and attitude rate up to the third derivative. Position is specified in Geo coordinates (latitude, longitude, altitude), while velocity, acceleration, and jerk are specified in North East Down (NED) coordinates. All attitudes are expressed in Body Frame coordinates. The PC also contains a GPS almanac file that is used in conjunction with the receiver position to calculate the line of sight (LOS) distance from each GPS satellite (SV) to the receiver. Additionally, the LOS distance and an antenna pattern file are used to generate the observed signal power for each SV. The maximum number of channels, one for each SV, is 8. The LOS distance and signal power for each channel are delivered to the DSP board at a rate of 2kHz.

DSP

The DSP is the main block of the GPS signal simulator. This processor receives the satellite signal strength and LOS distance for each channel. The DSP then uses this information to generate the C/A code for each channel at the appropriate times. The almanac data is also added onto the carrier signal.   The carrier signal is then passed through a mixer which modulates the signal up to the L1 frequency. A commercial receiver is used to test the validity of the signal generation. If the receiver tracks the position correctly, the operation of the simulator is confirmed.