# Assignment 2

SC42090 Robot Motion Planning and Control

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## Exercise 2.1

Figure 1 shows the effect of setting different initial (black dot) and goal (red dot) positions while keeping the scoring constant. For some combinations of initial and goal position, the robot gets stuck.

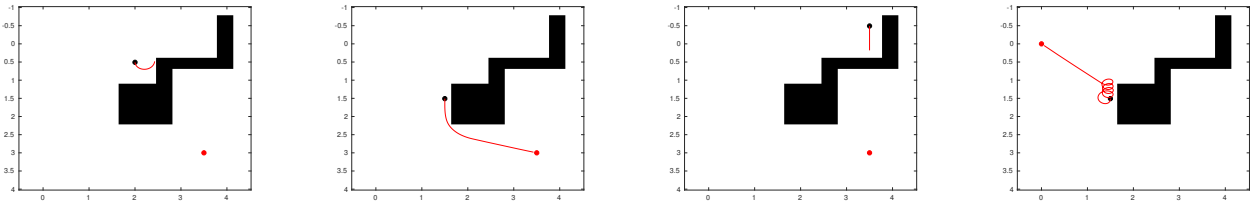

Figure 1: Resulting trajectories for different initial and final positions.

Figure 2 shows the effect of applying different sets of scoring. The scoring vector: $\bar{s} = [s_{heading}, s_{velocity}, s_{distance}]^T, |\bar{s} = 1|$. All trajectories start in the upper left corner. The first image shows the result of having a low weight on the error in heading, effectively causing it to circle around endlessly. The second image shows an increased heading cost but low cost in velocity, resulting in some circling behaviour. The third image show a too high distance cost resulting in a incomplete trajectory. The final image shows a relatively balanced set of weights where first the most logical path was followed after which a detour is found without getting stuck.

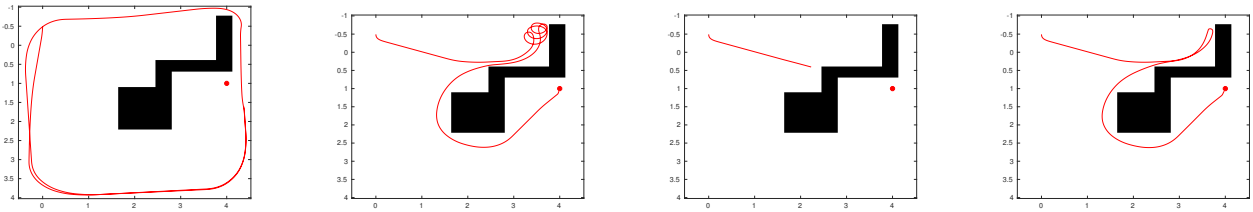

Figure 2: Resulting trajectories for different initial scoring of distance, heading and velocity. From left to right: $\bar{s} = [0, 0.55, 0.45]$,$\bar{s} = [0.05, 0.85, 0.1]$,$\bar{s} = [0.1, 0.05, 0.85]$,$\bar{s} = [0.1, 0.15, 0.75]$

## Exercise 2.3

Figure 3 shows the effect of different initial states on the resulting trajectory. Figure 4 shows the effect of different weighing factors on the resulting trajectory.

After some tuning, the robot performed the path as shown in Figure 5, left.

## Exercise 2.4

For the default initial position of the target and robot, the scoring set $\bar{s} = [0.1, 0.55, 0.35]$ provides a satisfactionary path (Figure 5, right.). One reason that the robot might get stuck is due to the discretization of the search space.Different combinations of cost can lead to local minima, when obstacles are present. When no obstacles are present, a high gain on the heading will suffice.


Figure 3: Resulting trajectories for different start positions.

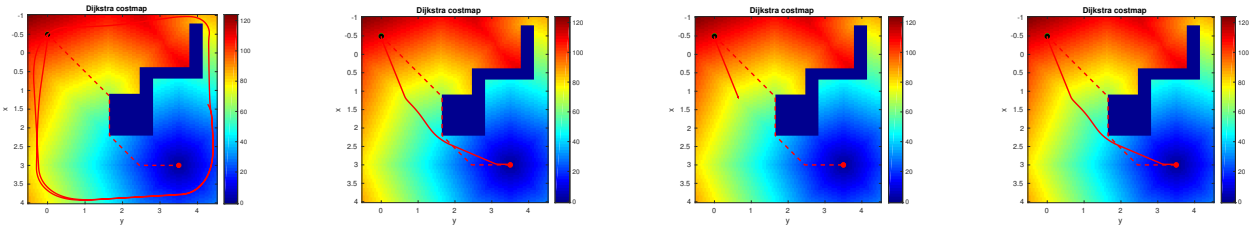


Figure 4: Resulting trajectories for different initial scoring of distance, heading and velocity.

Another problem might be that the dynamic window might be too small, causing the robot to get in a state where it might not escape from (dead-ends).

## Exercise 2.5

Possible improvements: (1)Increase number of hypotheses, (2) Multiple step ahead planning, and (3)Random tie braking for when possible paths have equal cost.

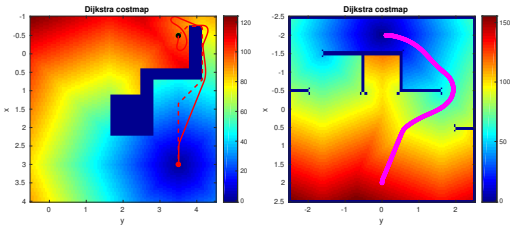


Figure 5: Left: Trajectory for $\bar{s} = [0.21, 0.68, 0.11]$. Right: Resulting trajectory in V-REP