Robot Autonomy Homework 3

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1. Breadth-First Search

Resolution	0.25	0.1	0.05
Path Length	5.0	5.4	5.4
Plan Time (secs)	0.49	5.18	44.48
Number of Nodes	679	5073	20303
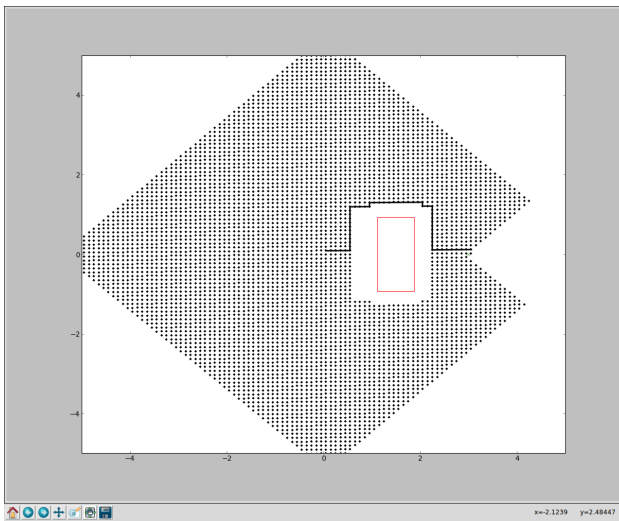
Figure 1. Breadth-First Search generated path for resolution 0.1

2. Depth-First Search

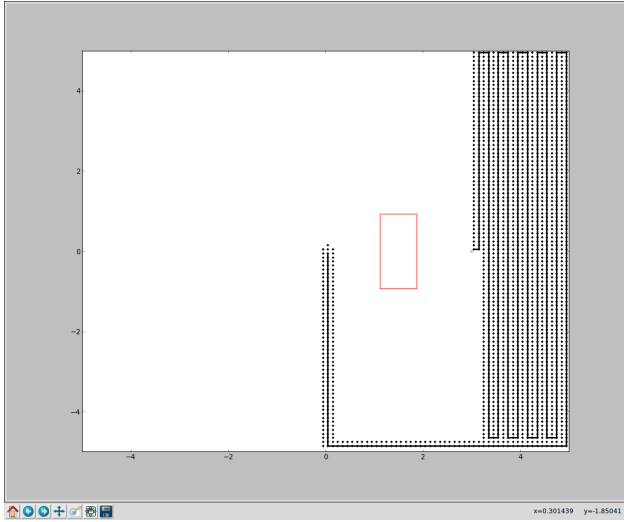| Resolution	0.25	0.1	0.05
Path Length	43.25	103.1	203.05
Plan Time (secs)	0.08	0.59	5.61
Number of Nodes	360	2094	8184

Figure 2. Depth-First Search generated path for resolution 0.1

3. A-Star Search: Simple Robot

Resolution	0.25	0.1	0.05
Path Length	5.25	5.3	5.45
Plan Time (secs)	1.29	3.39	23.72
Number of Nodes	85	288	867
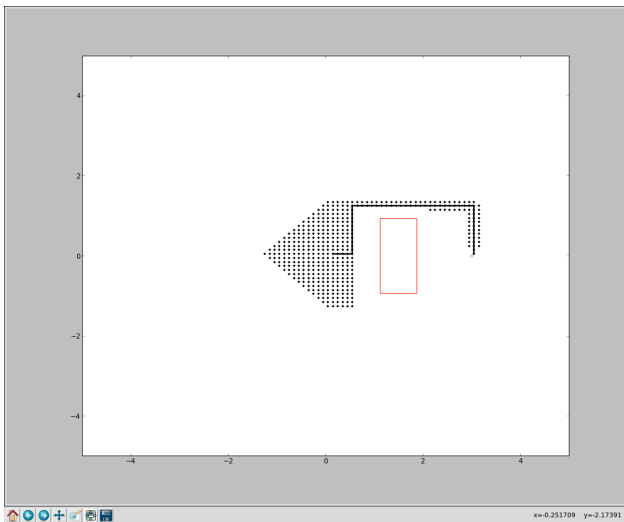
Figure 3. A-Star Search generated path for resolution 0.1

4. A-Star Search: HERB Robot

Resolution	0.1
Path Length	2.95
Plan Time (secs)	72.88
Number of Nodes	2612

5. RRT vs. A-Star: Simple Robot

A-Star with resolution: 0.1
RRT goal sampling frequency: 0.05
Number of runs: 10
Path shortening time: 5 secs

Algorithm	RRT	A-Star
Path Length	10.35	5.3
Plan Time (secs)	6.04	3.39

The path length generated by RRT after path shortening is about twice as much as A-Star and it also takes about twice as much time. Hence, A-Star is superior here.

6. RRT vs. A-Star: HERB Robot

A-Star with resolution: 0.1
RRT goal sampling frequency: 0.5
Number of Runs: 10
Path shortening time: 5 secs

Algorithm	RRT	A-Star
Path Length	10.834	2.95
Plan Time (secs)	7.582	72.88

The path length generated by RRT after path shortening is more than thrice as much as A-Star but it takes about 10 times lesser amount of time to do so. Hence, we can select RRT if we need to plan in a short amount of time or select A-Star if we need an optimal path.

7. HRRT vs. A-Star: Simple Robot

A-Star with resolution: 0.1
HRRT goal sampling frequency: 0.05
Pmin Bias: 0.5
Number of runs: 10
Path shortening time: 5 secs

Algorithm	HRRT	A-Star
Path Length	8.223	5.3
Plan Time (secs)	7.912	3.39

The path length generated by HRRT is lesser than RRT but still greater than A-Star by about 50%. Also, the planning time is more than twice of A-Star. Hence, A-Star is superior here. By changing the Pmin bias and goal-sampling frequency, the results of HRRT may vary in time and path length. But there is a compromise involved where the path length decreases for increase in time taken to plan. The performance still does not compare to that of A-Star.

8. HRRT vs. A-Star: HERB Robot

A-Star with resolution: 0.1
HRRT goal sampling frequency: 0.5
Pmin Bias: 0.5
Number of runs: 10
Path shortening time: 5 secs

Algorithm	HRRT	A-Star
Path Length	8.917	2.95
Plan Time (secs)	10.343	72.88

Here, HRRT is implemented much faster than A-Star but the path is not optimal. Due to high dimensionality and resolution, A-Star takes about 7 times longer to implement but gives a path that is 1/3rd of the length of that given by HRRT. Hence, we can select A-Star if we need an optimal path or we can select HRRT if there is a planning time constraint.