



Path Planning Experiments

Run Date: December 09, 2025 at 12:03:41



Experiment Summary

Total Experiments

5

Total Algorithm Runs

30

Success Rate

100.0%

Total Runtime

3.7s

Experiment 1: Low Density Environment

Compare RRTStar, BiRRTStar, PRRTStar, and Dubins variants in a low-density random environment

Environment: RandomEnvironment

Parameters: { "width": 100, "height": 100, "density": 0.1, "seed": 42, "robot_radius": 0.1 }

Start: (37.38935368297651, 33.32462720389405)

Goal: (17.680160467785434, 60.7052136761285)

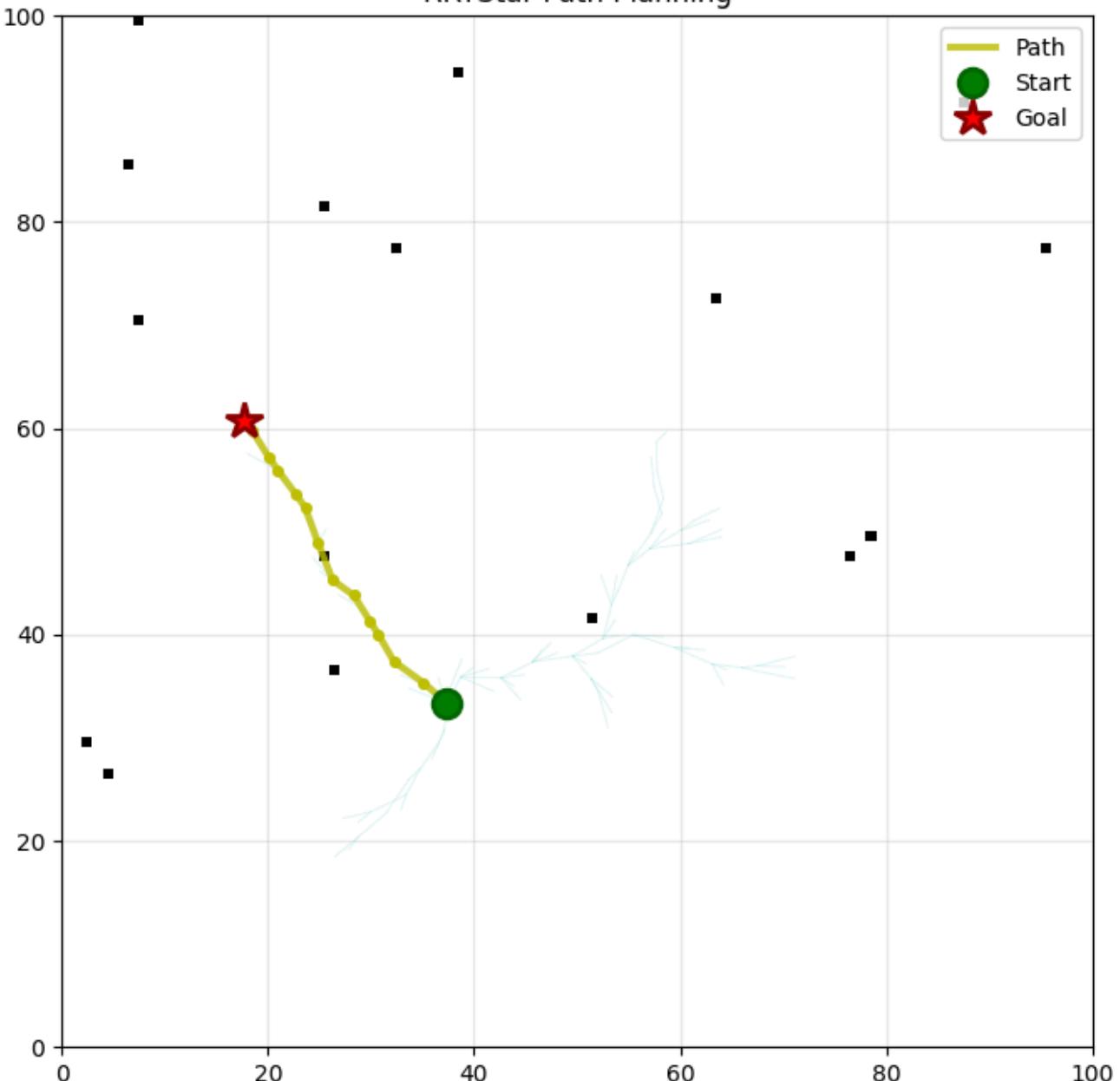
Algorithm Results

Algorithm	Status	Time (s)	Path Length	Nodes	Cost
RRTStar ES	✓ Success	0.02	34.42	105	34.42
BiRRTStar ES	✓ Success	0.00	34.67	30	34.67
PRRTStar ES	✓ Success	0.04	34.08	28	34.08
RRTStarDubins ES	✓ Success	0.00	35.23	56	40.62
BiRRTStarDubins ES	✓ Success	0.00	47.08	86	49.77
PRRTStarDubins ES	✓ Success	0.09	37.58	54	45.20

Path Visualizations

RRTStar [Early Stop]

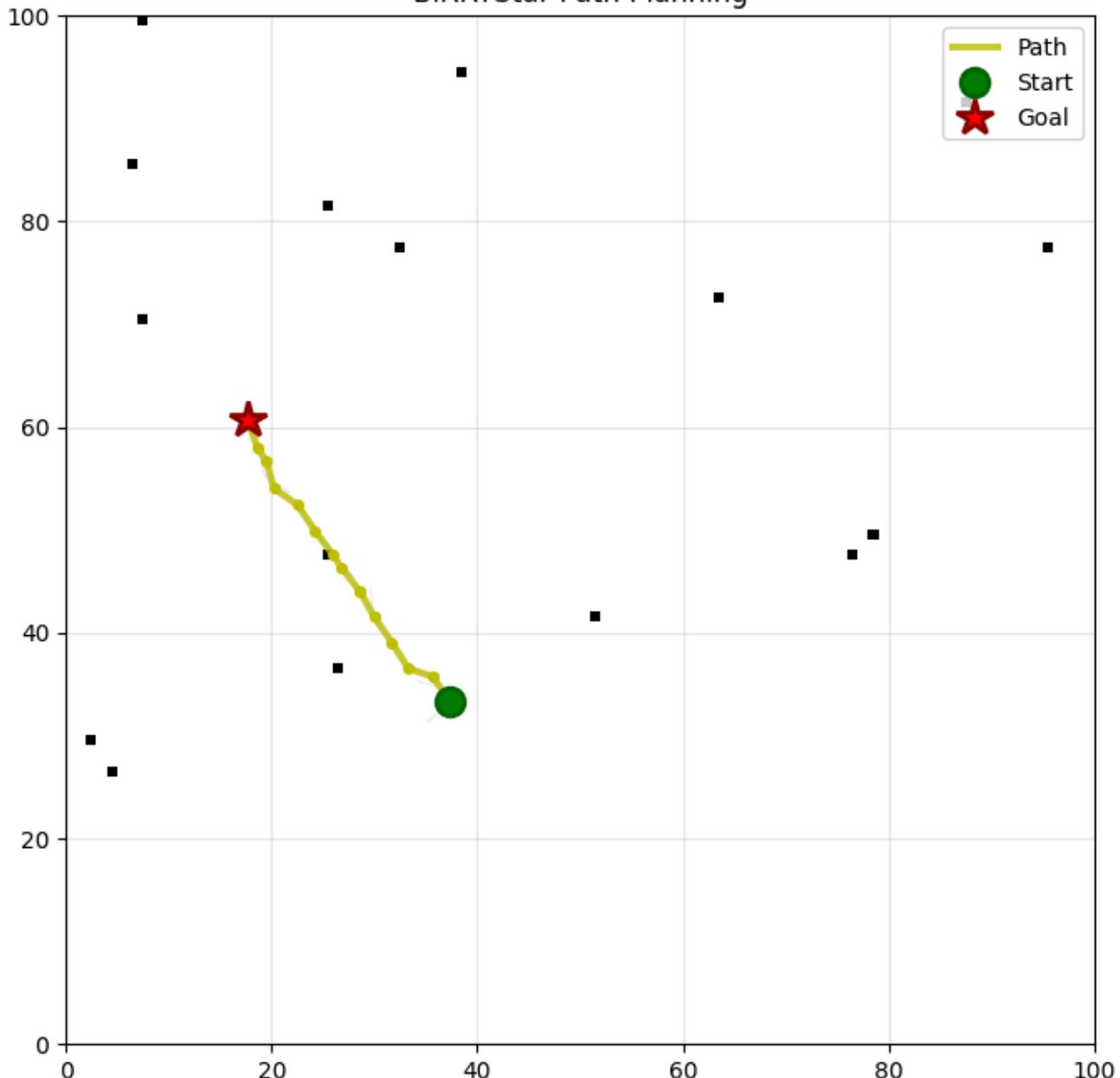
RRTStar Path Planning



Path Length: 34.42 | Nodes: 105 | Time: 0.02s

BiRRTStar [Early Stop]

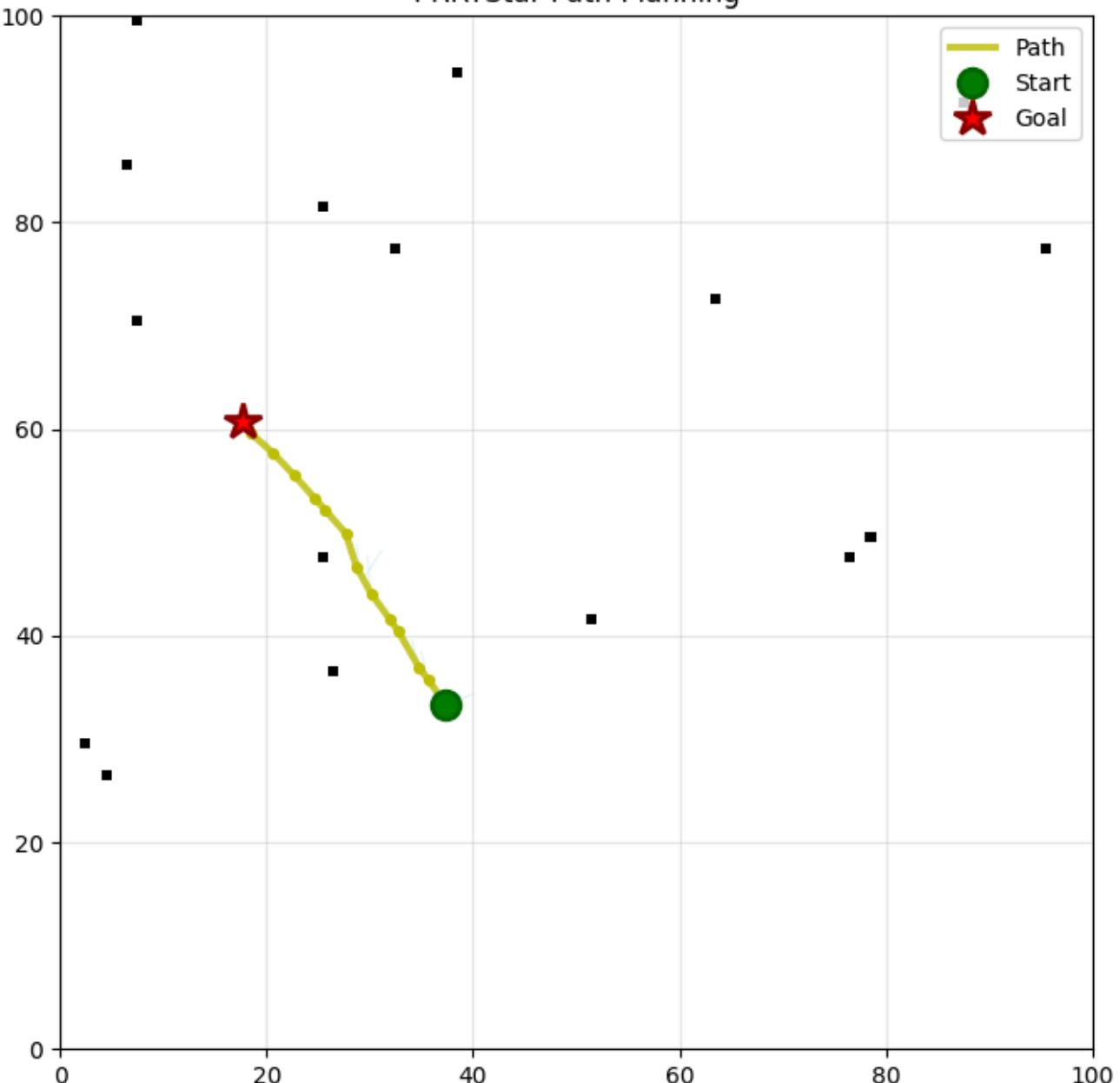
BiRRTStar Path Planning



Path Length: 34.67 | Nodes: 30 | Time: 0.00s

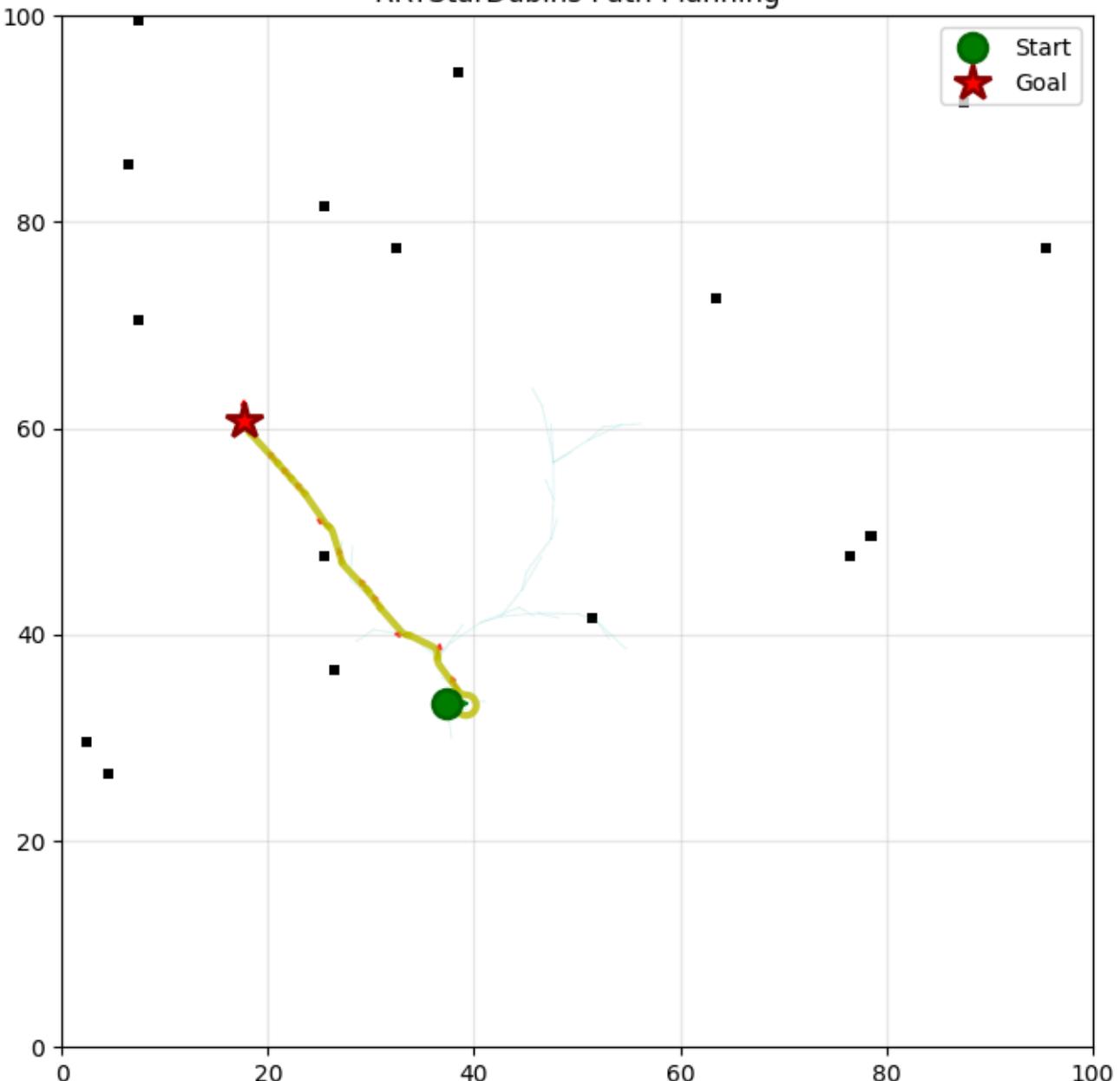
PRRTStar [Early Stop]

PRRTStar Path Planning



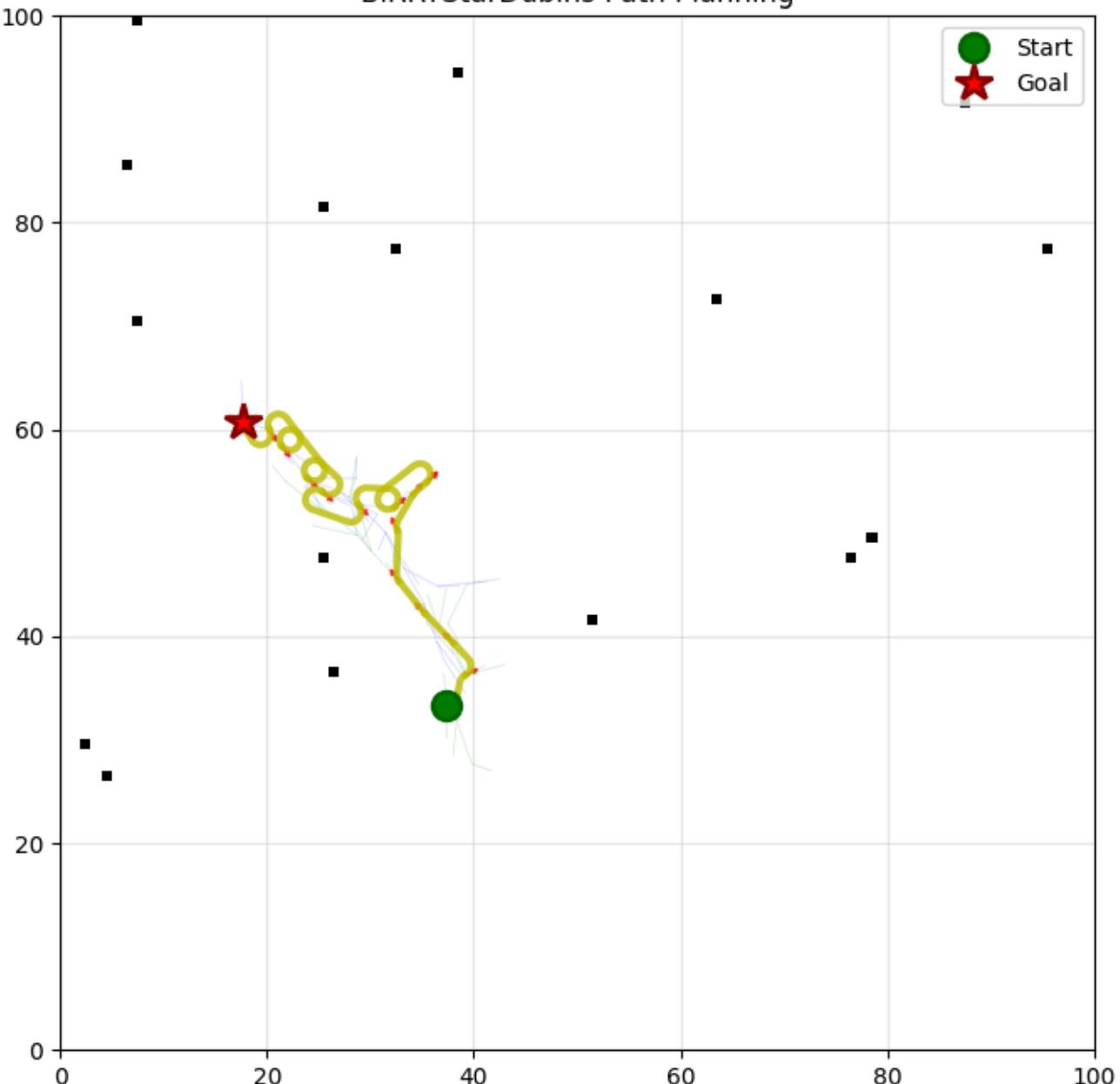
RRTStarDubins [Early Stop]

RRTStarDubins Path Planning



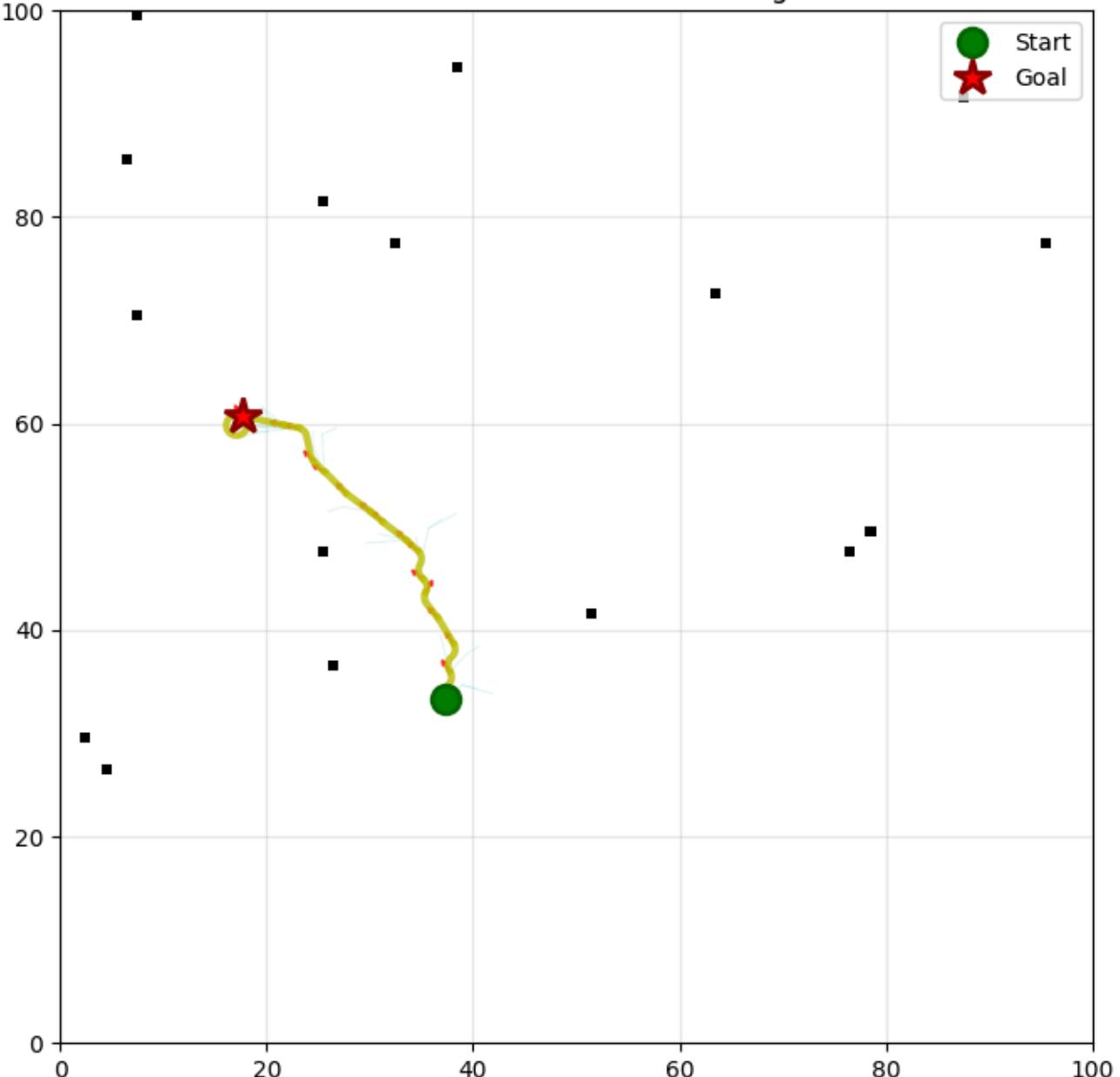
BiRRTStarDubins [Early Stop]

BiRRTStarDubins Path Planning



PRRTStarDubins [Early Stop]

PRRTStarDubins Path Planning



Experiment 2: Scaled Low Density Environment

Compare RRTStar, BiRRTStar, PRRTStar, and Dubins variants in a 200x200 low-density random environment

Environment: RandomEnvironment

Parameters: { "width": 200, "height": 200, "density": 0.1, "seed": 42, "robot_radius":

0.1 }

Start: (59.82262583264242, 19.044591477379196)**Goal:** (25.34657314944875, 36.19809141054817)

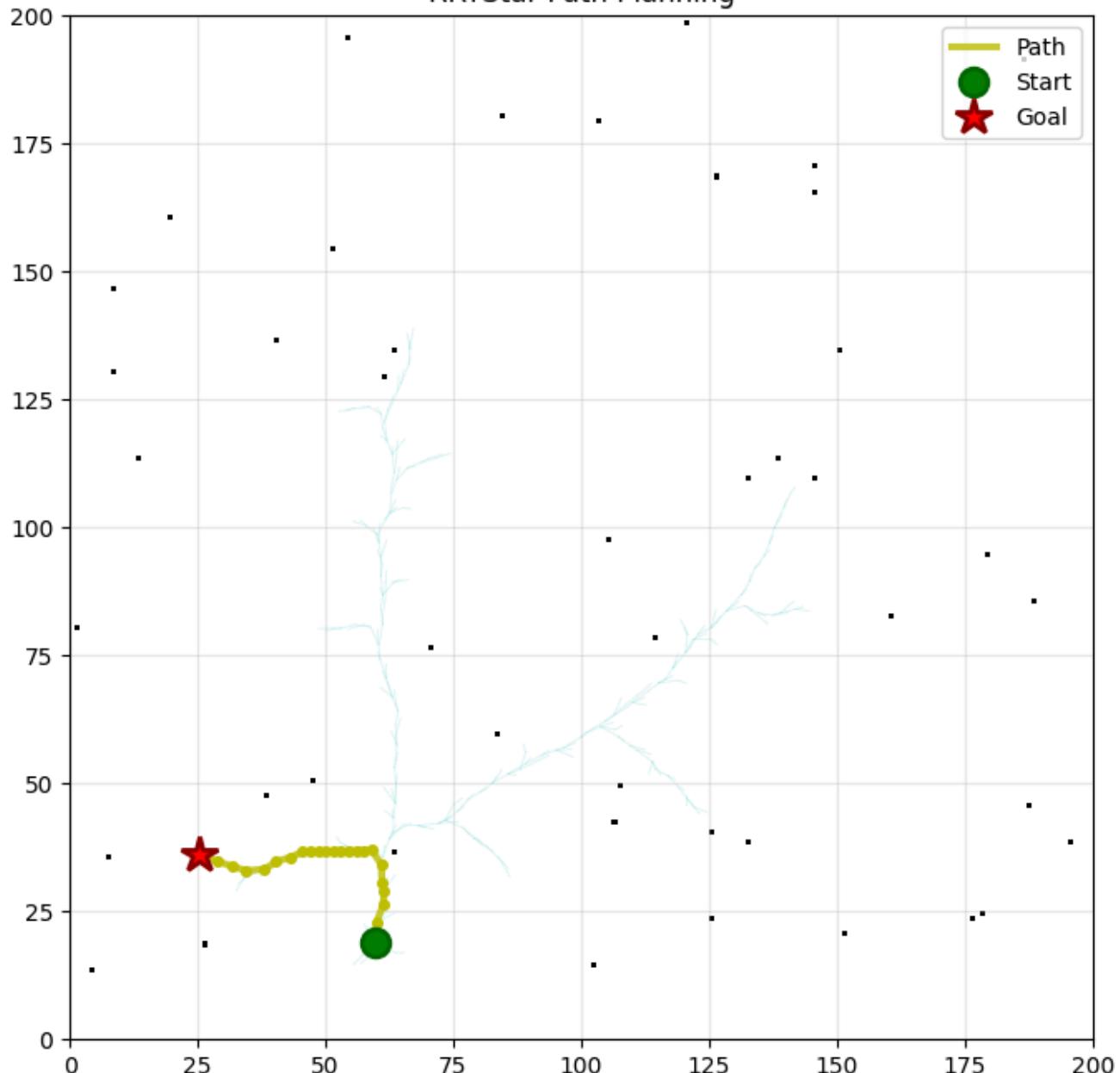
Algorithm Results

Algorithm	Status	Time (s)	Path Length	Nodes	Cost
RRTStar ES	✓ Success	0.08	53.80	311	53.80
BiRRTStar ES	✓ Success	0.00	40.19	32	40.19
PRRTStar ES	✓ Success	0.18	45.00	89	45.00
RRTStarDubins ES	✓ Success	0.02	42.53	122	44.07
BiRRTStarDubins ES	✓ Success	0.00	61.62	104	64.94
PRRTStarDubins ES	✓ Success	0.21	44.43	111	45.34

Path Visualizations

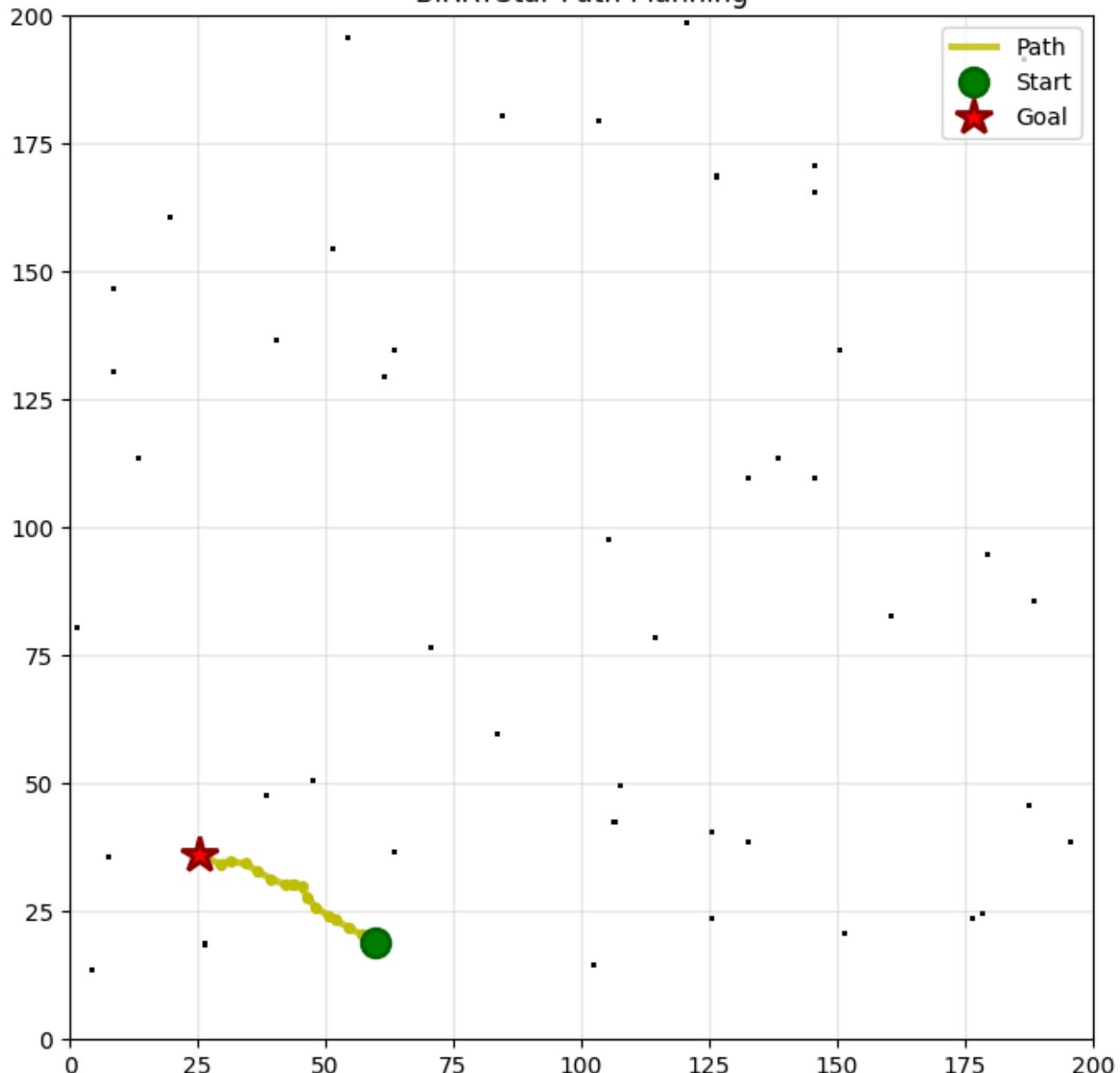
RRTStar [Early Stop]

RRTStar Path Planning



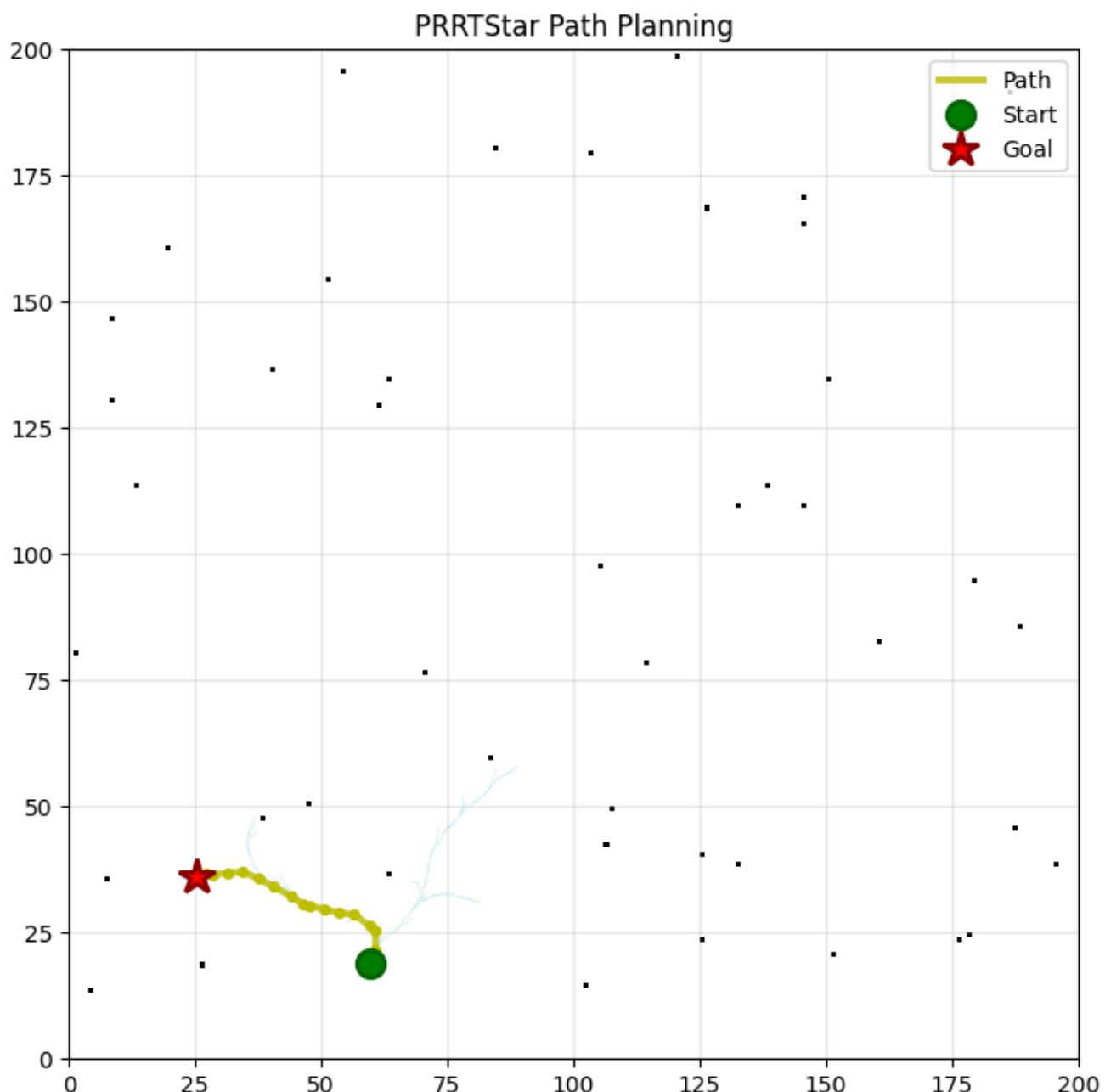
BiRRTStar [Early Stop]

BiRRTStar Path Planning



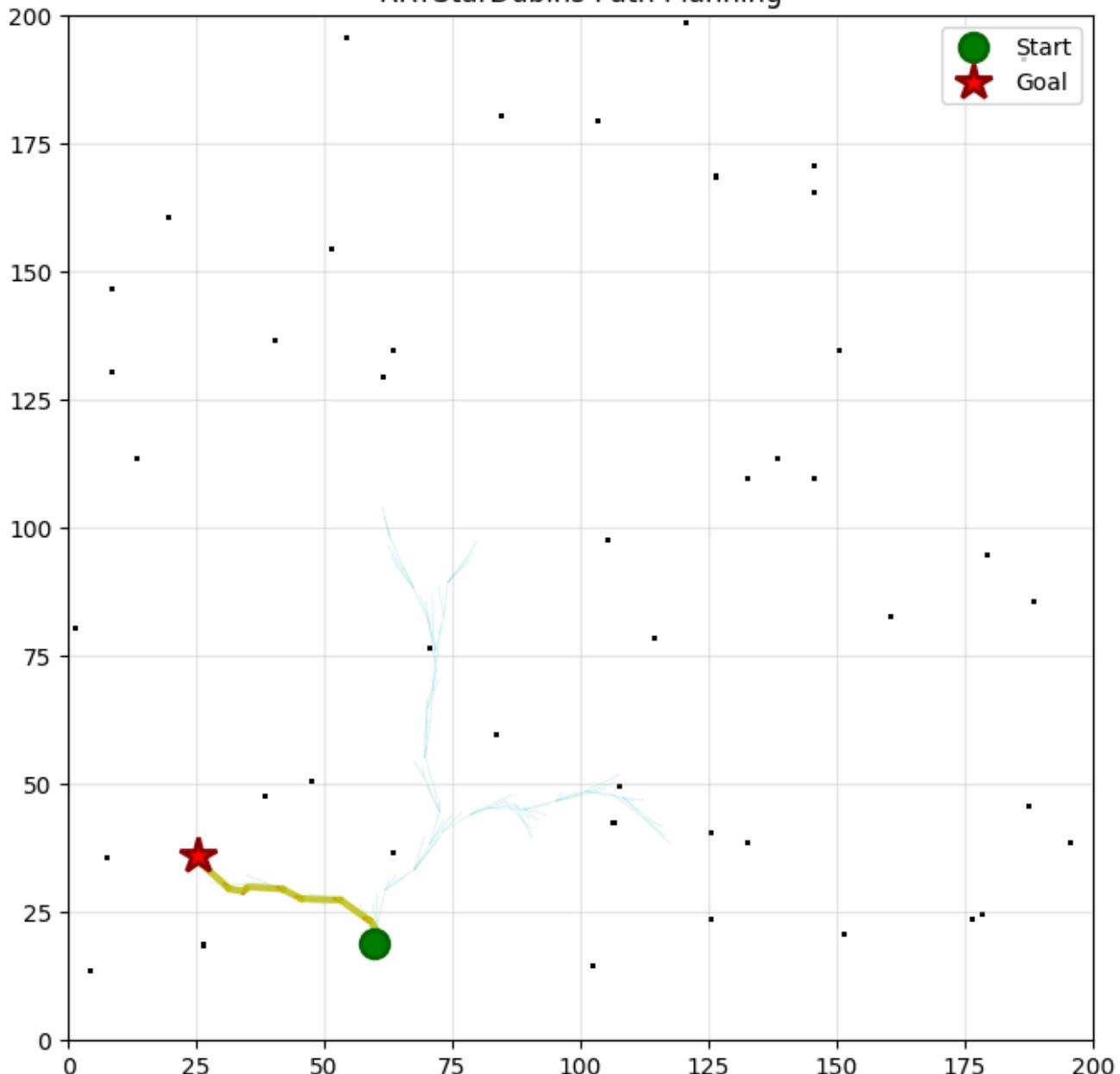
Path Length: 40.19 | Nodes: 32 | Time: 0.00s

PRRTStar [Early Stop]



RRTStarDubins [Early Stop]

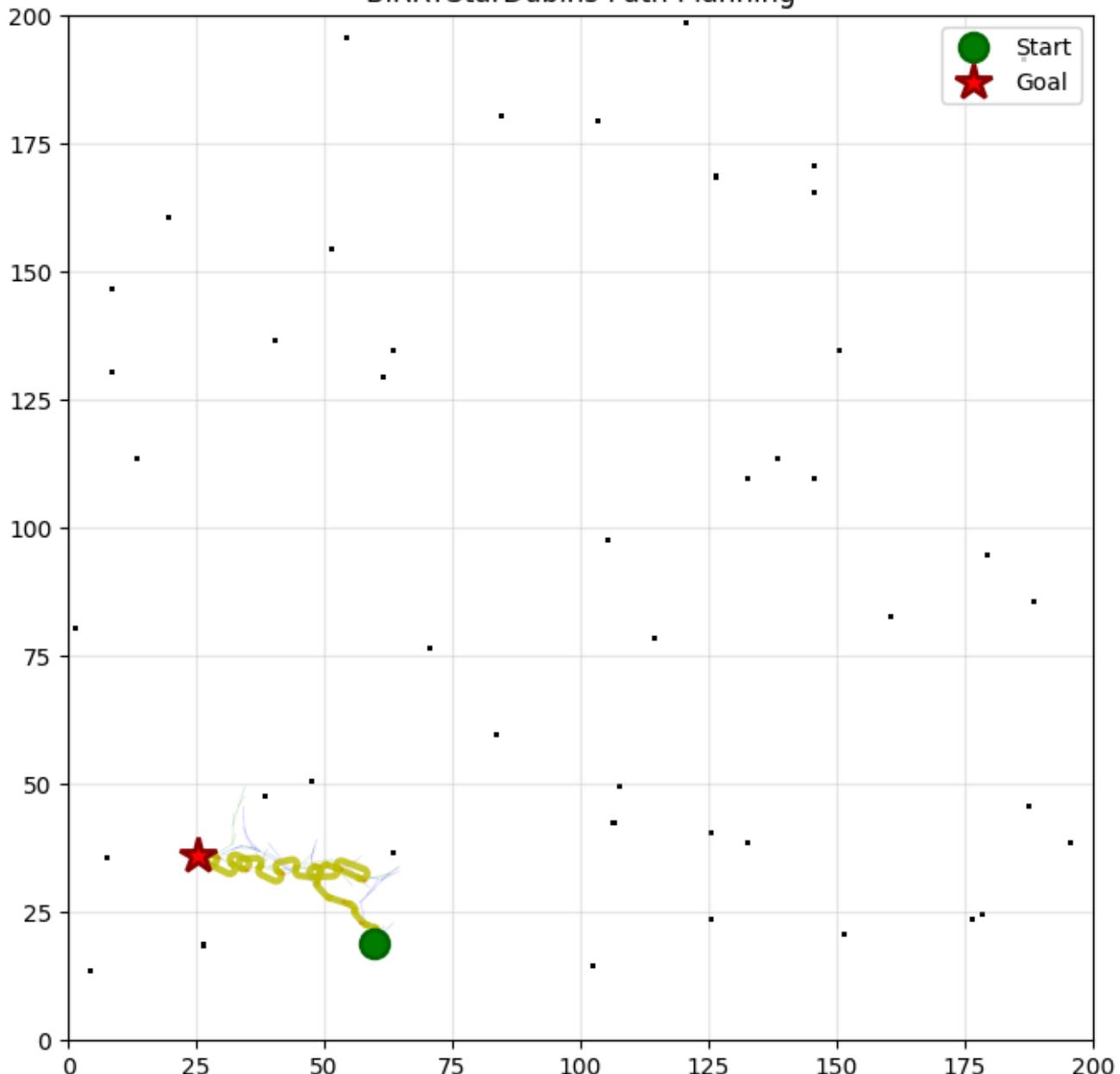
RRTStarDubins Path Planning



Path Length: 42.53 | Nodes: 122 | Time: 0.02s

BiRRTStarDubins [Early Stop]

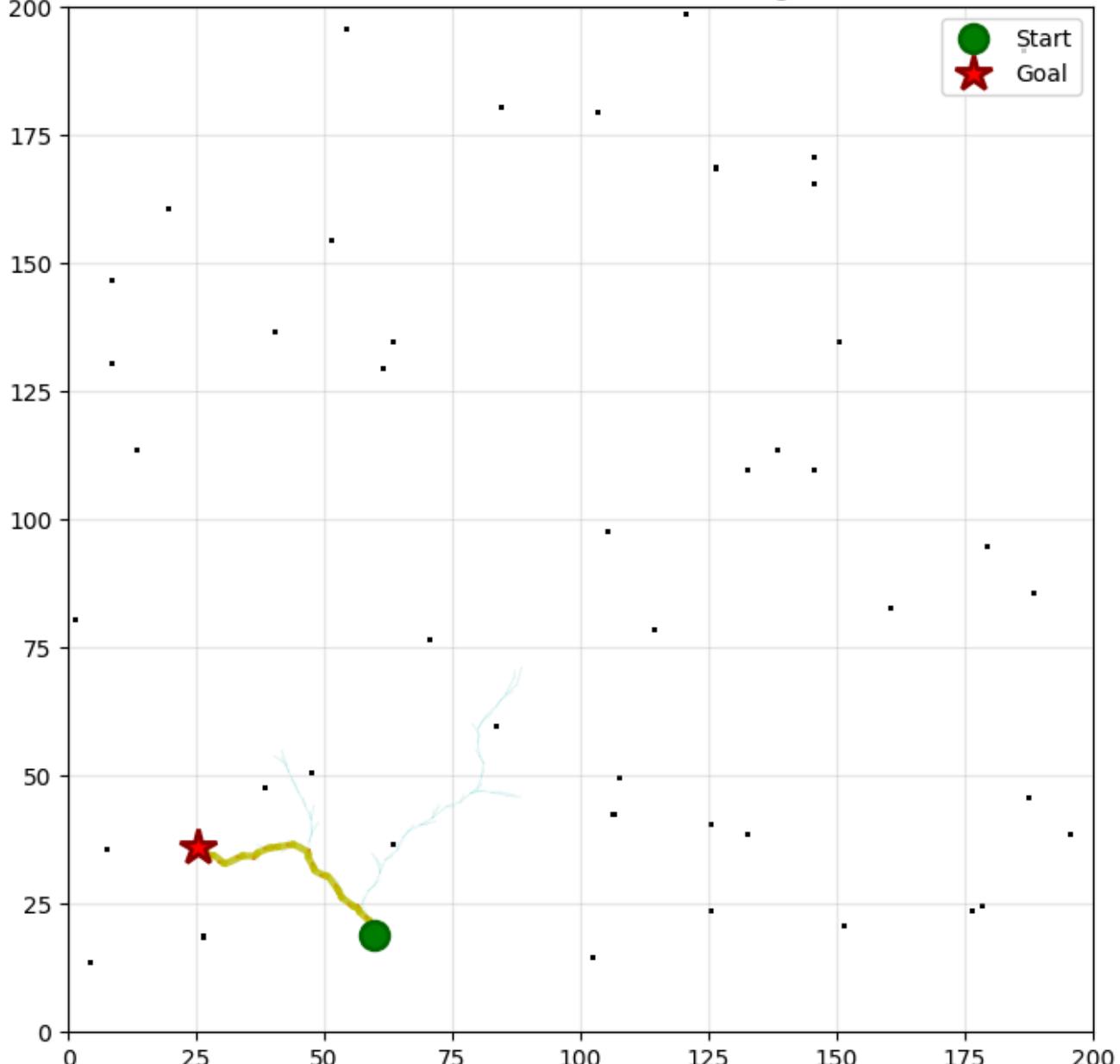
BiRRTStarDubins Path Planning



Path Length: 61.62 | Nodes: 104 | Time: 0.00s

PRRTStarDubins [Early Stop]

PRRTStarDubins Path Planning



Experiment 3: High Density Environment

Compare all 6 algorithms in a high-density random environment

Environment: RandomEnvironment

Parameters: { "width": 100, "height": 100, "density": 5, "seed": 42, "robot_radius": 1.0 }

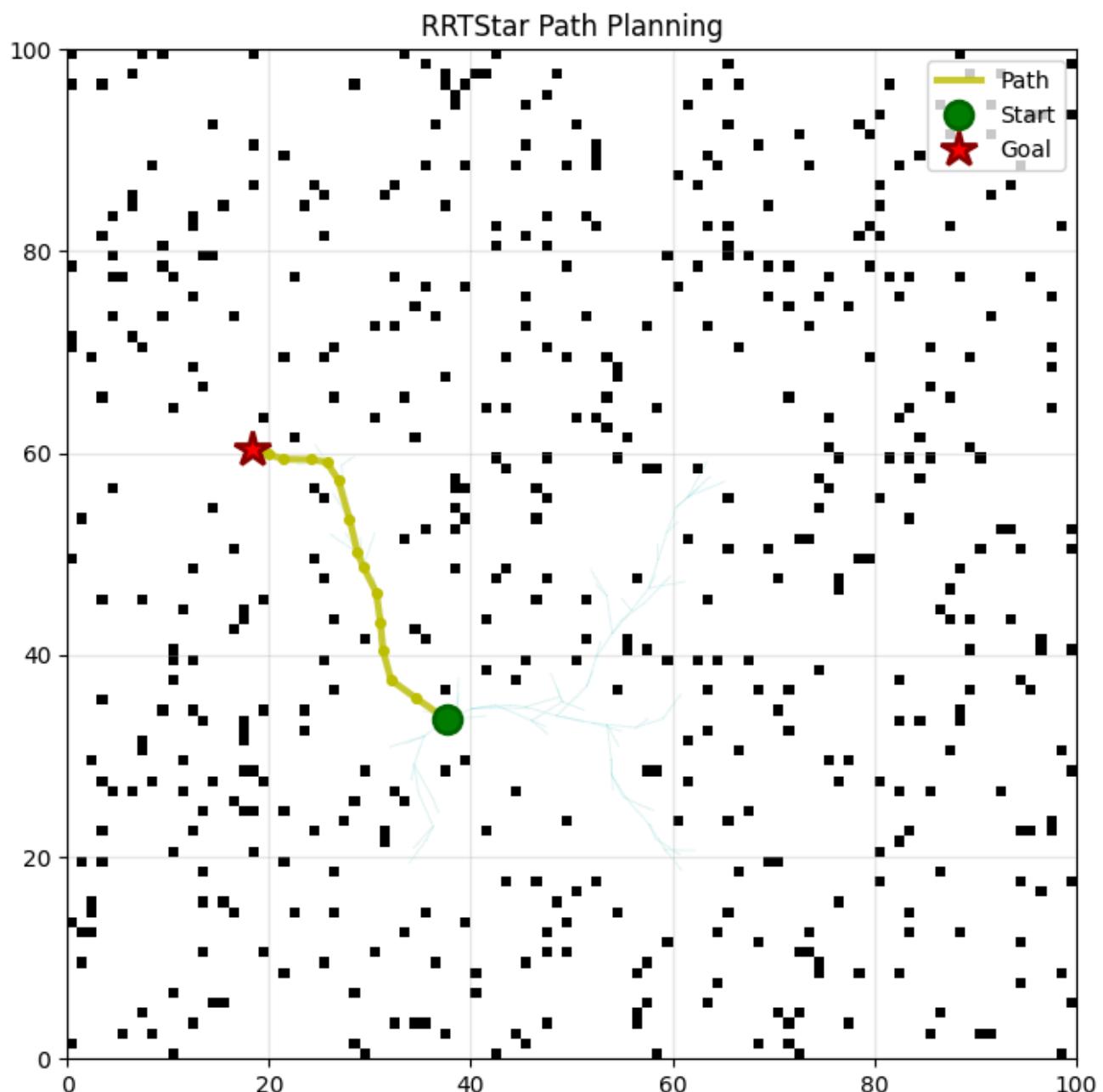
Start: (37.616800209736454, 33.62538543067752)**Goal:** (18.263083425280286, 60.51213366994582)

Algorithm Results

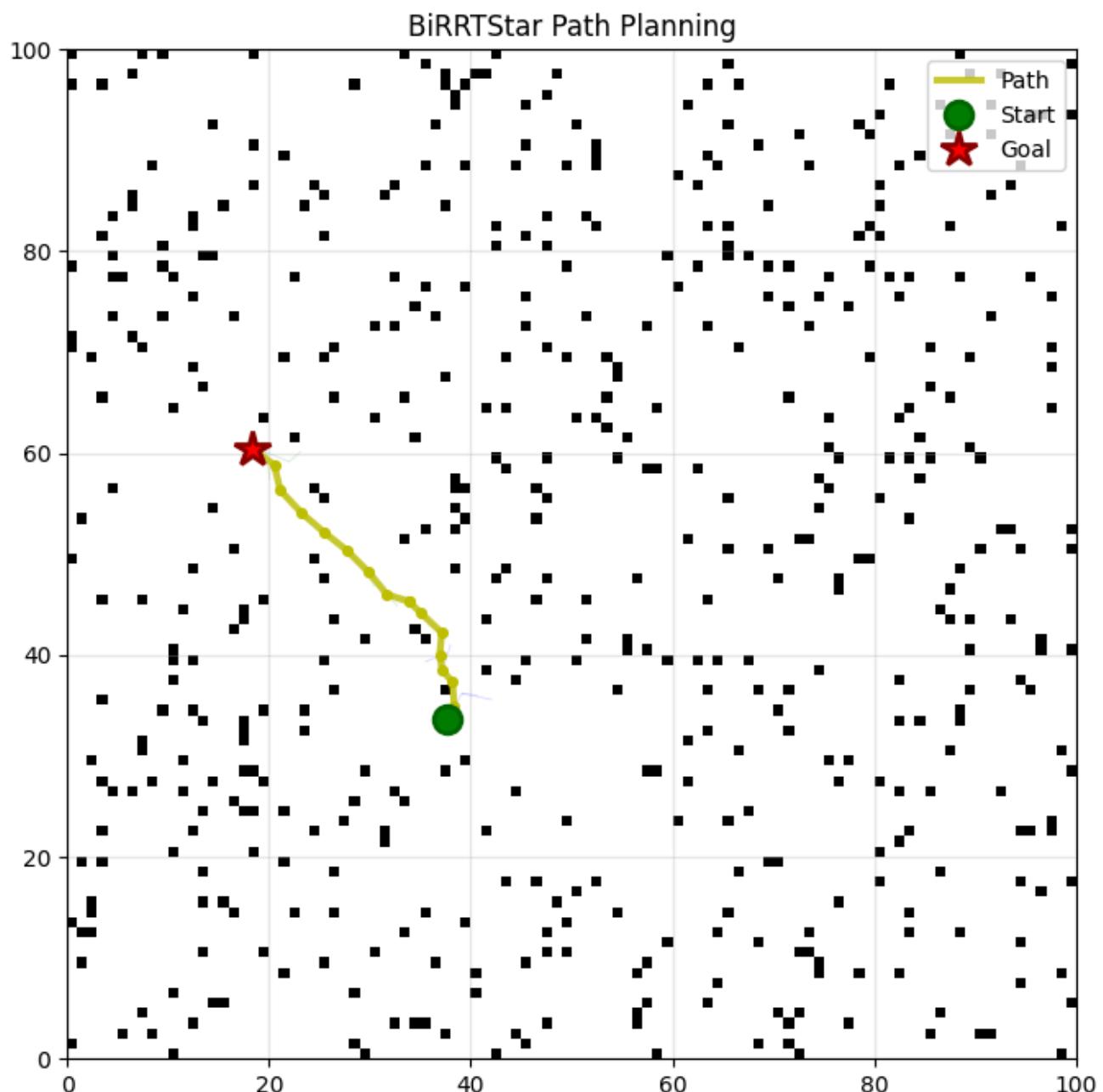
Algorithm	Status	Time (s)	Path Length	Nodes	Cost
RRTStar ES	✓ Success	0.03	37.17	116	37.17
BiRRTStar ES	✓ Success	0.00	36.20	34	36.20
PRRTStar ES	✓ Success	0.53	44.48	402	44.48
RRTStarDubins ES	✓ Success	0.02	39.28	76	47.68
BiRRTStarDubins ES	✓ Success	0.01	40.59	76	41.49
PRRTStarDubins ES	✓ Success	0.10	35.99	124	42.61

Path Visualizations

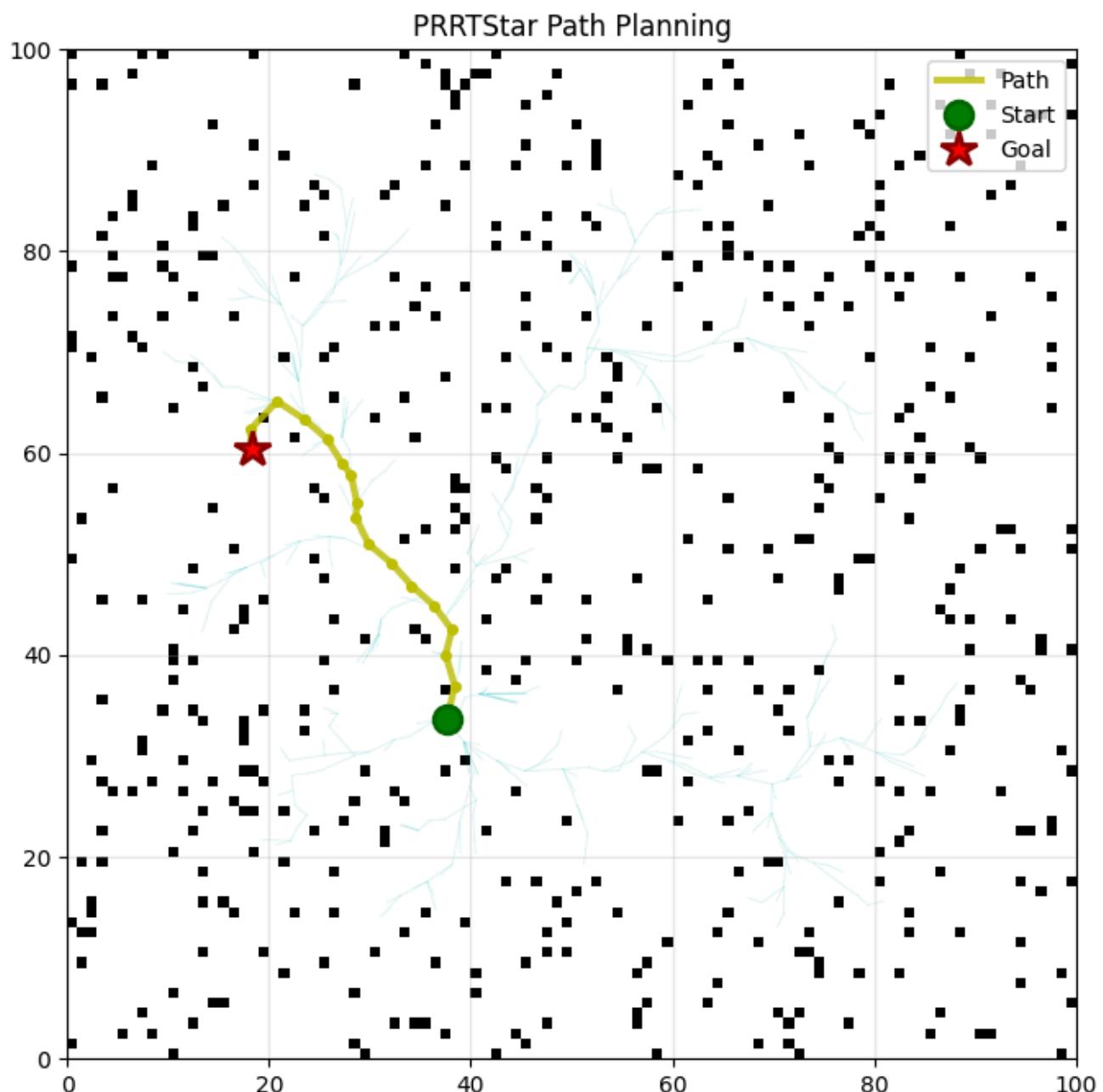
RRTStar [Early Stop]



BiRRTStar [Early Stop]

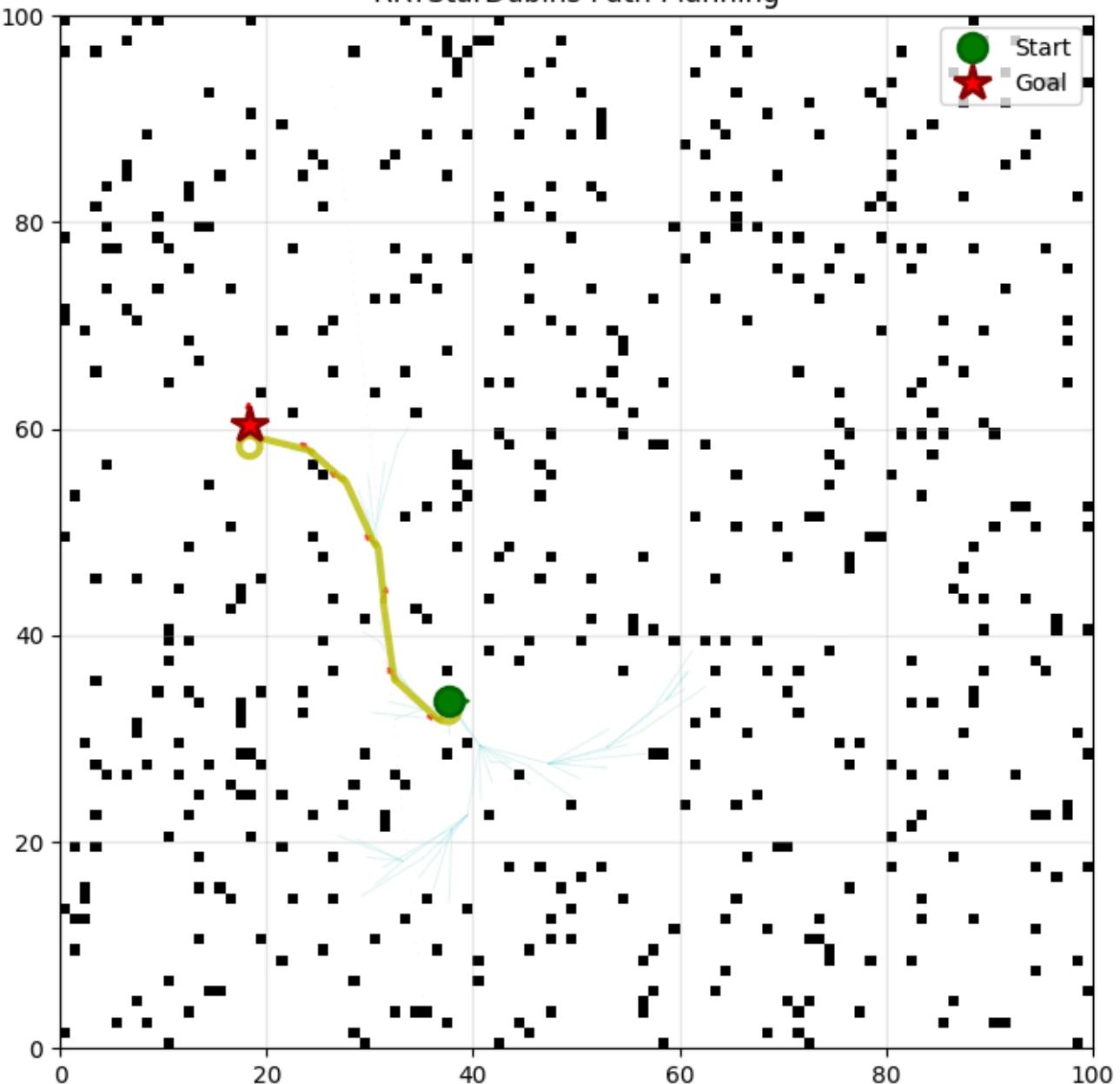


PRRTStar [Early Stop]

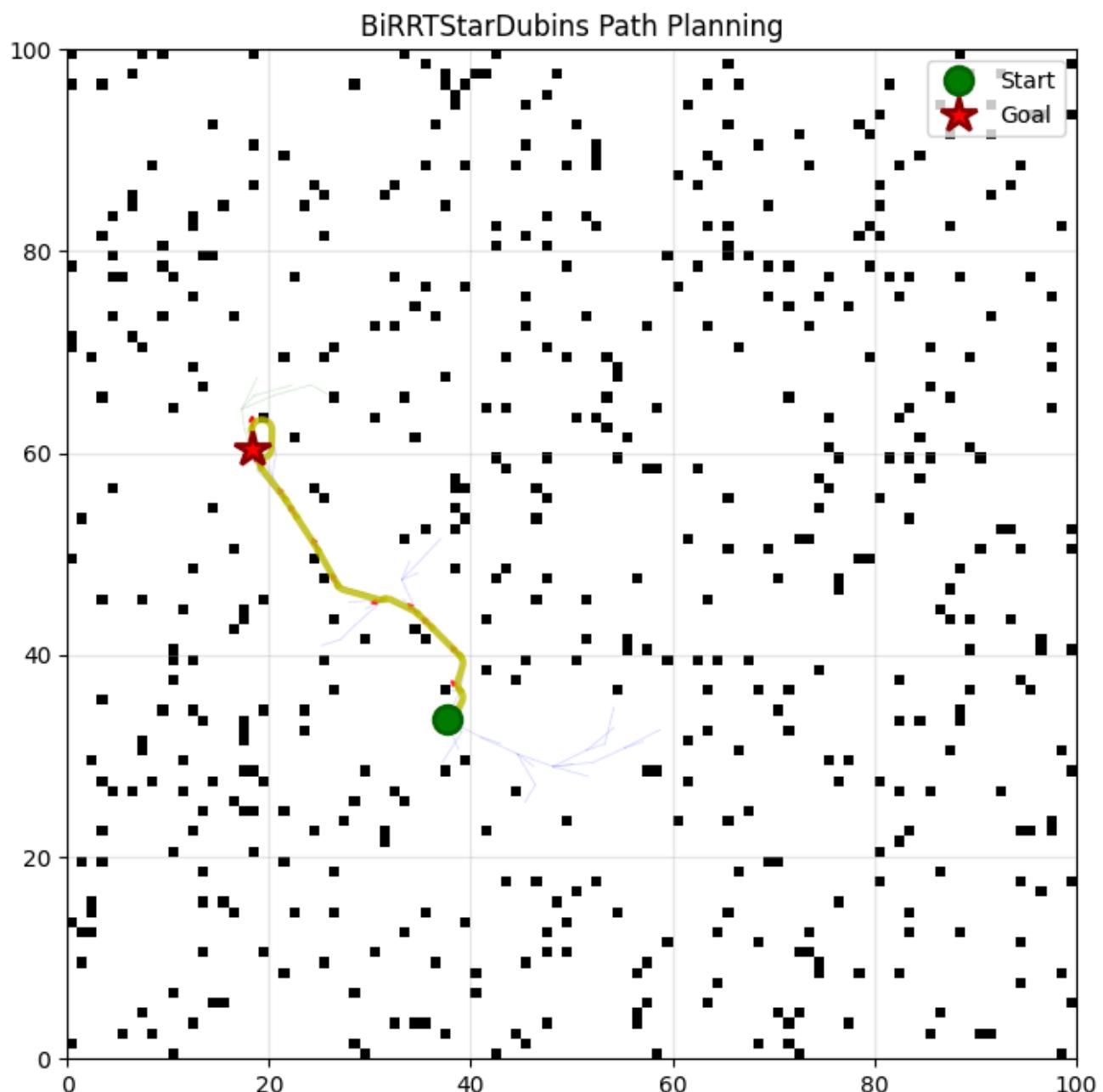


RRTStarDubins [Early Stop]

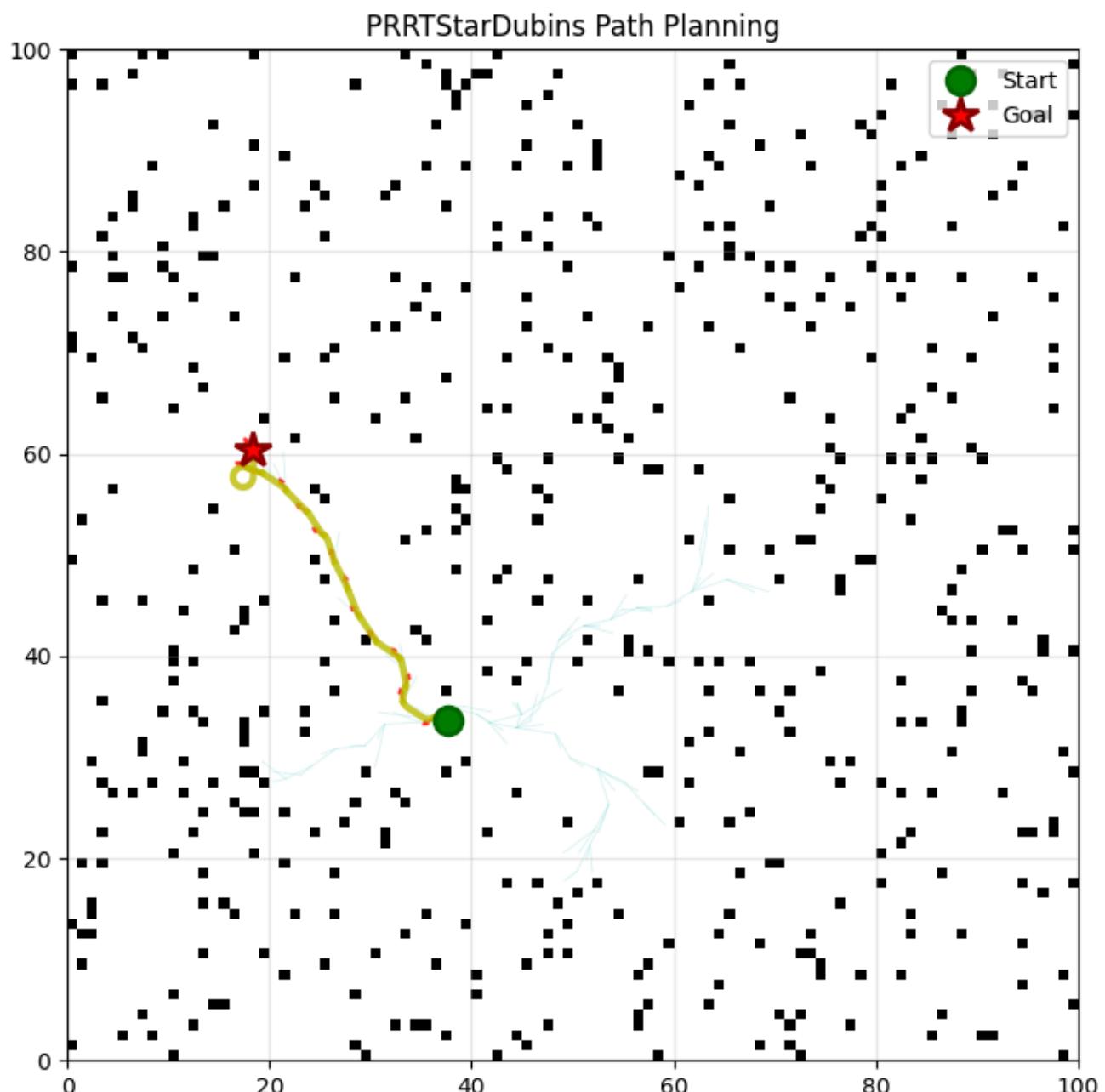
RRTStarDubins Path Planning



BiRRTStarDubins [Early Stop]



PRRTStarDubins [Early Stop]



Experiment 4: Square Corridor - Wide

Compare all algorithms in a wide square corridor environment

Environment: SquareCorridorEnvironment

Parameters: { "width": 100, "height": 100, "corridor_width": 20, "center_margin": 30, "seed": 42, "robot_radius": 1.0 }

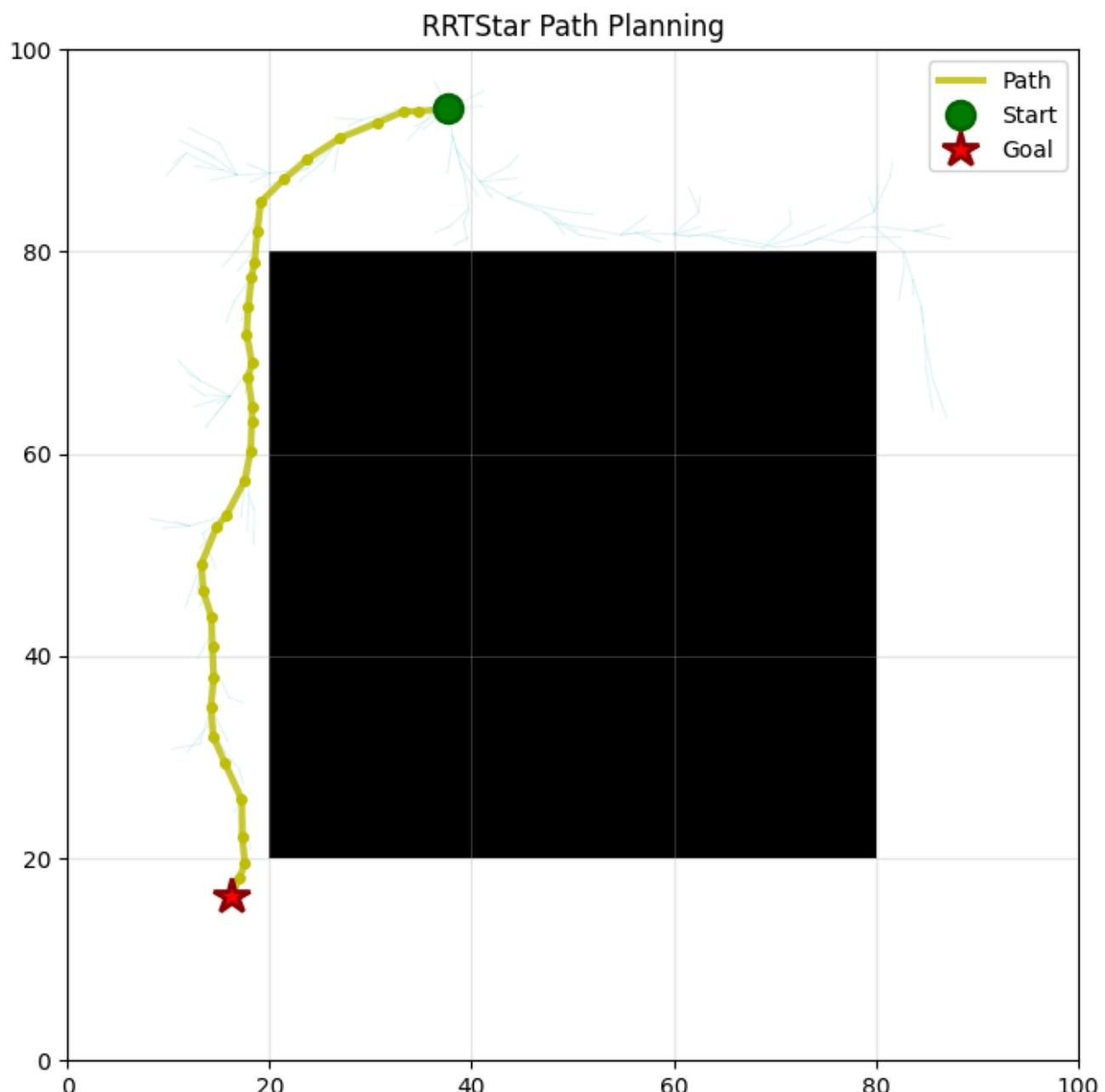
Start: (37.704931647041526, 94.17000202817178)**Goal:** (16.28982676335878, 16.28746299294786)

Algorithm Results

Algorithm	Status	Time (s)	Path Length	Nodes	Cost
RRTStar ES	✓ Success	0.03	92.43	209	92.53
BiRRTStar ES	✓ Success	0.01	93.83	144	93.83
PRRTStar ES	✓ Success	0.62	89.51	348	89.51
RRTStarDubins ES	✓ Success	0.02	96.65	207	109.65
BiRRTStarDubins ES	✓ Success	0.09	103.37	493	119.04
PRRTStarDubins ES	✓ Success	1.03	172.61	898	179.44

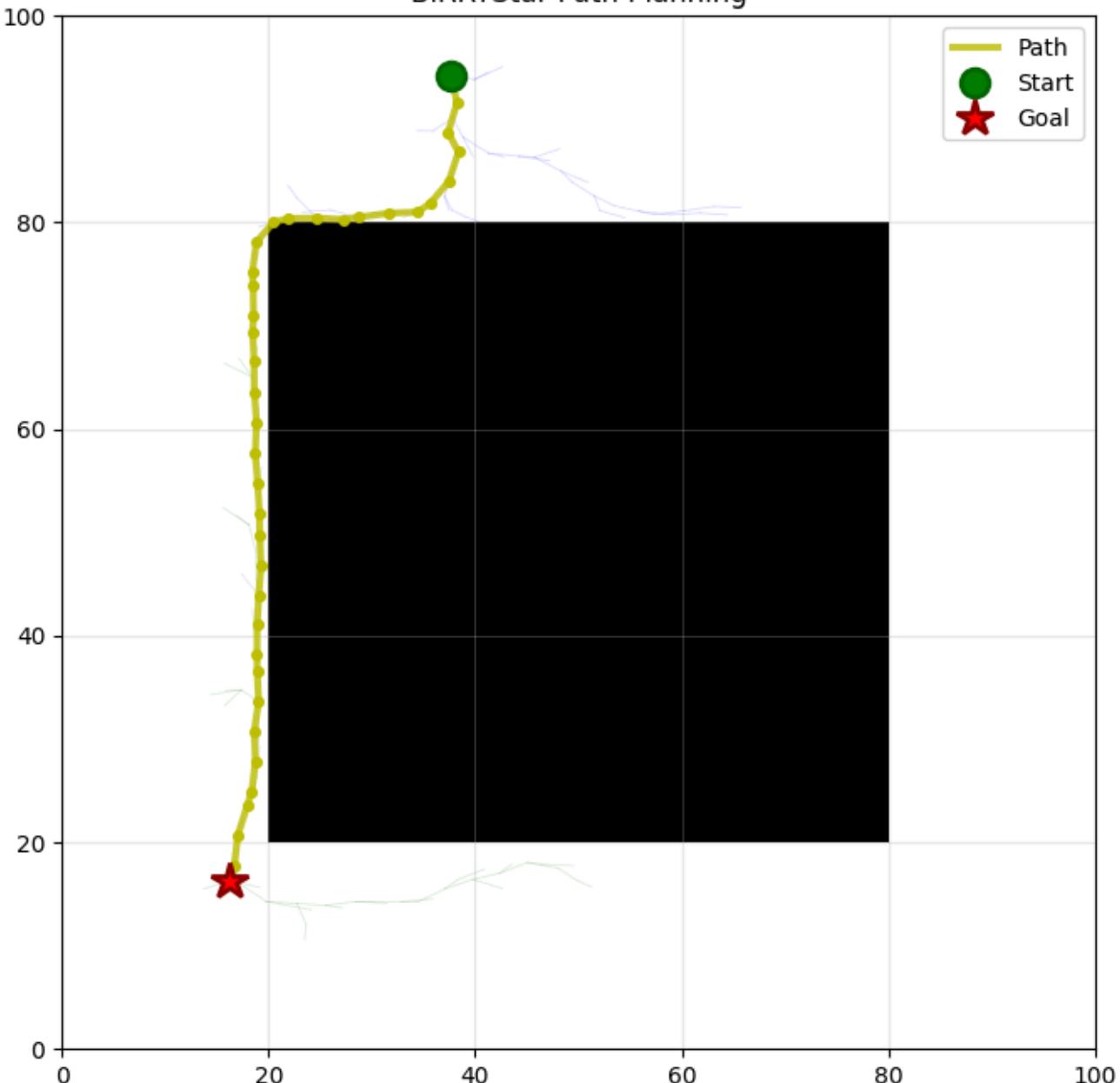
Path Visualizations

RRTStar [Early Stop]



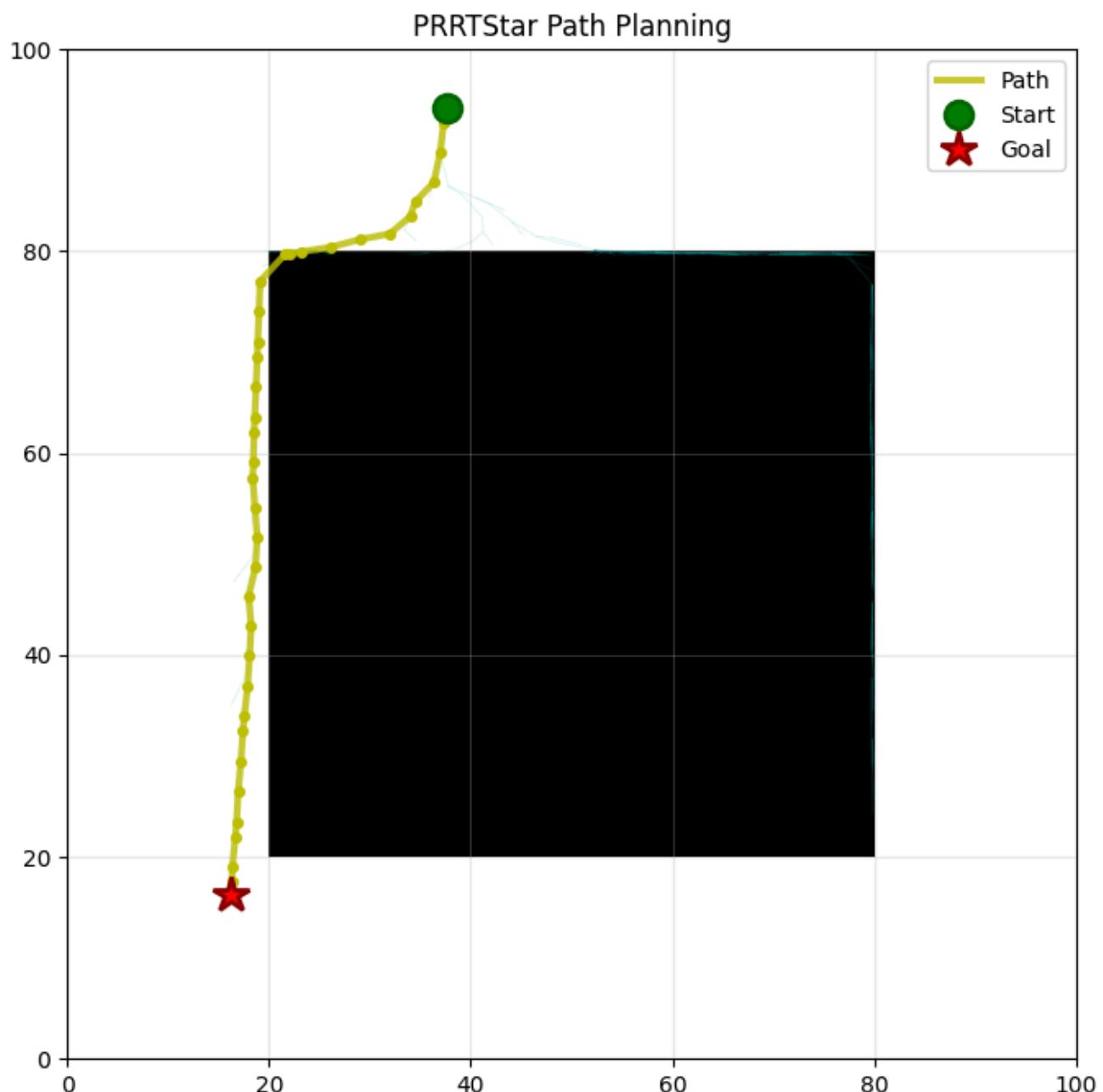
BiRRTStar [Early Stop]

BiRRTStar Path Planning



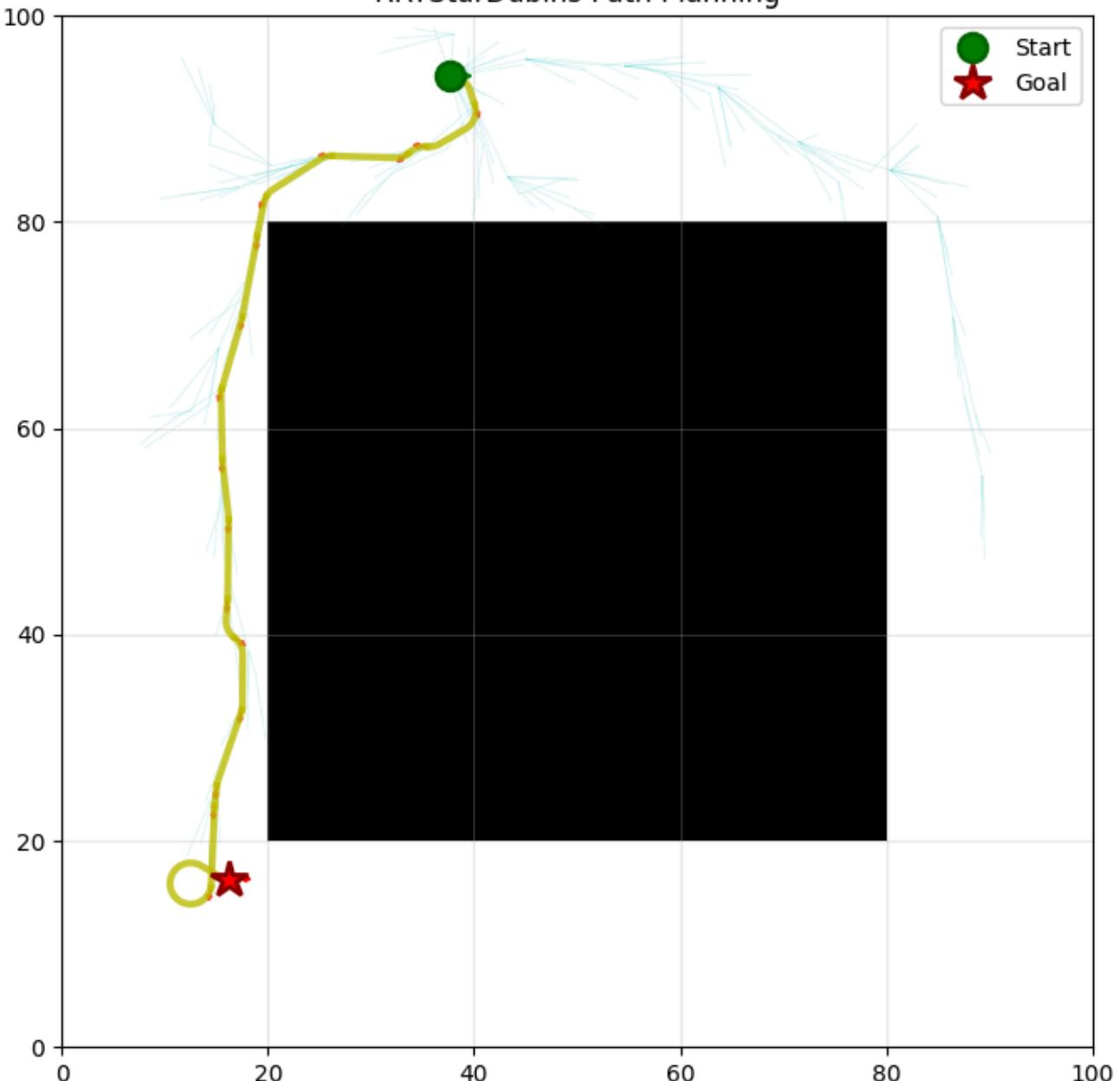
Path Length: 93.83 | Nodes: 144 | Time: 0.01s

PRRTStar [Early Stop]



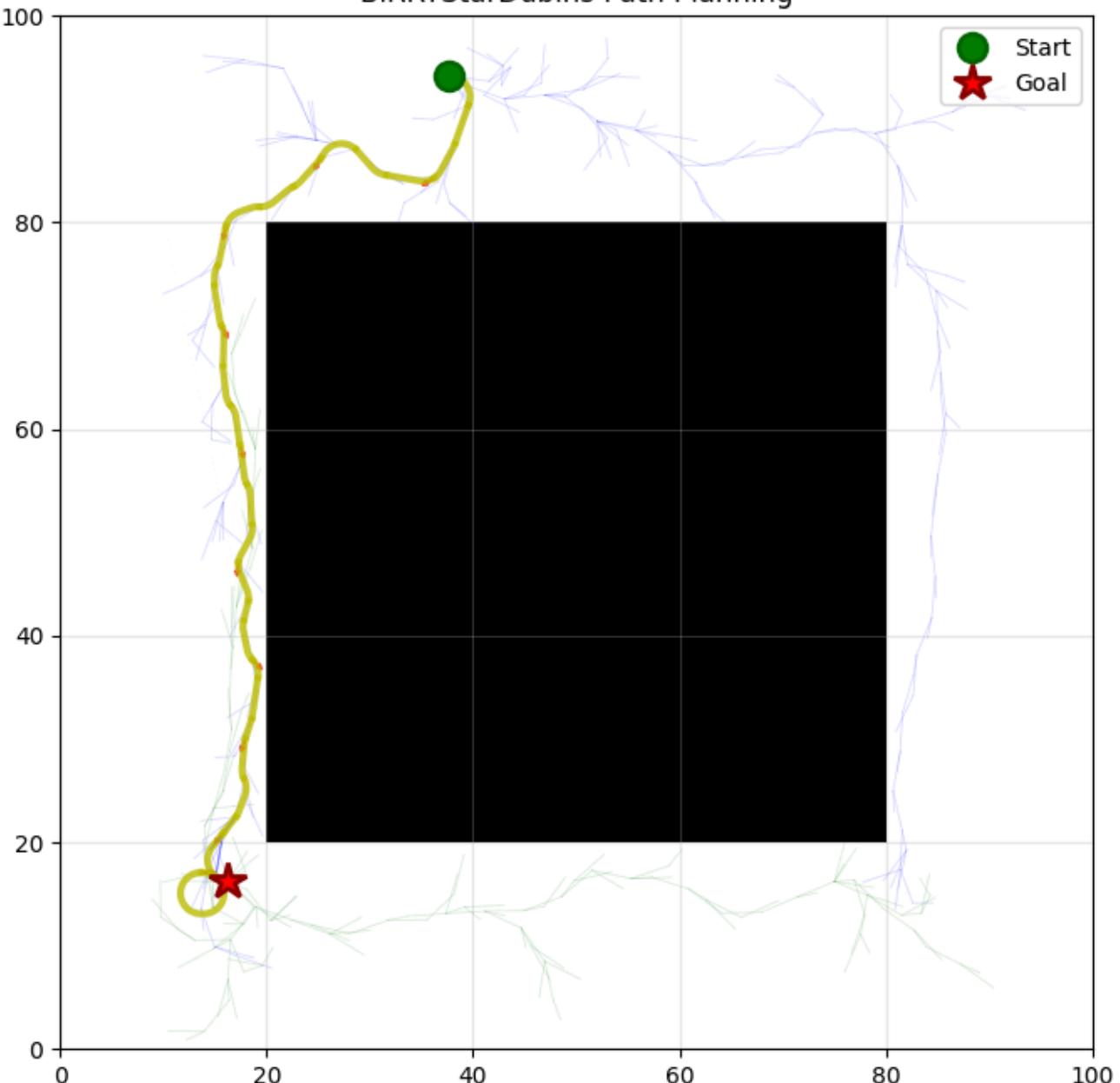
RRTStarDubins [Early Stop]

RRTStarDubins Path Planning



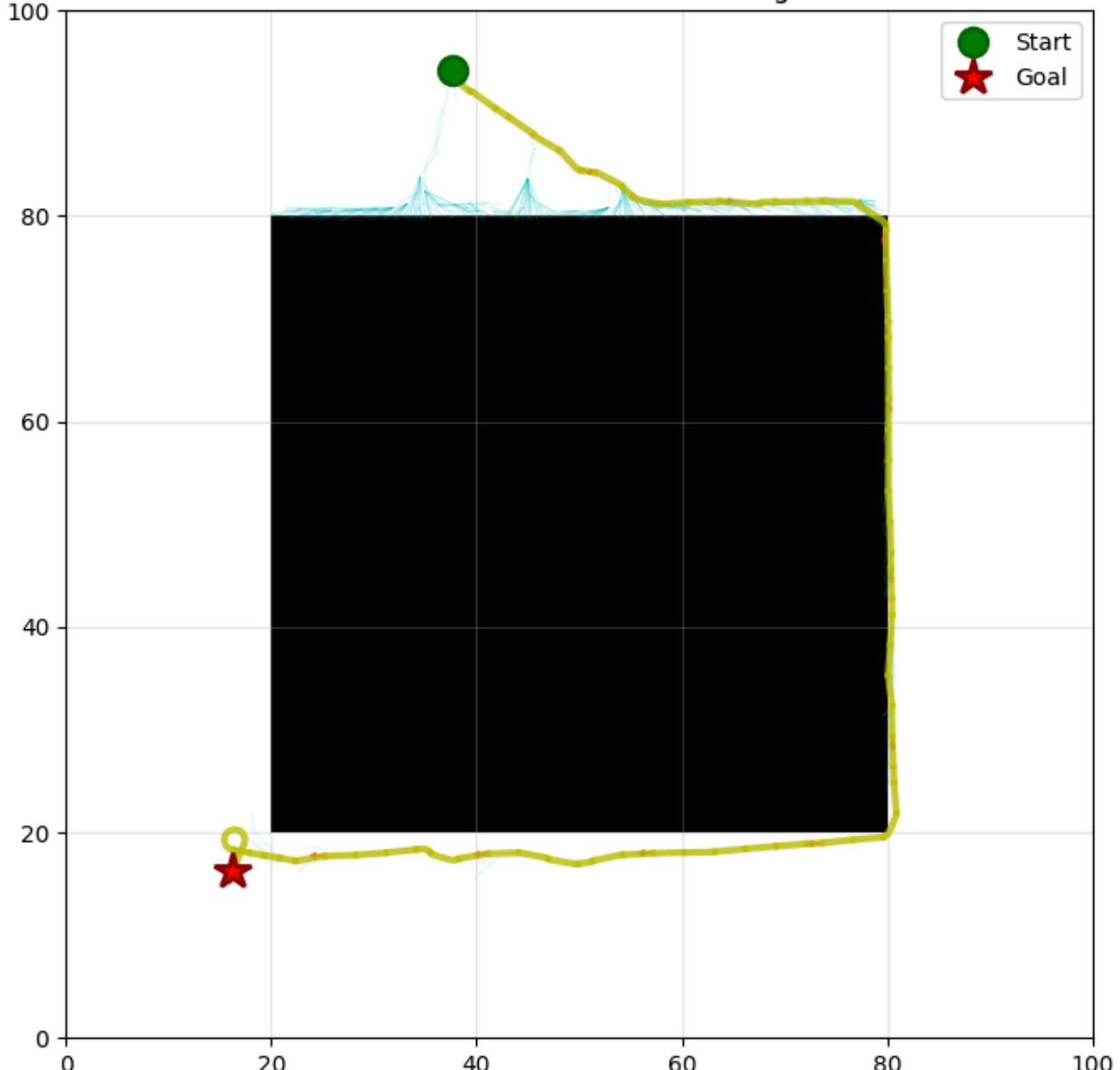
BiRRTStarDubins [Early Stop]

BiRRTStarDubins Path Planning



PRRTStarDubins [Early Stop]

PRRTStarDubins Path Planning



Path Length: 172.61 | Nodes: 898 | Time: 1.03s

Experiment 5: Square Corridor - Tight

Compare all algorithms in a tight square corridor environment

Environment: SquareCorridorEnvironment

Parameters: { "width": 100, "height": 100, "corridor_width": 8, "center_margin": 30, "seed": 42, "robot_radius": 1.0 }

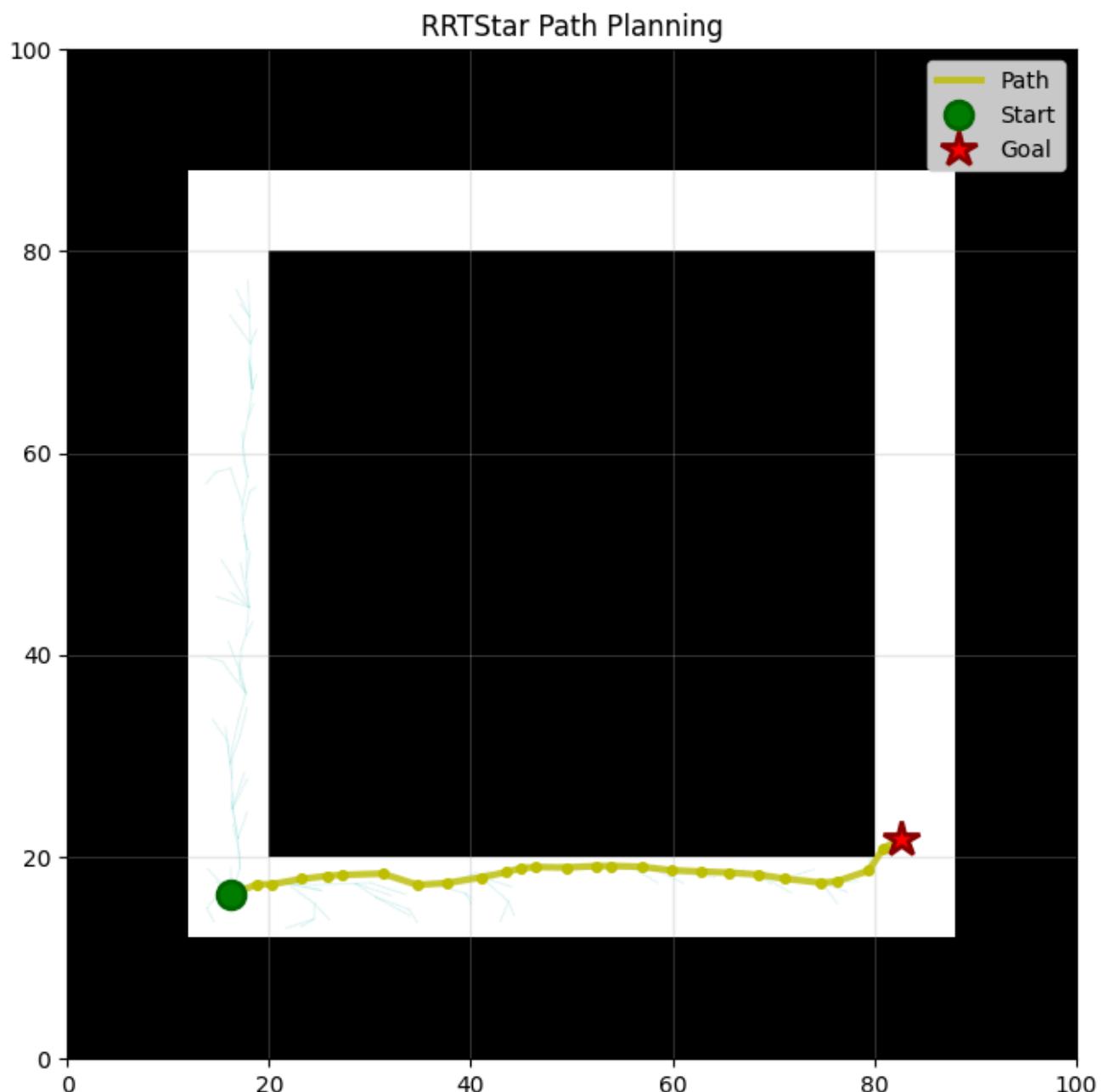
Start: (16.28982676335878, 16.28746299294786)**Goal:** (82.57937879844133, 21.809232846471062)

Algorithm Results

Algorithm	Status	Time (s)	Path Length	Nodes	Cost
RRTStar ES	✓ Success	0.02	68.60	150	68.60
BiRRTStar ES	✓ Success	0.01	68.20	140	68.20
PRRTStar ES	✓ Success	0.10	69.09	141	69.09
RRTStarDubins ES	✓ Success	0.04	68.30	237	77.83
BiRRTStarDubins ES	✓ Success	0.01	78.09	164	79.68
PRRTStarDubins ES	✓ Success	0.41	67.69	392	68.17

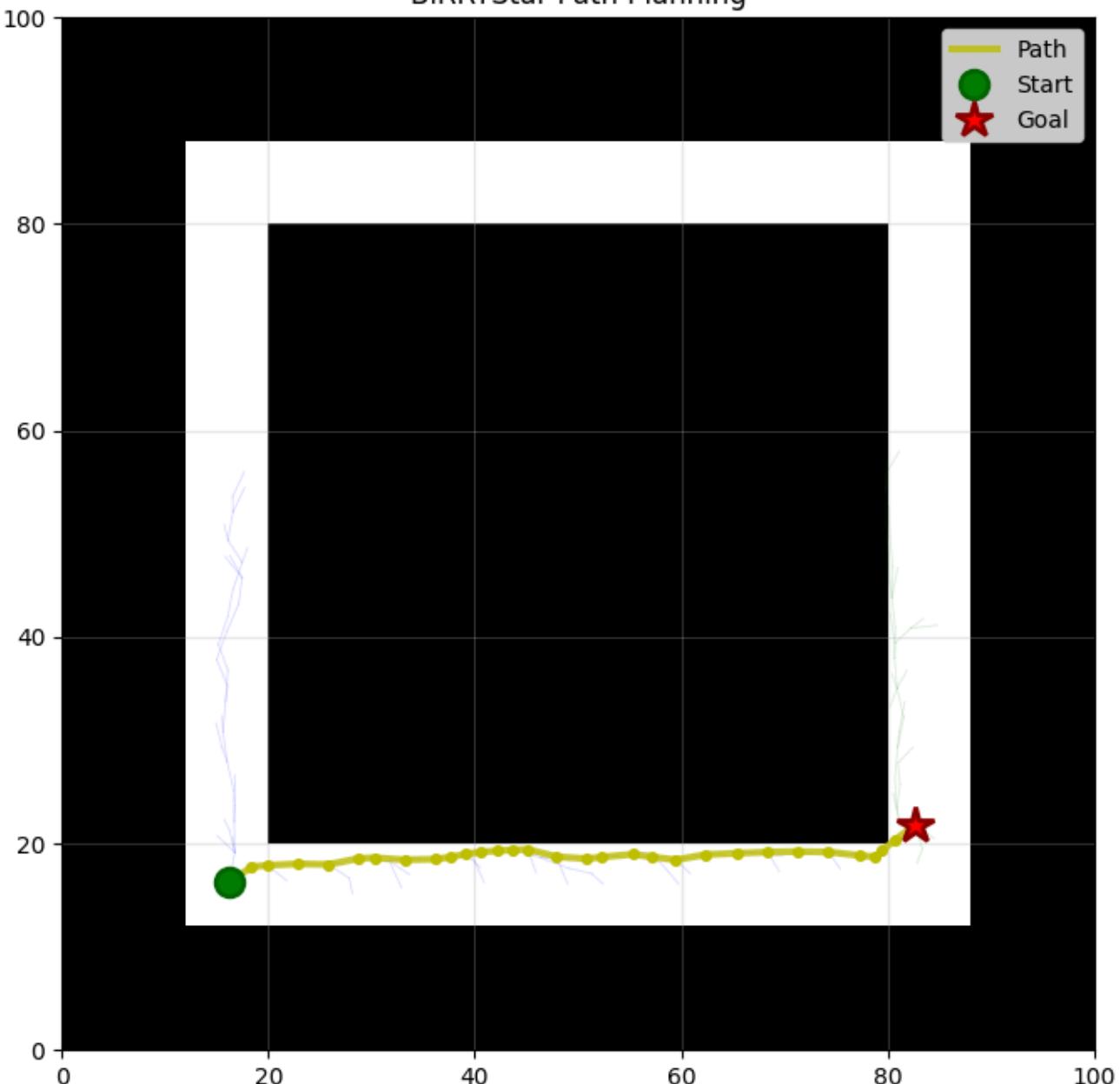
Path Visualizations

RRTStar [Early Stop]

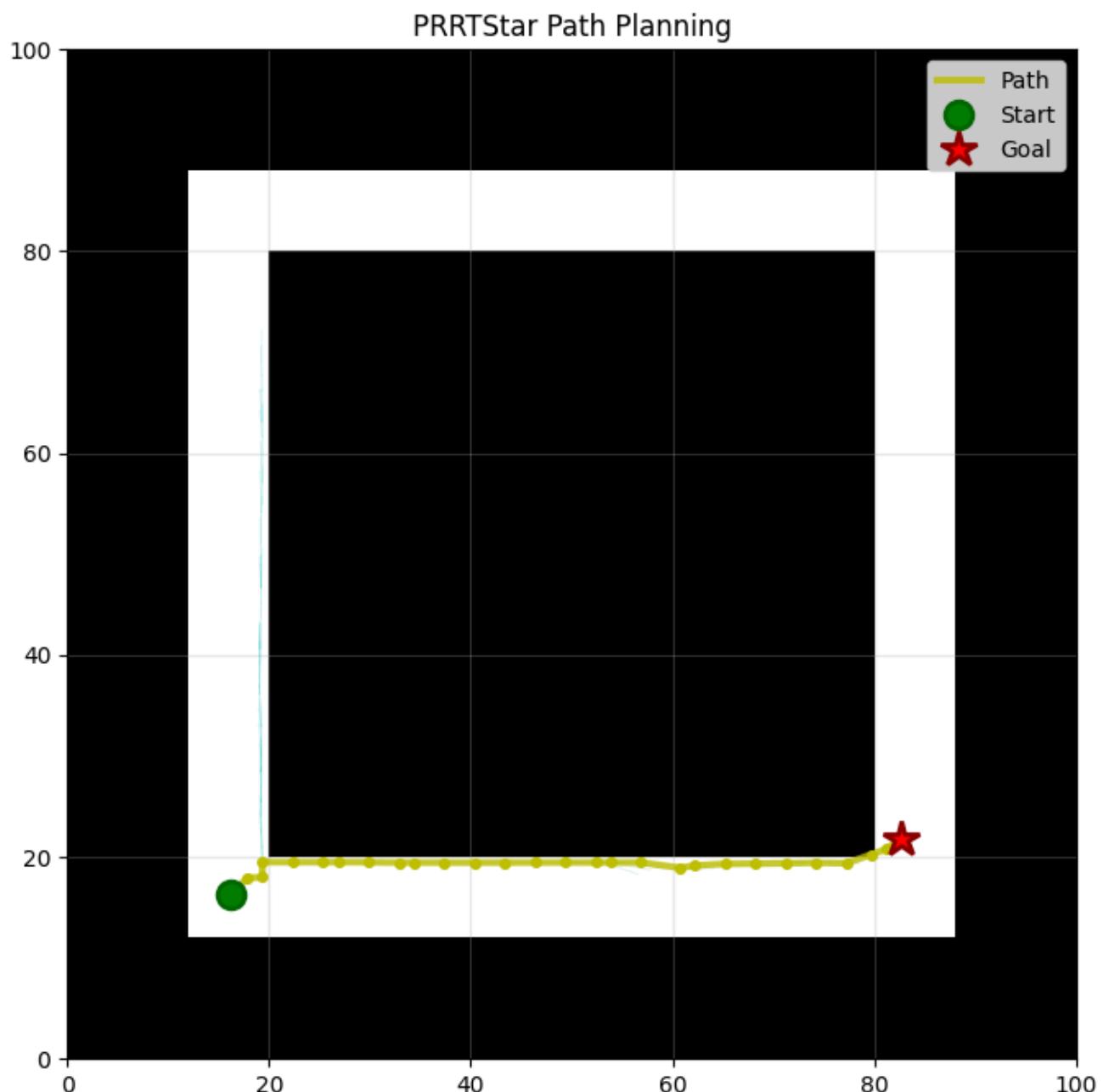


BiRRTStar [Early Stop]

BiRRTStar Path Planning

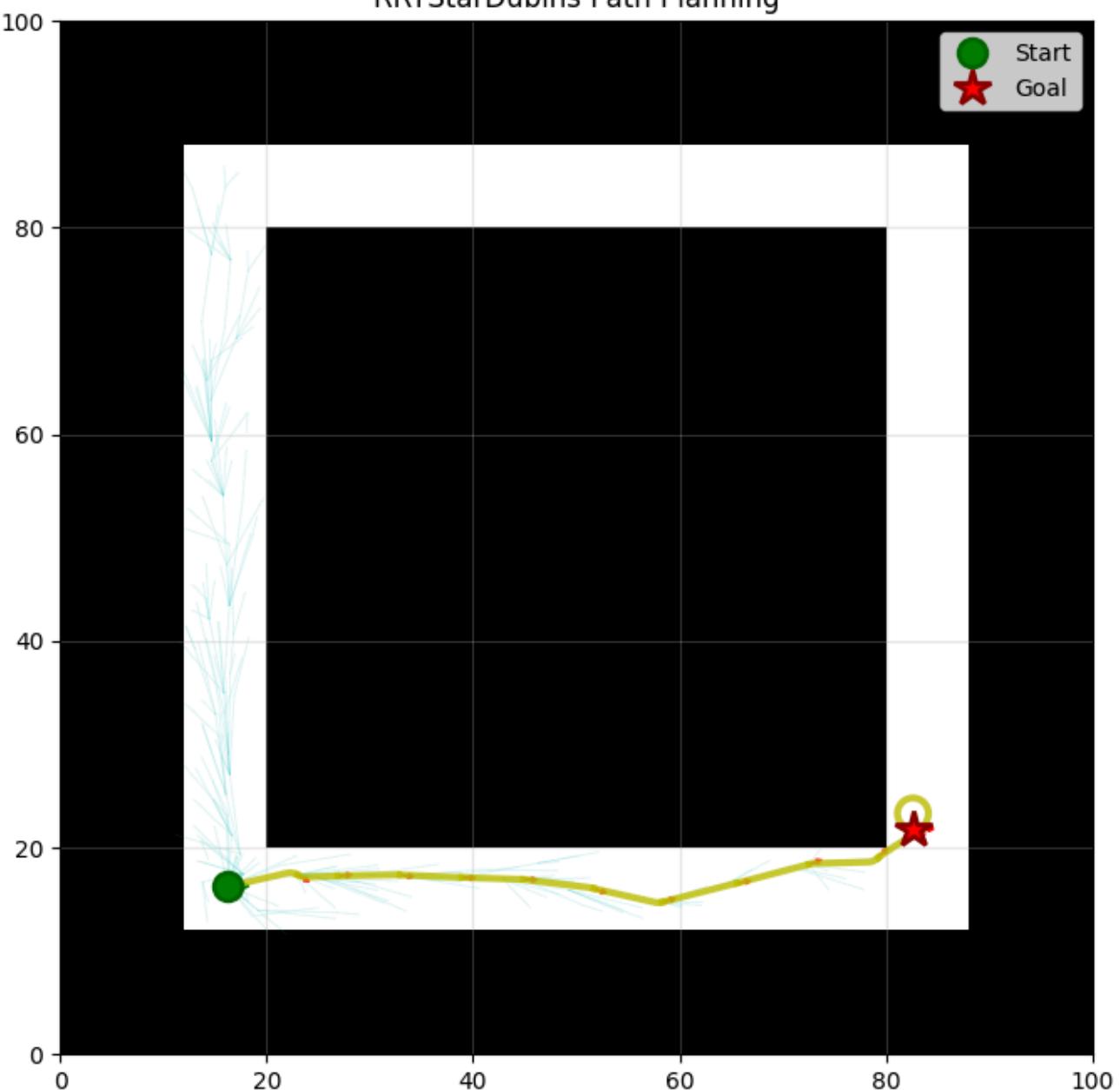


PRRTStar [Early Stop]



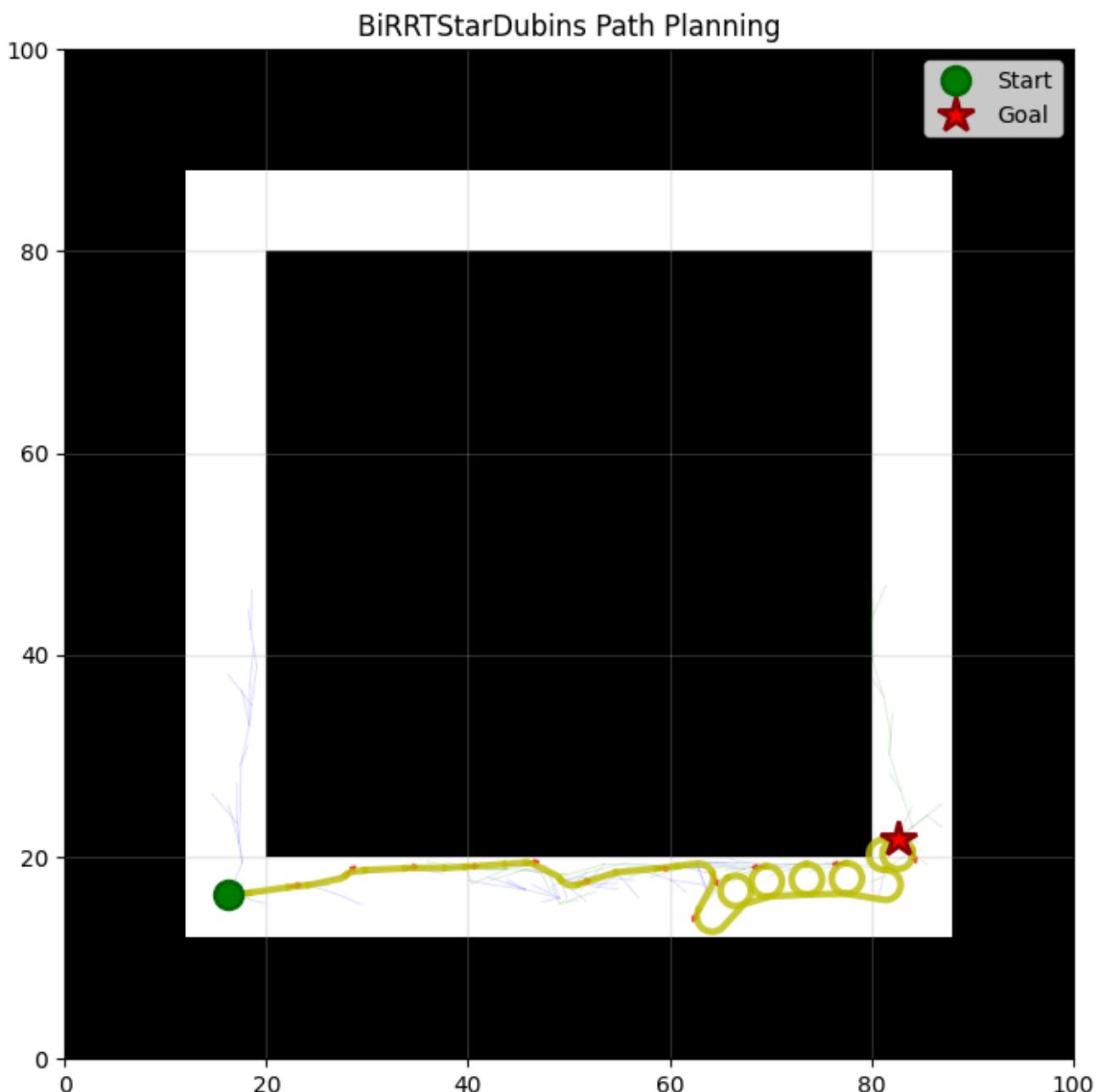
RRTStarDubins [Early Stop]

RRTStarDubins Path Planning



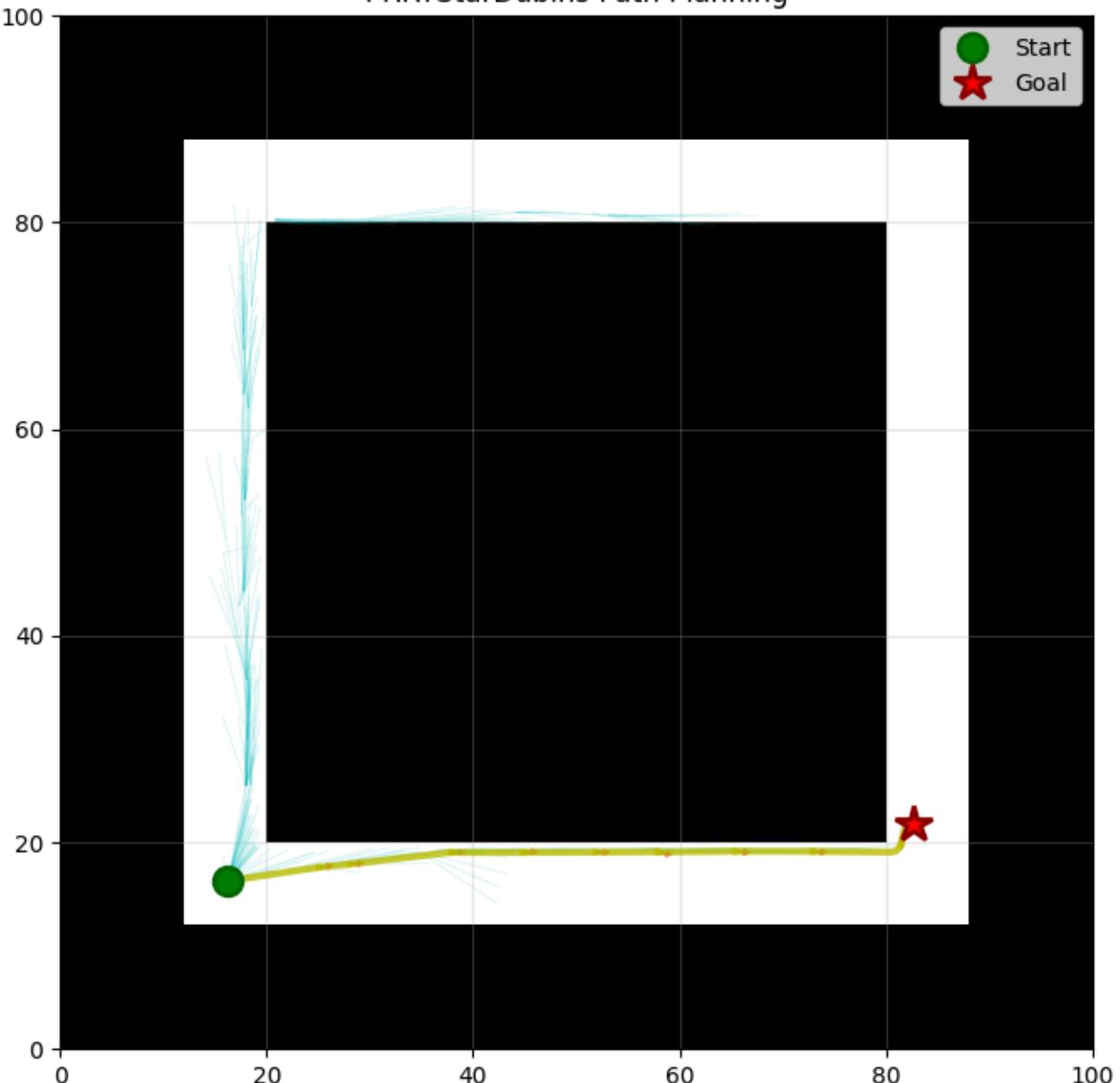
Path Length: 68.30 | Nodes: 237 | Time: 0.04s

BiRRTStarDubins [Early Stop]



PRRTStarDubins [Early Stop]

PRRTStarDubins Path Planning



Overall Algorithm Performance

Algorithm	Success Rate	Avg Time (s)	Avg Path Length	Avg Nodes
BiRRTStar	5/5 (100.0%)	0.01	54.62	76

Algorithm	Success Rate	Avg Time (s)	Avg Path Length	Avg Nodes
BiRRTStarDubins	5/5 (100.0%)	0.02	66.15	185
PRRTStar	5/5 (100.0%)	0.30	56.43	202
PRRTStarDubins	5/5 (100.0%)	0.37	71.66	316
RRTStar	5/5 (100.0%)	0.03	57.28	178
RRTStarDubins	5/5 (100.0%)	0.02	56.40	140

Generated by Path Planning Experiment Framework

Configuration: experiments.json | Timestamp: 20251209_120334