

Homework 1 Report

Jiahang Wang

Task 1: Point robot

2A

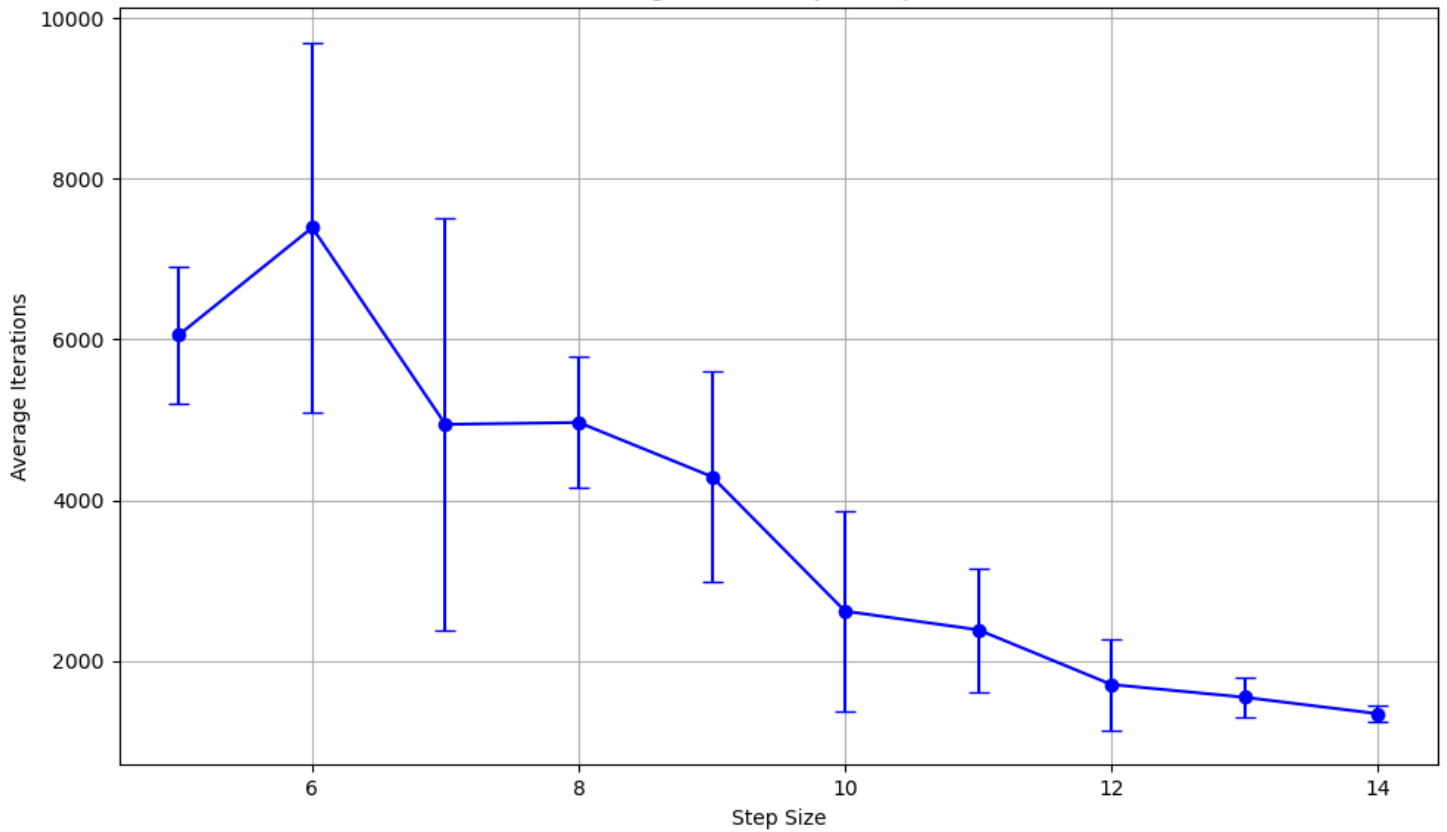
- Implementing the RRT algorithm for the point robot. The `rrt_search` function incrementally explores the configuration space by continuously generating random points, identifying nearest neighbors, attempting to add new points and edges to the graph while avoiding obstacles, ultimately finding a path from the start point to the target.

2B

- Uniform sampling select the point from the environment with equal probability, regardless of the robot's current position. Meaning it is not biased toward any particular area of the environment. This may result in slower exploration of certain types of environments where important areas are sparsely sampled.
- Gaussian sampling, however, by concentrating the sampled points around the destination, the robot is more likely to expand the tree toward the goal. This can lead to faster path planning, especially when the goal is visibly clear. Also, the expansion of the RRT is no longer uniform, resulting in more tree branches around the goal and relatively fewer branches elsewhere.

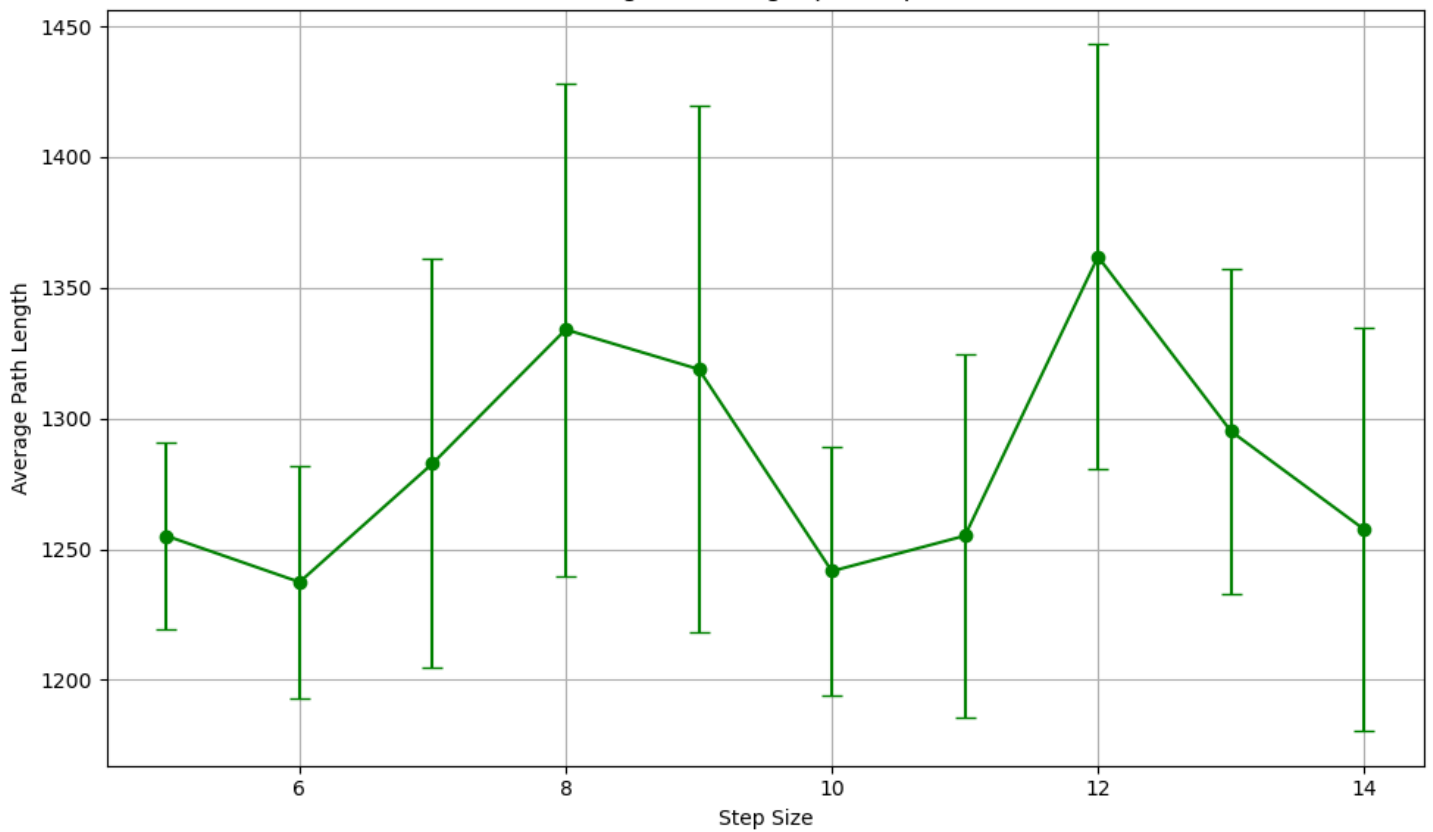
2C

Average Iterations per Step Size



- As the step size increases, the average number of RRT iterations exhibits a noticeable downward trend.

Average Path Length per Step Size



- Different step sizes yield varying values for the average path length.

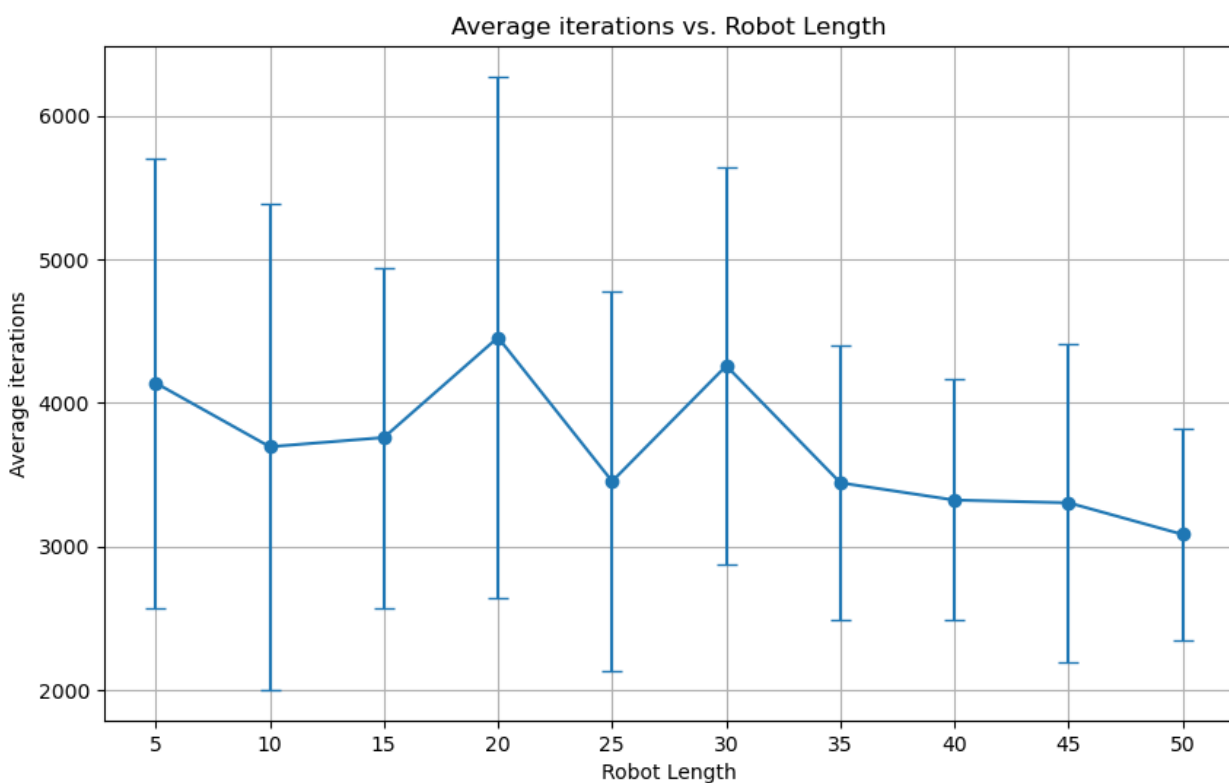
- From the two analyses above, I have chosen a step size of 10 as a good selection because this step size simultaneously exhibits lower average iterations and average path length compared with other in the group.

Task 2: Line Robot

3A

- Implementing the RRT algorithm for the point robot. The `rrt_search` function explores a path from the start to the target point on a 2D plane by generating random samples in each iteration. It generates a random point and identifies the closest line segment already present in the tree to that point. A new line segment is attempted to be established between these two points and is only added to the tree if it does not intersect with any obstacles. This process continues until a path to the target is found.

3B



- As the robot length increases, there is a relative downward trend in the average number of RRT iterations.

Challenges and Insights

- In the process of implementing the line robot movement, my procedure was to first have the line robot rotate in place to the direction of the target point, and then move straight towards the target point. I believe a more optimized algorithm should allow the line robot to adjust its direction while simultaneously advancing towards the target point.