MTRN4230 Robotics Problem Solving Exercise 5 (PSE5) Description

Problem Solving Exercise 5 requires you to work individually to compare several path planning algorithms. It is worth 3 course marks in total.

Learning Outcomes

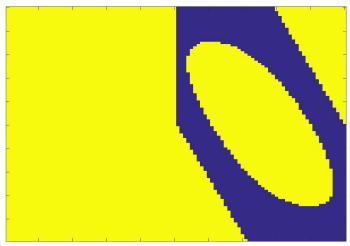
1. Learn a robot environment and put it to use effectively and efficiently on a given task.

Aims

1. **Path Planning:** Compare several path planning algorithms

Assessed Tasks

Start with a two-link model of a robot manipulator used in the lecture examples (see Moodle), with lengths of 0.5m per link. θ_1 can range from -180 degrees to +180 degrees and θ_2 can range from -150 degrees to +150 degrees. Assume that there is a fixed obstacle at y = 0 like a horizontal surface below which any point on the manipulator is not permitted to reach. This can be trivially checked by examining the position of both the end of the first link and the end effector. Another fixed obstacle above y = 0.6m is like a horizontal surface above which any point on the manipulator is not permitted to reach. The joint space has been discretised into 100 x 100 cells for computation and has been plotted for you (see sample code on Moodle), showing the free (blue) and occupied (yellow) regions of the joint space.



Functions are provided to convert the joint angle to and from a cell value. Note in the sample code the transposed cost map is used as input to the planner due to the ordering of Matlab indices.

1. Path Planning

For a starting pose of $[\theta_1, \theta_2]$ = [5, 5] degrees and a goal pose of [175, -5] degrees, use the following D* and PRM algorithms to generate the path of the end effector. Show an animation (eg. using `two_link.plot(prm_path_angles)` where `prm_path_angles` are a set of joint angles) for each of the paths generated.

1.1. (1 point) Plot the obstacles above and below the robot arm

1.2. (2 points) Generate the shortest path using D* and plot it in the discrete joint space overlaid on the cost map. See section 5.2.2. of the Corke textbook.

1.3. (1 point) Convert this path back to joint angles and animate the robot to follow the path

1.4. (2 points) Generate a path using PRM and plot it in the discrete joint space overlaid on the road map. See section 5.2.4. of the Corke textbook.

1.5. (1 point) Convert this path back to joint angles and animate the robot to follow the path

1.6. (3 points) Describe and discuss the difference between the paths generated in terms of the algorithms used.

Assessment

Show your individual solutions to the above tasks to your demonstrator within your PSS time in week 9. There is a total of 10 points for this PSE which is scaled to 3% of your final grade in MTRN4230.