ESE650 Project 4: Localization and Mapping
Due Date: **3/19/2013 at 1:30pm** on Blackboard, and in class

In this project, you will map the structure of an indoor environment using information from an IMU and range sensors. You will be integrating the IMU orientation and odometry information with a 2D laser range scanner (LIDAR) in order to build a 2D occupancy grid map of the walls and obstacles in the environment. After this, you will then integrate additional camera and depth imagery from a Kinect sensor to build a 3D visualization. You will first present your simpler 2D localization and mapping system before moving on to the 3D models.

1. Training sets of odometry, inertial, and depth measurements from a mobile robot will be provided for this project. The data files will contain time-stamped sensor values, corresponding to the raw sensor readings. Additional information about sensor conversions and calibration will be also be provided. Download these files and be sure you can load and interpret the file formats.

   - Dataset hosted at http://www.seas.upenn.edu/~smcgill3/ese650/

2. First, you should run your robot using pure wheel odometry measurements and yaw gyro readings. Make a 2D map using this data before correcting using range readings. We will find a day to demo this code before the final deadline, and you will submit your results from this first phase.

3. You should then be able to provide a visualization of the motion of the robot within a 2D map. You will present the results of your 2D system for the first phase of this project. You can check the accuracy of your results at loop closures, when the robot returns to a previous pose.

4. Next, you will need to simultaneously localize the robot pose, and construct the surrounding 2D map using a pose filter and occupancy grid algorithm. Some Matlab Mex routines will be provided to help you

experiment with 2D LIDAR scan matching.

5. The second portion of this project will be to integrate the RGB and depth images from the Kinect to build a 3D representation of the environment. You may work with dense point clouds, or with a sparser set of tracked features for this part. You will do this with pure odometry, and with your full SLAM routine.

6. You will upload to Blackboard a written description of your algorithm in PDF form and a zip file of your code. Use the naming convention "project4_[pennkey].pdf" and "project4_[pennkey].zip" where [pennkey] is replaced by your pennkey. Steve would submit as project4_smcgill3.pdf, project4_smcgill3.zip

7. You should also be prepared to present a brief demonstration of your system in class, using new measurements provided. During the presentation in class you are expected to bring your own laptop or use the classroom computer. The projector has a VGA port and you may need a VGA adaptor for your laptop. You will be asked to run your code on the test set images which will be released both online and on a USB flash disk prior to the presentations