CS8803: STR, Spring 2017. Lab 1: Robot Localization

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

Due: Monday, February 13th, beginning of class

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). Feel free to utilize any techniques that we have discussed in class, as well as extensions discussed in Probabilistic Robotics or elsewhere.

Your lost robot is operating in a building with nothing but odometry and a laser rangefinder. Fortunately, you have a map of and a deep understanding of particle filtering to help it localize. The data directory that you received with this handout (courtesy of Mike Montemerlo, now at GoogleX developing self-driving cars) 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 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).

If you have a different localization data set from an existing robot that you would like to use, you may use it, but must run it by me before doing so.

The faster your code, the more particles you will be able to use feasibly and the faster your parameter tuning iterations will be. Profile your code and consider parallelization.

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 (about 4-5 pages) describing your approach, results, and implementation. Make sure you describe your sampling distribution, 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 a pointer to the videos by email to the Teaching Assistant.

Extra credit

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

Parameter sensitivity analysis: How robust is your particle filter? Perform an analysis of your parameters by changing some select parameters and observing the behavior of your localization filter.