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CSC477 – Introduction To Mobile Robotics
assignment 4, 15 points
due: Dec 7, 2022, at 3pm

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Course Page: http://www.cs.toronto.edu/~florian/courses/csc477_fall22

Overview: In this assignment you will implement a particle filter for Monte Carlo localization.

1 Monte Carlo Localization (10 pts)

In this exercise you are going to implement Monte Carlo Localization (i.e. localization in a known occupancy grid map, using particle filters), as discussed in class. Your robot is going to start by being completely lost in the environment, so particles are going to be spread out uniformly at random in the known world. After many LiDAR measurements, the robot's pose is going to be constrained and the particles are going to converge to a small cluster. The main mechanism for survival of the fittest among particles will be: which particles are more likely to have generated the laser scans that the robot is observing?
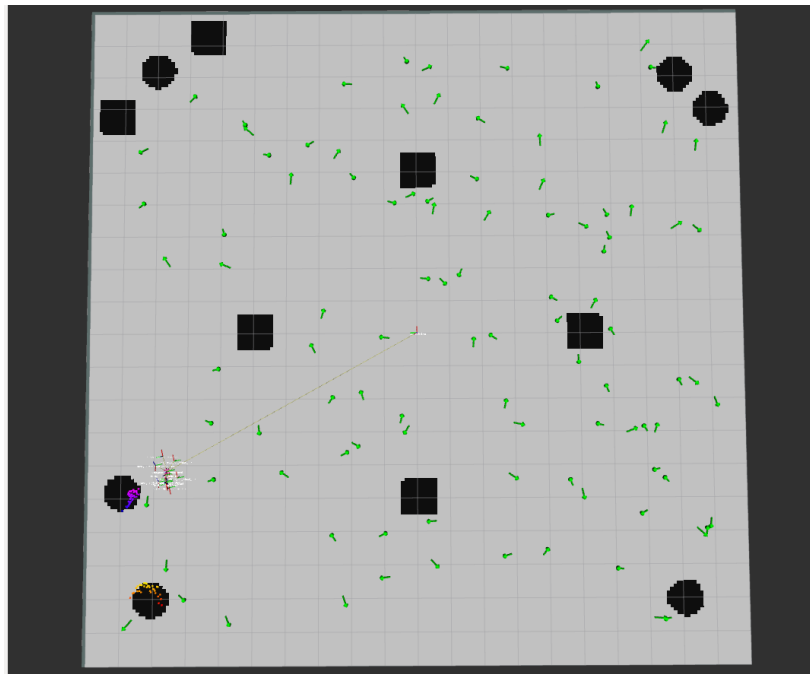

Figure 1: Uniform initialization of particles in Monte Carlo Localization, within the boundaries of a workspace. Your task is to make the particles cluster around the robot, as it makes LiDAR measurements of the environment. The environment consists of the black square and circular-shaped obstacles, shown above.

Starter code

Do `git pull` under your CSC477 repository to get the starter code. The functionality that you need to implement is marked using comments in the file `estimation_and_vision_assignment/python/monte_carlo_localization_v2.py`. To run your code, `cd path/to/csc477_fall22/estimation_and_vision_assignment/` and execute the following commands on three different terminals:

```
rosbag play laser_controls_and_odometry.bag
roslaunch estimation_and_vision_assignment monte_carlo_localization_v2.launch
```

```
rosrun  rviz  rviz
```

When rviz initializes, go to `File > OpenConfig` and then load the configuration file in `estimation_and_vision_assignment/resources/comp417.rviz` which is going to start the visualization of laser scan messages, frames of reference, and particles. Save this configuration file as the default in your `/home/username/.rviz/default.rviz`, so you won't have to do this every time you restart rviz. What you will see initially, before the robot makes any measurements is Fig. 1: What you need to submit: in addition to your code, a video recording of the rviz visualization demonstrating your particles converging from beginning to end. Your video should be named `mcl_firstname_lastname.mp4/avi/ogg`.

2   How to submit

Submit all your work in a file called `estimation_and_vision_assignment.zip` that contains your extensions to the provided starter code, as well as the required files, as explained above. Submissions will be done on Quercus.