

CS593-ROB Assignment 1

Sampling-based Motion Planning

Report

Part1: RRT and BiRRT in 3D environment

Summarize your findings regarding the pros and cons for each of these three motion planning algorithms:

1. RRT:

The RRT algorithm will always find a path between the start and goal position. However, a con is that it is extremely slow as it finds the next position of the path by testing a lot of random positions. Moreover, it does not provide the most optimal path. Another con is how this path almost never reaches the exact position of the goal, as only reaches a point within the Goal radius. Thus, it is up to the user to define how much time he/she wants to wait to obtain the path and how close to the goal.

2. BiRRT:

The BiRRT algorithm always finds a path and it is much faster than the RRT algorithm. This is because it runs two different trees at the same time. However, it does not provide the most optimal path.

3. Smoothing:

This function is very useful as it takes the path obtained from the BiRRT algorithm and optimizes it. A con would be that if the algorithm removes the wrong position in the path, a "best" configuration might not be obtained, because it was already discarded.

Part2: RRT* in 2D environment

Question 4:

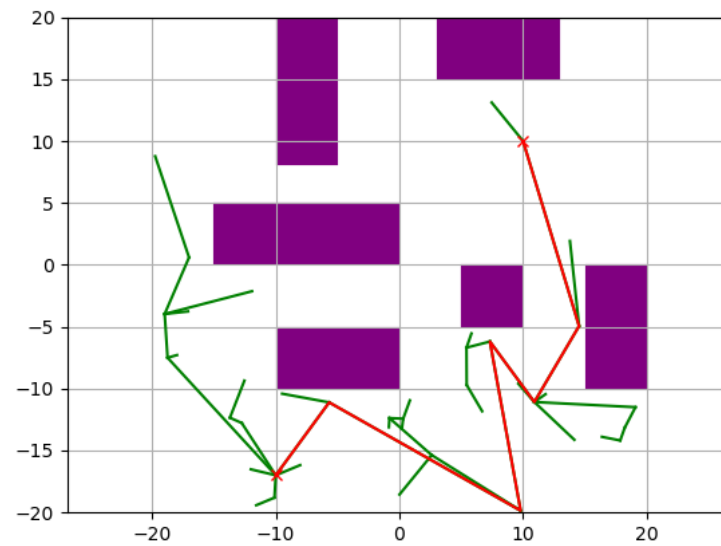


Figure 1: RRT algorithm for 2D point-mass

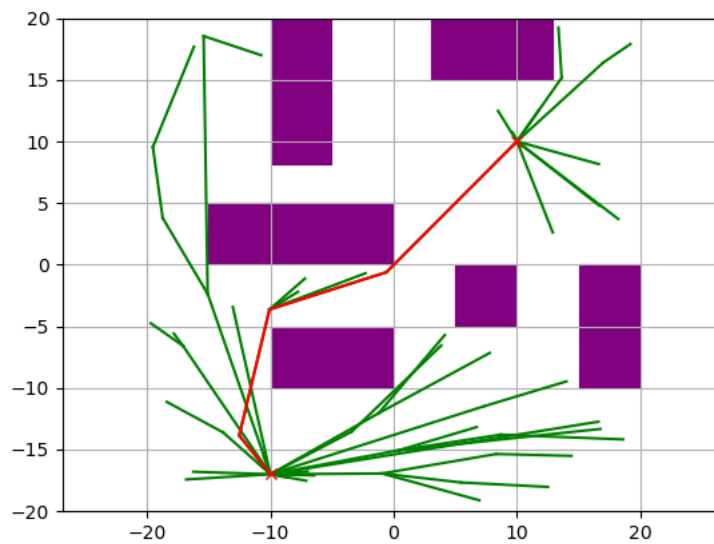


Figure 2: RRT* algorithm for 2D point-mass

Table 1: RRT and RRT* Comparison for 2D point-mass

	RRT	RRT*
PATH COST	53.175	40.821
COMPUTATION TIME	10.979	12.071

As expected, RRT provides less optimized path than RRT*, but RRT takes less time.

Question 5 – Circular Rigid Body

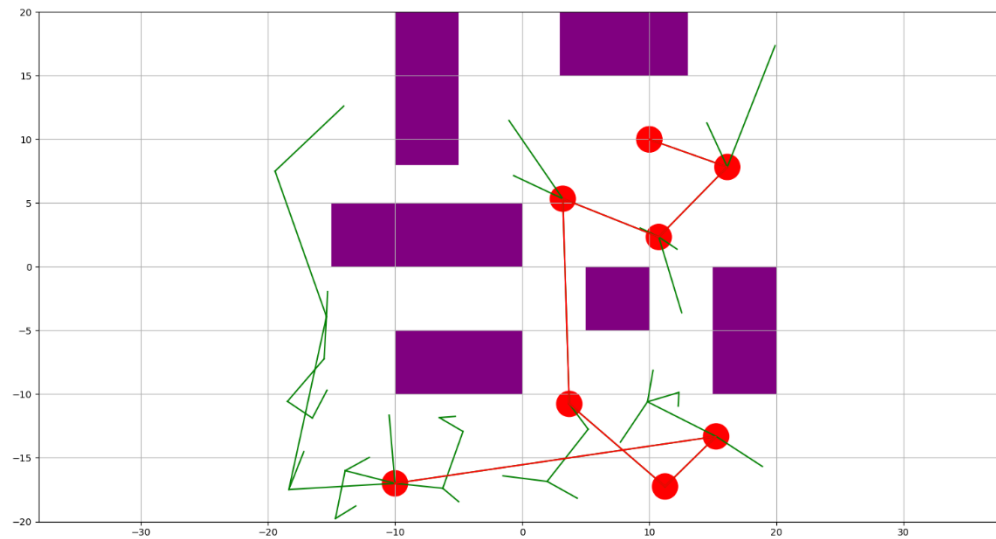


Figure 3: RRT algorithm for circle

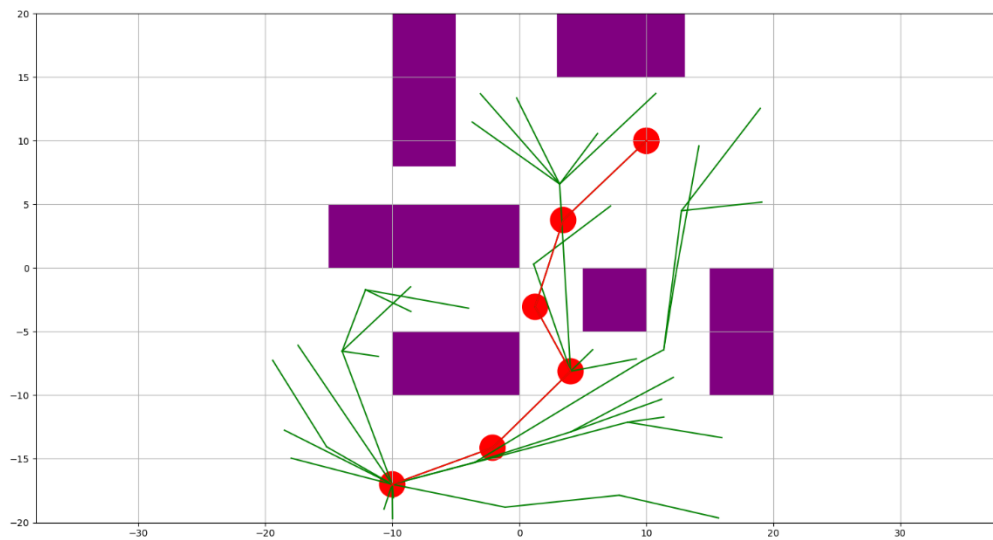


Figure 4: RRT* algorithm for circle

Table 2: RRT and RRT* Comparison for circular rigid body of radius 1

	RRT	RRT*
PATH COST	55.514	43.412
COMPUTATION TIME	10.322	18.959

As expected, RRT provides less optimized path than RRT*, but RRT takes less time.

Question 6 – Rectangular Rigid Body

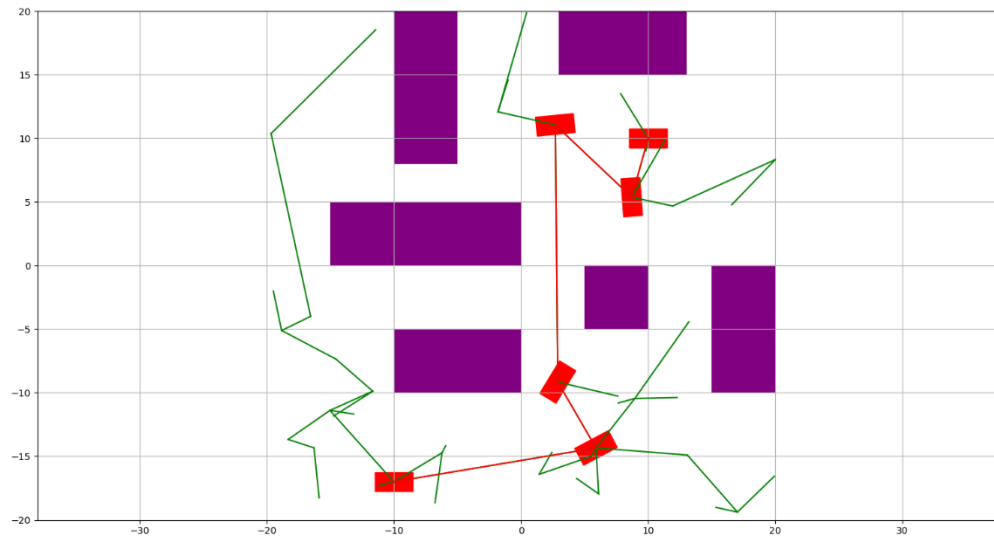


Figure 5: RRT algorithm for rectangle

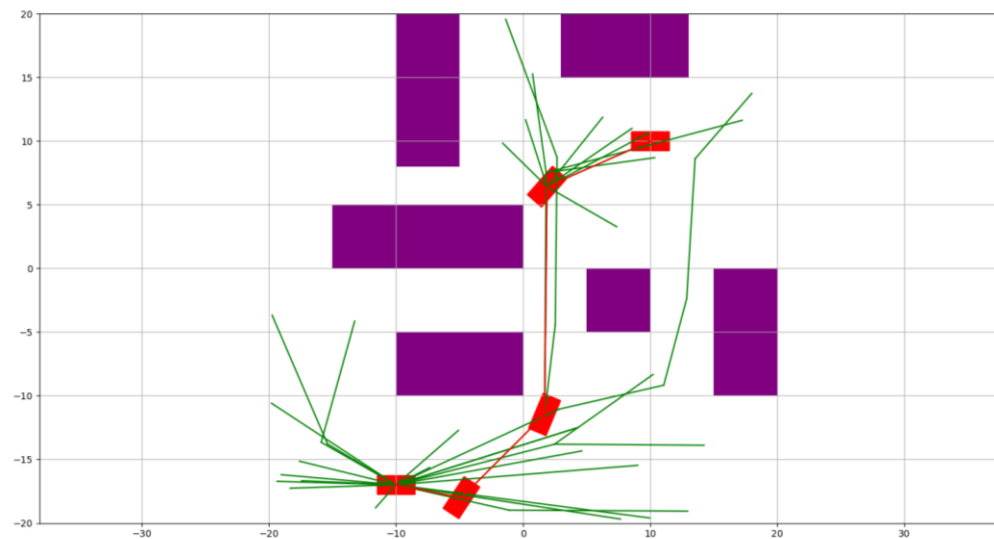


Figure 6: RRT* algorithm for rectangle

Table 3: RRT and RRT* Comparison for rectangular rigid body of $W=3$ and $L=1.5$

	RRT	RRT*
PATH COST	57.052	45.186
COMPUTATION TIME	5.925	10.555

As expected, RRT provides less optimized path than RRT*, but RRT takes less time.