Name of students in the group: Andrew Aubry

Exact title of the project: GPS and Inertial Navigation

Advisors of the project: Dr. In Soo Ahn, Dr. Yufeng Lu

No more than 8 lower case letter acronym for the project: GIN

University login name of each student in the group: aaubry

A brief description of the project:

A combined navigation system will be the primary deliverable for the project. The system will consist of two navigation methods fused to create a single position and attitude solution. The first subsystem is an Inertial Measurement Unit (IMU). The IMU consists of three accelerometers and three gyroscopes to measure the accelerations and angular rates about a 3-dimensional coordinate system. Successive integrations of the acceleration measurements yield the velocity and position of the body-fixed system. Additionally, a three axis magnetometer provides the ability to compute the initial body attitude. After initialization, the body attitude and position will be updated utilizing the measurements from the IMU.

The second subsystem uses the Global Positioning System (GPS) which can determine the velocity and position of the body independently of the IMU, and will be introduced to complement the IMU. The GPS uses a constellation of satellites and the measurement of a radio signal's transit time to determine the position of the body on the earth.

Both navigation methods have inherent strengths and weaknesses. The IMU is short-term stable, and can provide near instantaneous updates of a body's position and attitude. The IMU utilizes MEMS sensors to provide a small and compact package, but are highly susceptible to drift. This drift prevents the inertial sensor from long term stability, as the error from each measurement is compounded and can quickly grow to large errors in position and attitude when uncorrected for a period of time. In contrast to the IMU, the GPS provides long-term stability, and can accurately compute a body's position over indefinite amounts of time. Due to the slower update speed of the GPS, the system is unable to provide detection of quick changes, such as a car quickly shifting lanes.

By fusing these two navigation methods, a system can be built that is stable in both the short term and long term. The IMU will provide the body's position and attitude and will be compensated periodically by the GPS location data. The goal is to design and implement a tightly-coupled system in which the data from the IMU and GPS are fed into a Kalman filter to accurately determine a body's attitude and position. The filter design, sensor fusion, and system integration are areas that will be focused on for this project.