16831 Statistical Techniques, Fall 2016
Project 3: Robot Localization

This assignment may be completed in groups of three (max).

Due: Thursday October 27, 11:59pm

Assignment

The goal of this homework is to become familiar with robot localization and particle filtering. You will be implementing a global localization filter for a lost robot (global meaning that you do not know the initial pose of the robot). You may implement this using any programming language (there is no real-time-ness requirement), although we recommend not using MATLAB. Feel free to utilize the techniques that we have discussed in class as well as extensions discussed in Probabilistic Robotics or elsewhere.

Your lost robot is operating in Wean Hall with nothing but odometry and a laser rangefinder. Fortunately, you have a map of Wean Hall and a deep understanding of particle filtering to help it localize. The data directory that you received with this handout (courtesy of Mike Montemerlo) has the following files:

- instruct.txt – Format description for the map and the data logs.
- robotdataN.log.gz – Five data logs (odometry and laser data).
- wean.dat.gz – Map of Wean Hall to use for localization.
- wean.gif – Image of map (just for your info).
- bee-map.c – Example map reader from BeeSoft that you may use if desired.
- robotmovie1.gif – Animation of data log 1 (just for your info).

The faster your code, the more particles you will be able to use and the faster your parameter tuning iterations will be. Profile your code and consider parallelization. From the experiences of several students from previous years, it seems advisable to use something faster than Matlab for this assignment (C++, Python, etc.).

What to turn in

You should generate a visualization (video) of your robot localizing on `robotdata1.log` and another log of your choice. You should also submit a short report describing your approach, implementation, and results. Make sure you describe your motion and sensor models, your resampling procedure, as well as the parameters you had to tune (and their values). Include some future work/improvement ideas in your report as well.

Turn in your report, code, and the videos or a pointer to the videos through Blackboard (one group member submits) by the due date.

Extra credit

Focus on getting your particle filter to work well before attacking the extra credit. These are meant more as extra exercises than extra points.

Kidnapped robot problem: Deal with the kidnapped robot problem. You can either fuse two of the log files, or remove a chunk of readings from one log.

Adaptive number of particles: Describe the metric you use for choosing the number of particles.