ROB 456: Homework Set 3

Part I

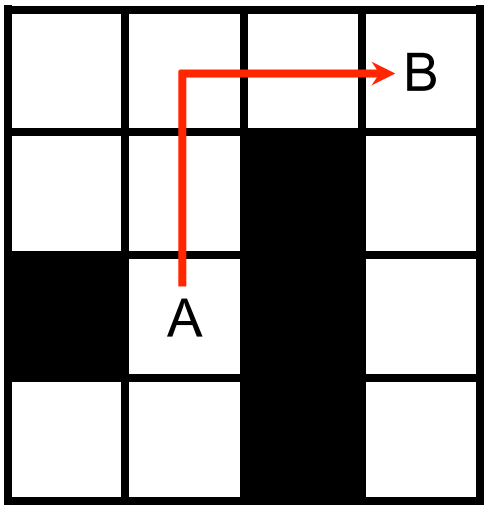

Figure 1

Given the 4x4 grid world shown in Figure 1, the robot moves from position A to position B as indicated by the arrow. Each grid cell is 1 unit^2.

At each location, the robot takes a sensor measurement (5 scans in total). The sensor characteristics are as follows:

- Probability of true positive = 0.XXX*(1/distance)
- Probability of true negative = 0.99
- Sensor range = 1 cell
- Distance = distance between cell centers
- XXX = 0.1+(last three digits of your OSU ID)/2000

On the second scan, the sensor returns the measurement that all neighboring cells are free. On all other scans, the sensor returns the correct measurements.

Calculate the occupancy grid map $bel\left(m^t\right)$ for $t = 1:5$. State all assumptions that you make in your calculations.

Part II

Download "rob456_hw3.zip" and unzip it into your catkin_ws/src folder.

0. Make it!
1. There are three .py files in the "src" folder
    a) hw3.py
    b) odom_error_printer.py
    c) slam_error_printer.py
2. Modify hw3.launch in the "launch" folder to include the slam_gmapping node
3. If you are able to run rviz, include the rviz node in the launch file (optional: this helps you visualize the SLAM algorithm in action). An rviz configuration file, rvizsetup.rviz, is available in the main package folder.
4. Call hw3.launch in a terminal
5. In a separate terminal, run odom_error_printer and print to a file (e.g. .txt or .csv file) using the following command:

```
rosrun rob456_hw3 odom_error_printer.py > odomlogfile.txt
```

6. In a separate terminal, run slam_error_printer and print to a file (e.g. .txt or .csv file) using the following command:

```
rosrun rob456_hw3 slam_error_printer.py > slamlogfile.txt
```

7. Plot the logged [x,y,theta] errors for the odometry and the SLAM solutions
8. **Analyze and compare the error plots, your discussion should include but is not limited to:**
    a) General observed trends
    b) Accuracy of the two estimates

What to turn in:

1. Five matrices showing the occupancy probabilities over time (5 marks)
2. Statement of assumptions and any associated code/calculations used to solve this problem (3 marks)
3. Plots of the odometry error and the SLAM error over time (3 marks)
4. Your analysis of the plots (9 marks)

A few notes:

1. It is *strongly recommended* that you code your solution to Part I.
2. There are a few aspects in the implementation of the scenario in Part I that are open to interpretation, make sure you clearly state the assumptions you make and provide justification where appropriate.
3. Marks for the analysis will be awarded according to the depth of discussion linking the physical motion of the robot in the world and its sensor returns to the accumulated errors.