Tutorial 3

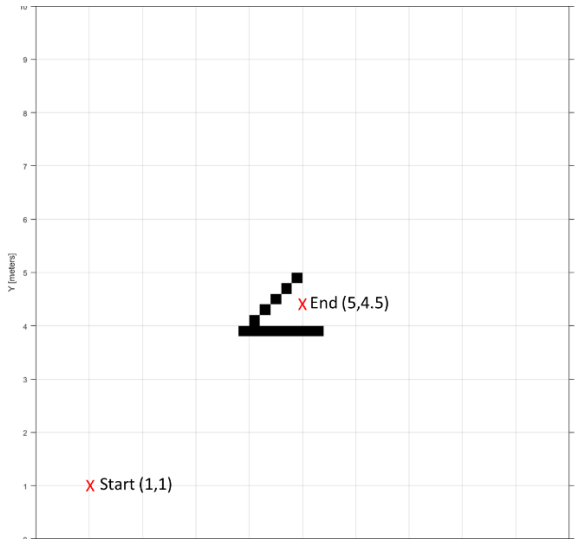
Mobile Robot Path Planning: Probabilistic Roadmap and Pure Pursuit path tracking algorithms

DO NOT edit the original examples in Matlab folders. Make a copy and edit.

Example 1: Path Planning in Environments of Different Complexity

This example is on Probabilistic Roadmap (PRM) algorithm in Matlab.
https://au.mathworks.com/help/robotics/examples/path-planning-in-environments-of-difference-complexity.html

1. Set a breakpoint at line number 1 in the Matlab livescript and run it step by step.
2. Read the comments and understand all steps.
3. Right click on the file name in the Live Editor and go to the file location.
4. In this file location, create three different livescripts for simpleMap, complexMap and ternaryMap (*PathPlanningExample_simpleMap.mlx, PathPlanningExample_complexMap.mlx* and *PathPlanningExample_ternaryMap.mlx*).
5. In *PathPlanningExample_complexMap.mlx*,
    a. Find a suitable value for *NumNodes*.
    b. Set start position – closer to top left corner, end position – closer to bottom right corner.
    c. Find the first 10 paths (non-empty).
    d. Calculate the total distances in each non-empty path.
    e. Find the difference between the min and max distances. Show it as a % of min distance.
    f. Select the minimum distance path as the preferred path and show it on the map.
6. Repeat the steps given in 5 for *PathPlanningExample_complexMap.mlx.*
7. What is Occupancy Grid?
8. Check the example available on https://au.mathworks.com/help/robotics/ug/occupancy-grids.html
9. Create an occupancy grid as shown below. Save it as map1.mat in the same file location. The map size should be 50x50.



10. Use map1.mat with *PathPlanningExample_simpleMap.mlx* and find the PRM path between the two points shown in the map (start, end).

Example 2: Path Following for a Differential Drive Robot

https://au.mathworks.com/help/robotics/examples/path-following-for-differential-drive-robot.html

1. What is Pure Pursuit path tracking algorithm? Find the answer here: https://au.mathworks.com/help/robotics/ug/pure-pursuit-controller.html
2. Before moving to step 3, make sure you read the article about Pure Pursuit tracking algorithm.
3. Intentionally run the robot on to obstacle and see what happens.
4. Now the robot has two goal positions - (2,12) and (12,10).
5. Manually set waypoints (6 waypoints) to go to these two goal positions.
6. Now make a copy of this example and save in the same file location as *PathFollowingControllerExample_YOURNAME.mlx*
7. Change this new file to use *complexMap*
8. Set a new goal position (24,19).
9. Set a suitable number of waypoints and run the example. You can use *show(robot.Map),impixelinfo* to know the X-Y coordinates of a particular point.
10. Increase the linear velocity until the robot becomes unstable. Then, try to fine tune other parameters to get a smooth navigation. You should fine tune the parameters to achieve the maximum speed.

Example 3: Mapping With Known Poses

https://au.mathworks.com/help/robotics/examples/mapping-with-known-poses.html

1. Run the example step by step and understand each line.
2. Now make a copy of this example and save in the same file location as *MappingWithKnownPosesExample_YOURNAME.mlx*
3. Use the map you created in example 1 (map1.mat) and create its occupancy grid.

- No marks will be given for this tutorial, but complete and show this to the demonstrator.
- Find the original references of PRM and Pure Pursuit algorithms, and enter them in to your log book. You might need them for your project report.