Assignment 4

The objective of this assignment is for you to expand your familiarity with the Turtlebot 2 robot, develop some basic behaviours and identify the accuracy of different odometric schemes. This assignment is also, in part, a team assignment.

1.Develop basic behaviours [10%].

Implement three functions *translate(double d)*, *rotate_rel(double angle)*, and *rotate_abs(double angle)*. The translate function takes one argument the distance to be travelled in meters. The relative/absolute rotate functions take one argument the angle of rotation. Use the time-needed multiplied by the commanded velocity to calculate how much you have travel. See, as in assignment 3:
http://www.cse.sc.edu/~jokane/teaching/574/notes-turtlebot.pdf
In particular ensure you have installed the *robot_pose_ekf* node, and subscribe both to *odom* and *odom_combined* messages.

2. Odometry Study 40%

For this question each team should implement different test patterns:

- Straight line (1 m)
- Rotation (relative) (+/- 30)
- Square (side 1 m) extra rotation to end at the same orientation

Then run the robot several times for each pattern and manually estimate distance travelled and actual rotation. This will provide enough information to characterize the noise of the motion model.
Report:

- Actual distance travelled (manual measurement), commanded distance travelled, odom estimate, and odom_combined estimate.
- Actual angle rotated (manual measurement), commanded distance travelled, odom estimate, and odom_combined estimate.
- Estimate, mean error, and variance.

3. Extend the Grid-Mapper (individual) 50%

Extend the program created in Assignment 2, to calculate also the occupied grid cells based on the laser returns. Remember to transform the laser points from the local (laser) coordinate frame to the global coordinate frame. Use a line drawing algorithm to label the grid cells as free if they are between the robot and the laser return. The most standard line drawing algorithm is the Bresenham's line algorithm. Ensure that all quadrants are taken care of. Improve the accuracy of the grid mapper of Assignment 2 to have a resolution of 5 cm. Measure the area of the experiment and ensure the map fits the expected area. Use the Stage simulator and the turtlebot for this question. Apply the grid-mapper using the kinect of the Turtlebot 2. Use your random walk, to guide the robot and create a map of the environment.

4. Bonus question 20%

For the odometry study use the Kinect sensor to estimate motion. Use flat surfaces (wall) to recover lines (or planes). Measure distance to the line before and after, together with relative orientation.

Evaluation:

I will arrange with every team to see a demo of the test pattern behaviours. In addition write a report discussing your findings, problems encountered, and the distribution of work among the team members. Each team member should submit a report for the individual question.