SC 627 Motion Planning

Second Assignment

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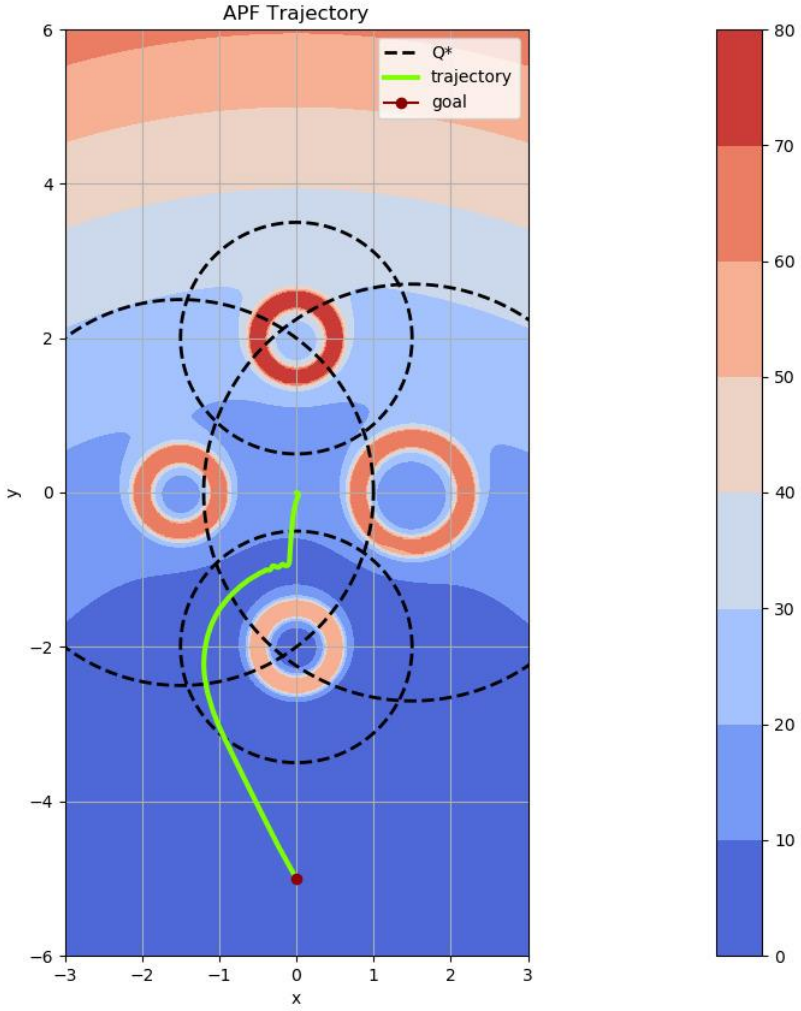
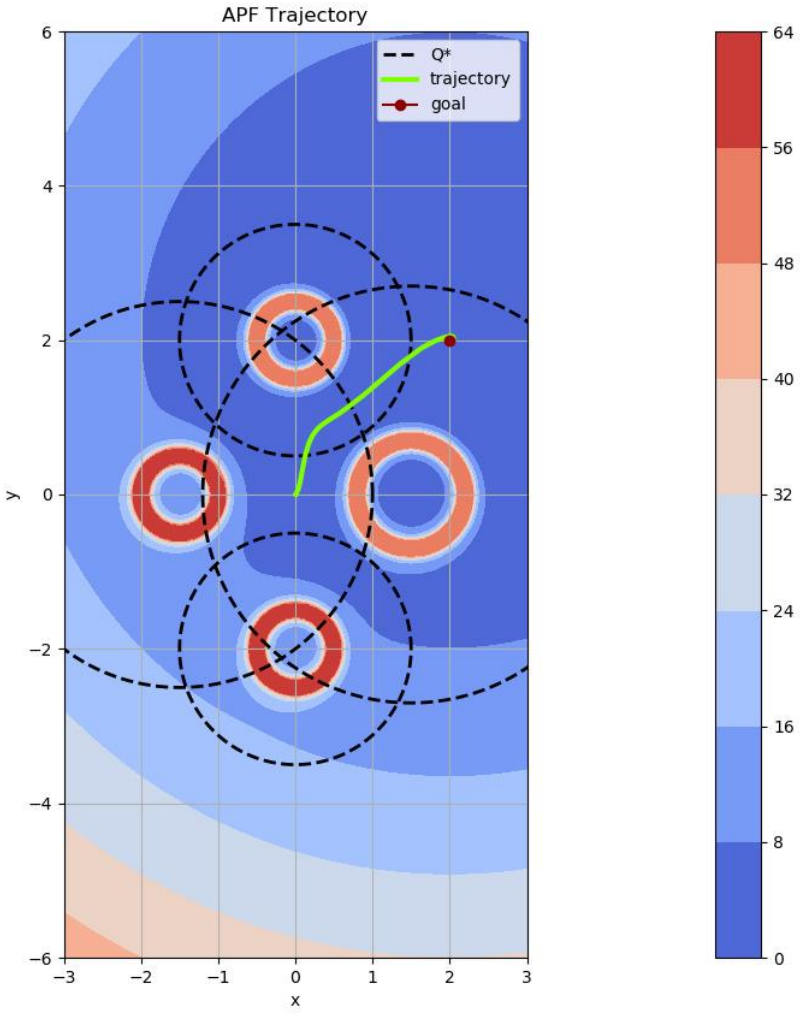
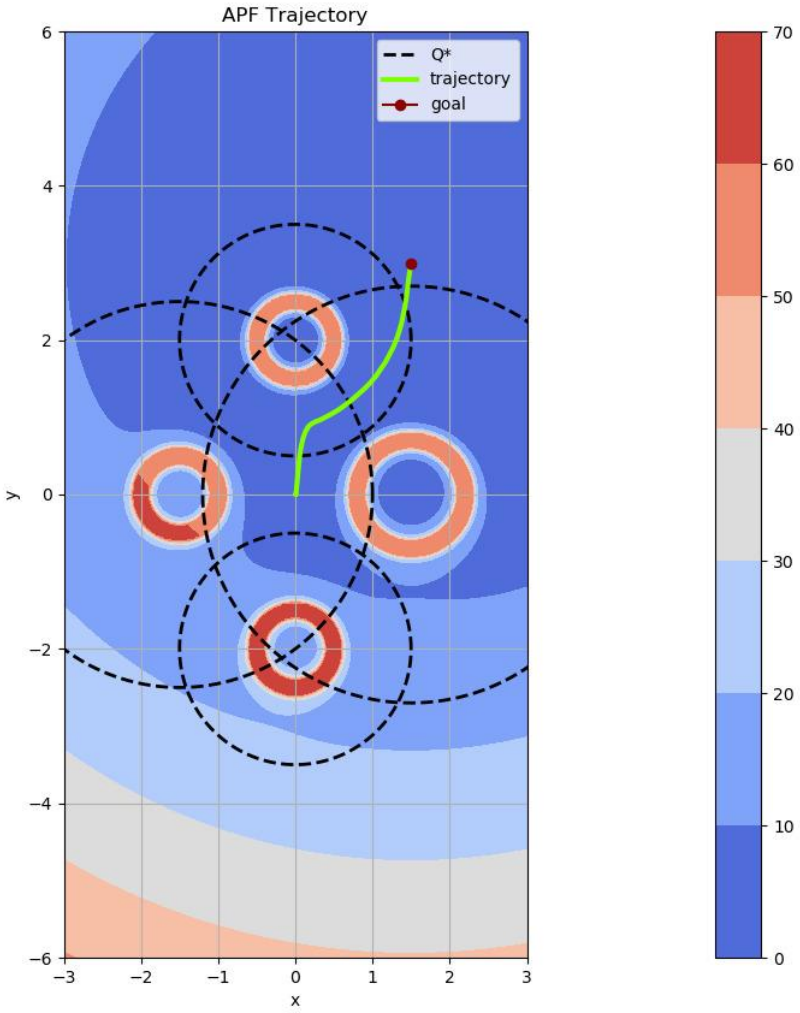
Group 4

Problem 1: Plan a path using artificial potential field in the given world file for any start and end point.

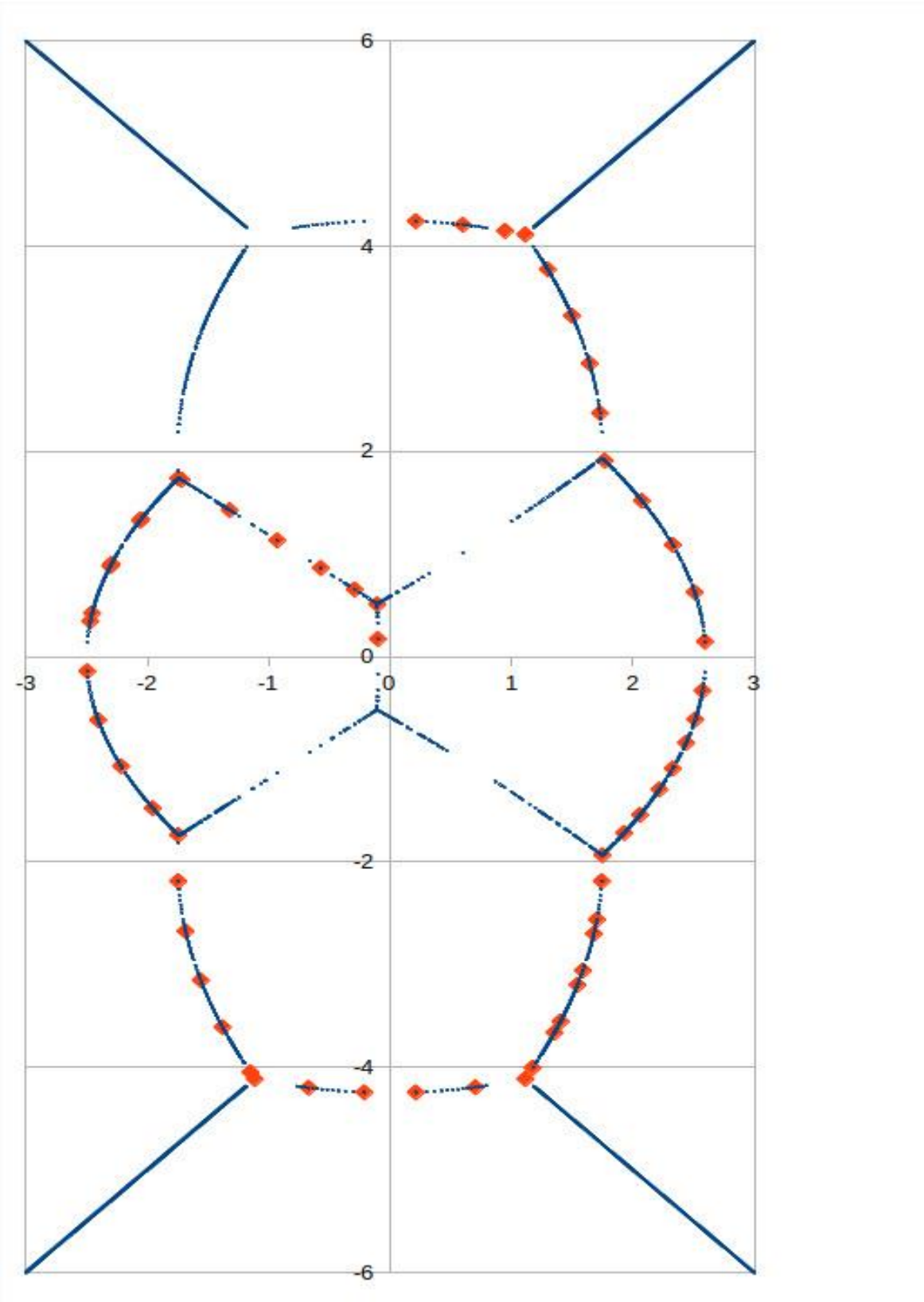
These plots for simultion

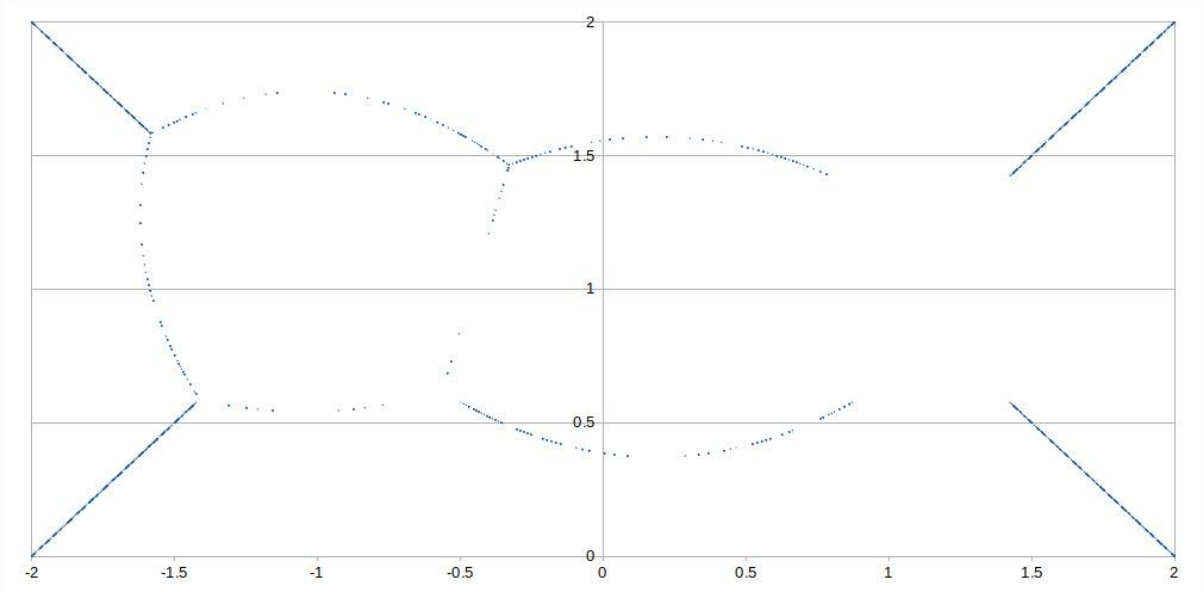



APF Trajectory
Q*
trajectory
goal
x
y
6
4
2
0
−2
−4
−6
−3
−2
−1
0
1
2
3
64
56
48
40
32
24
16
8
0


APF Trajectory
Q*
trajectory
goal
x
y
6
4
2
0
−2
−4
−6
−3
−2
−1
0
1
2
3
70
60
50
40
30
20
10
0

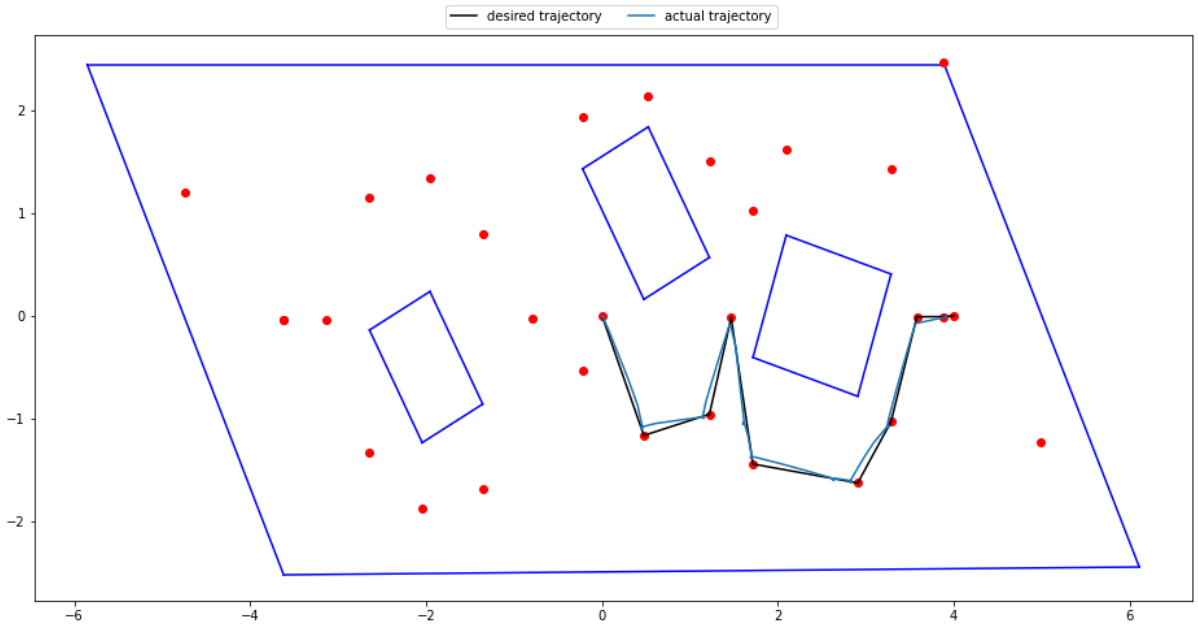
Problem 2: Make a roadmap using Voronoi diagram in the given world and find the shortest path between start and end point



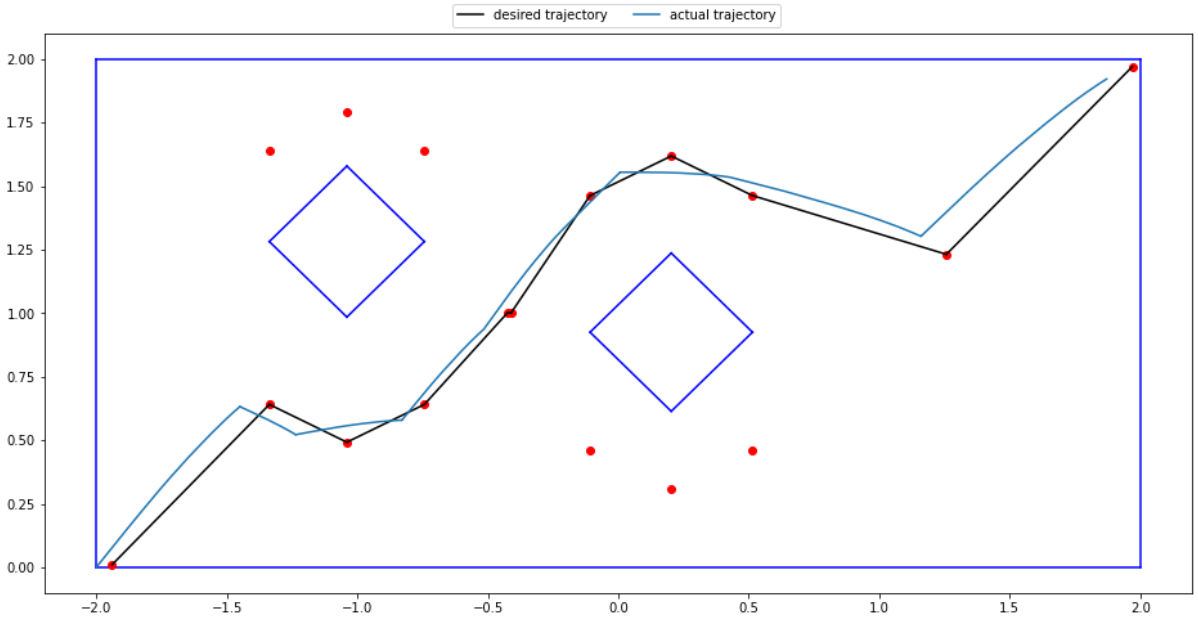

2
1.5
1
0.5
0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2

Problem 3: Make a roadmap using vertical cell decomposition (trapezoidal decomposition) and find the shortest path between start and end point in the world

The simulation par the goal point is (4,0):



The plot for demo:



Observation:

Problem 1 involves using artificial potential field (APF) to plan a path between two points in a given world file. APF is a commonly used method for path planning in robotics, where the robot is guided towards the goal by a potential field generated by the obstacles in the environment. The APF method has several advantages, such as its simplicity, efficiency, and ability to handle dynamic obstacles.

Problem 2 involves generating a Voronoi diagram of the given world file and then finding the shortest path between two points on the diagram. Voronoi diagrams are a common geometric structure used in computational geometry and robotics for path planning. The diagram consists of a set of points that are equidistant to the nearest obstacles in the environment. The shortest path between two points on the Voronoi diagram can be found using any standard path planning algorithm.

Problem 3 involves generating a vertical cell decomposition (trapezoidal decomposition) of the given world file and then finding the shortest path between two points on the decomposition. Vertical cell decomposition is another commonly used method for path planning in robotics. It involves decomposing the environment into a set of vertical trapezoids that can be easily searched for the shortest path between two points.

In summary, Problem 1 uses APF for path planning, Problem 2 uses Voronoi diagrams, and Problem 3 uses vertical cell decomposition. **All three methods are commonly used in robotics for path planning** and have their own strengths and weaknesses. The choice of method depends on the specific requirements of the application and the characteristics of the environment.

Depends on several factors such as the **characteristics of the environment, the requirements of the application, and the available computational resources.** Each of these methods has its own strengths and weaknesses.

APF is a simple and efficient method for path planning that can handle dynamic obstacles. However, it may struggle to find the global optimal path and can get stuck in local minima.

Voronoi diagrams provide an exact and efficient way of finding the shortest path between two points in a given environment. However, they can be computationally expensive to generate, especially for large environments with many obstacles.

Vertical cell decomposition is a robust and efficient method for path planning that is especially useful for environments with complex geometries. However, it requires a preprocessing step to decompose the environment, and the resulting decomposition may not be optimal.

Therefore, the choice of method depends on the specific requirements of the application and the characteristics of the environment. It is always recommended to compare and evaluate the performance of different methods based on the specific problem at hand.