CSCI/ARTI 4530/6530 Introduction to Robotics - Fall 2018
Mid-term Exam - Project-based test

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Oct 8, 2018

General Information

Deadline: October 15, 2018, 12:30 pm
Worth: 30 pts (undergraduate); 40 pts (graduate)

This is a group project and all members should actively contribute to the team. There will be three projects assigned to three teams - Team A, Team B, and Team C. The assignment of team is uploaded in eLC. You mainly need to simulate the sensors and robot in ROS Gazebo. If you want, you can use the KUKA youBot platform (a holonomic, omnidirectional mobile platform) or any other similar omnidirectional robot driver in your simulations/verification.

Task

Assume an omnidirectional mobile robot available to you. Simulate this robot in a 2D room (world) free of obstacles in Gazebo as shown in Fig. 1. The robot receives command velocity of message type geometry_msgs/Twist. The robot can make six actions: Move Forward, Move Backward, Move Left, Move Right (each of these actions with 1m displacement). No Turn action. The state of the robot is (x, y). The robot is equipped with two range sensors providing how far the robot is (in meters) in x and y direction, respectively. Note, x is the horizontal axis and y is the vertical axis. Initially, the robot is at $(0, 0)$.

Team A

Implement a Kalman Filter localization algorithm. State your assumptions for the probability distributions of the motion model and observation models. You can use the code available here for your reference.

Team B

Implement a Particle Filter localization algorithm. State your assumptions for the probability distributions of the motion model and observation models. You can use the code available here for your reference.

Team C

Implement a pure Markov Localization localization algorithm. State your assumptions for the probability distributions of the motion model and observation models. You can restrict your world to 100m x 100m discrete grid of resolution 1m.

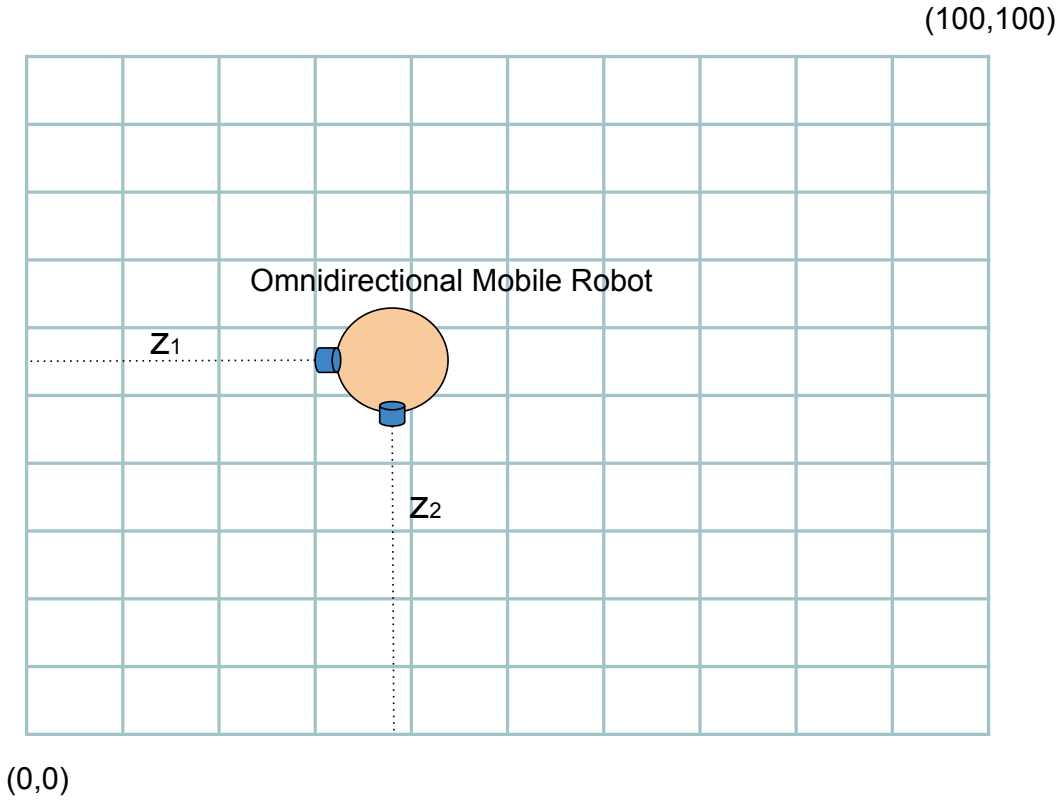

Figure 1: Problem Environment

Submission Instractions

Prepare a ROS package that has up to four scripts/nodes. First, a robot driver (ONLY IF you are creating a robot by yourself using the omnidirectional kinematics instead of using an already available omnidirectional robot driver for Gazebo). Second, a sensor driver for which you create (simulate) two range sensors using the ground truth available in Gazebo (Use a custom message type for this message which contains two float values - z_1 and z_2). Third, the main script that does the localization and produces a new geometry_msgs/Pose message as the odometry information and in another topic it publishes the error (of same message type - Pose) in the localization algorithm compared to the standard odom message published by the robot). Fourth, a teleoperation driver, which received the command from the keyboard (or the teloop node) and convert them into the four actions the robot can receive.

Provide images of the world (along with the localization outputs) captured at 8 different instants after performing actions in the following sequence: Move Forward, Move Left, Move Forward, Move Left, Move Backwards, Move Backwards, Move Right, Move Right.

Also, importantly, add a README file that briefly describes the role and contribution of each member in the team (this is the one I will use to assign your scores). Submit the Zip file in eLC.