



# 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

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## 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)

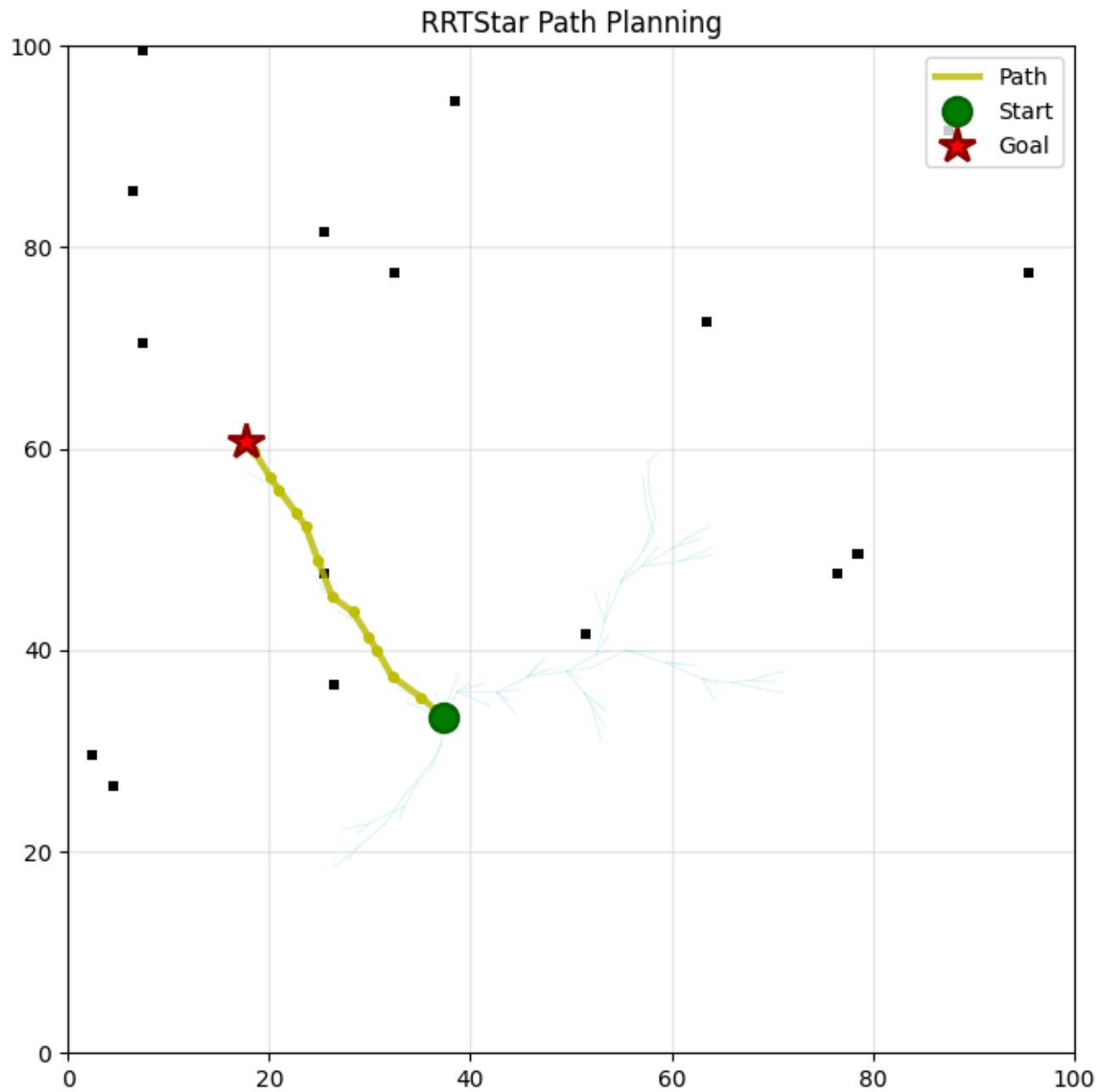
**Goal:** (17.680160467785434, 60.7052136761285)

## 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

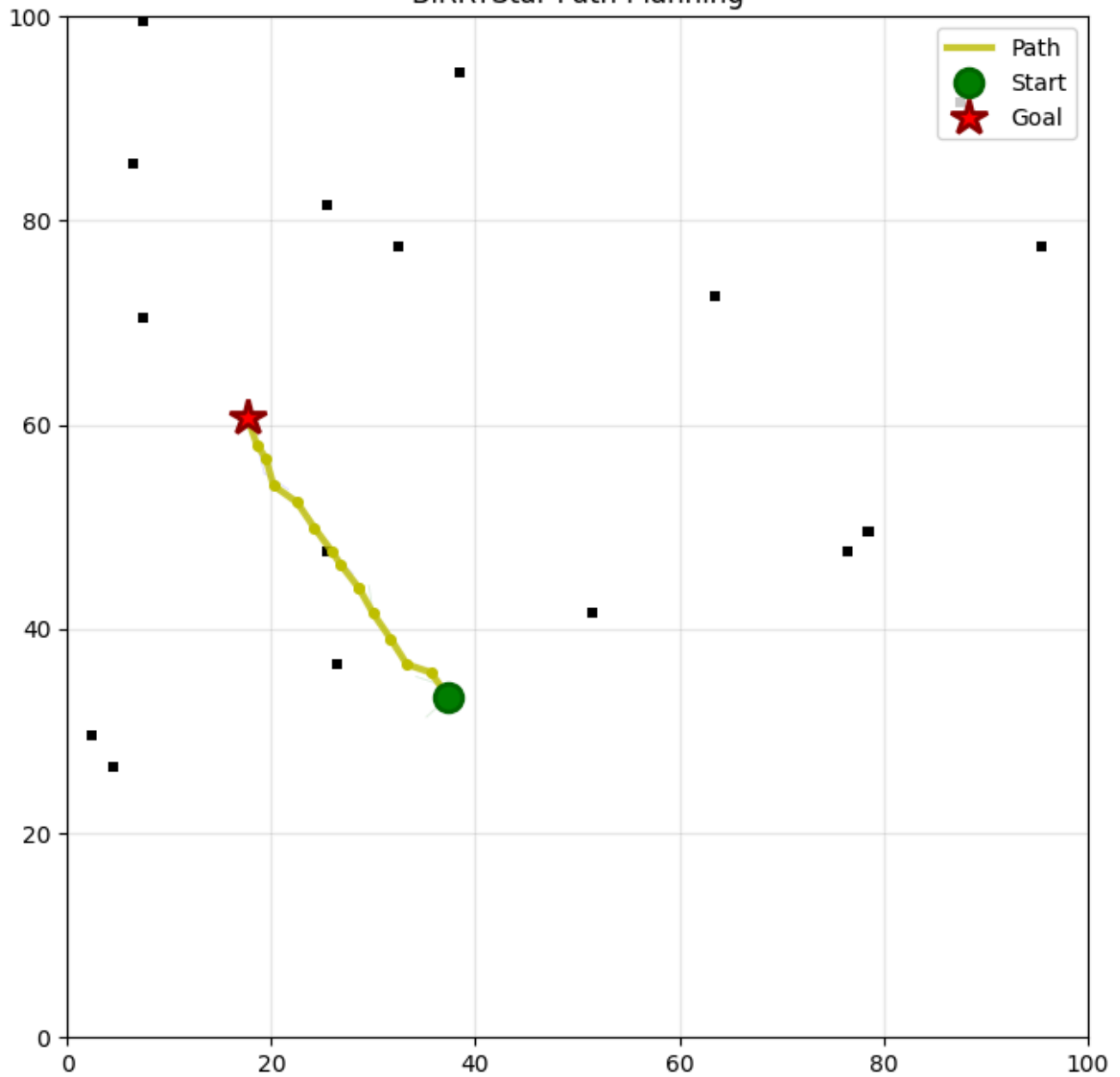
RRTStar [Early Stop]



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

### BiRRTStar [Early Stop]

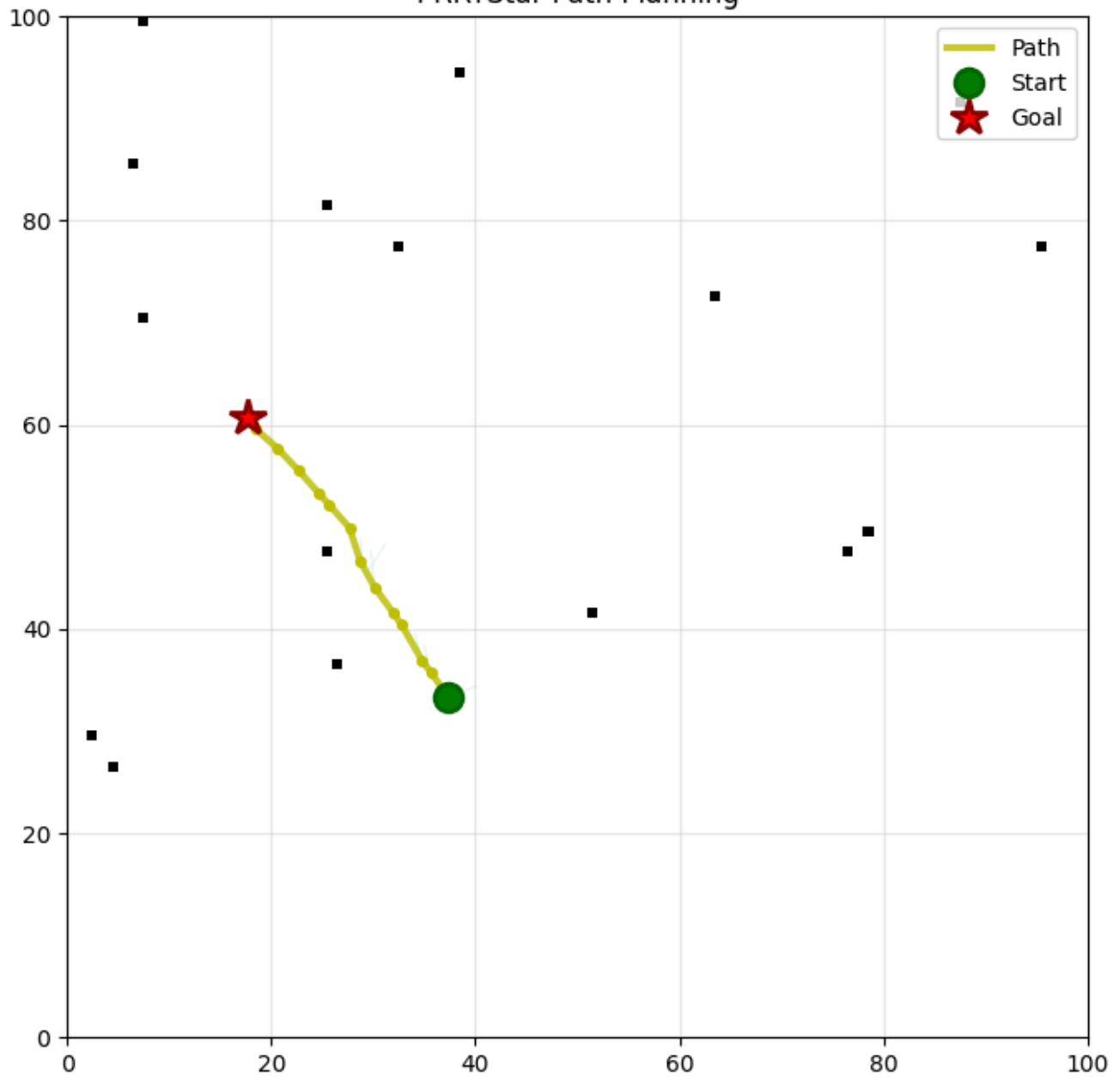
### BiRRTStar Path Planning



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

### PRRTStar [Early Stop]

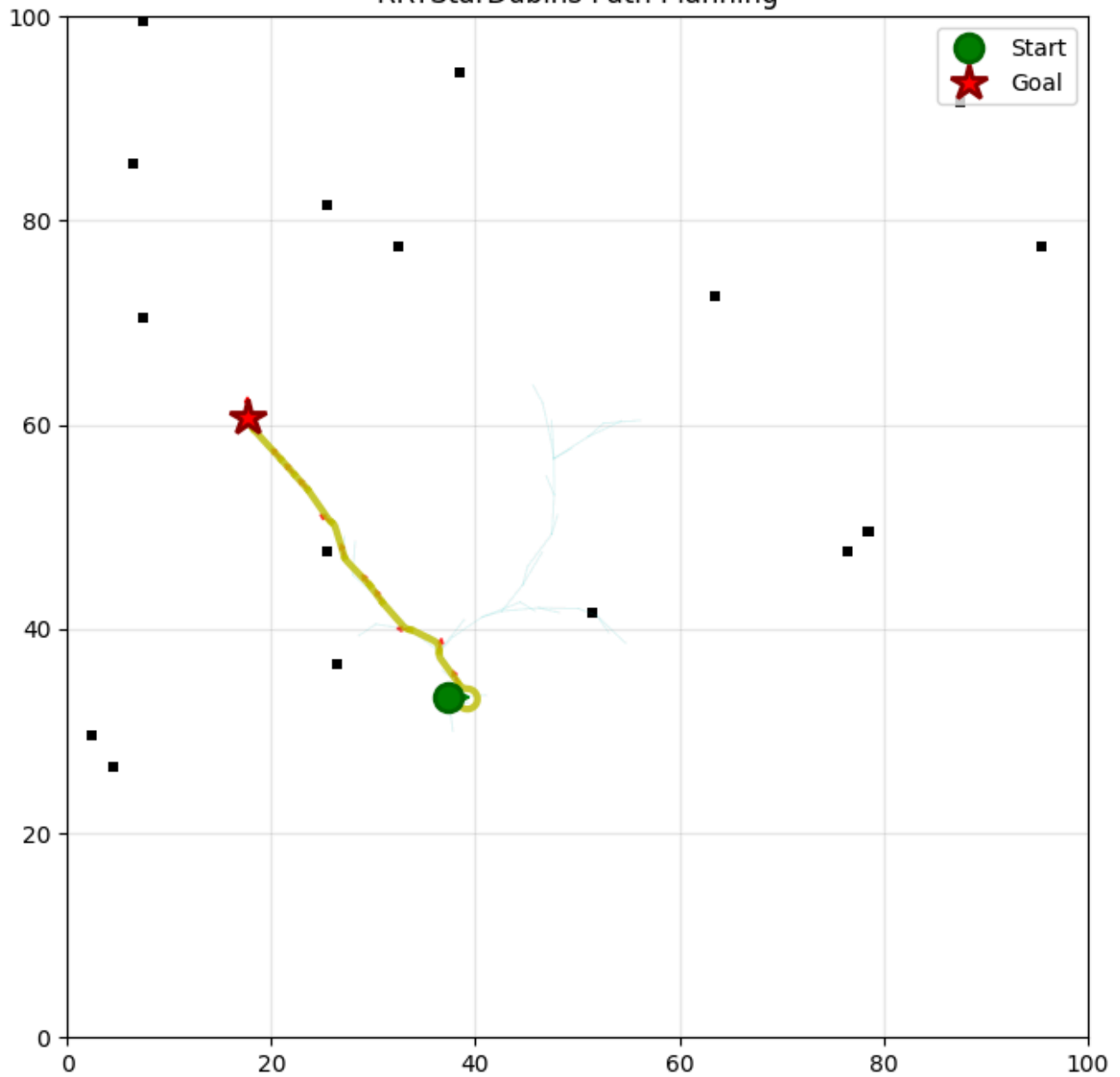
### PRRTStar Path Planning



Path Length: 34.08 | Nodes: 28 | Time: 0.04s

### RRTStarDubins [Early Stop]

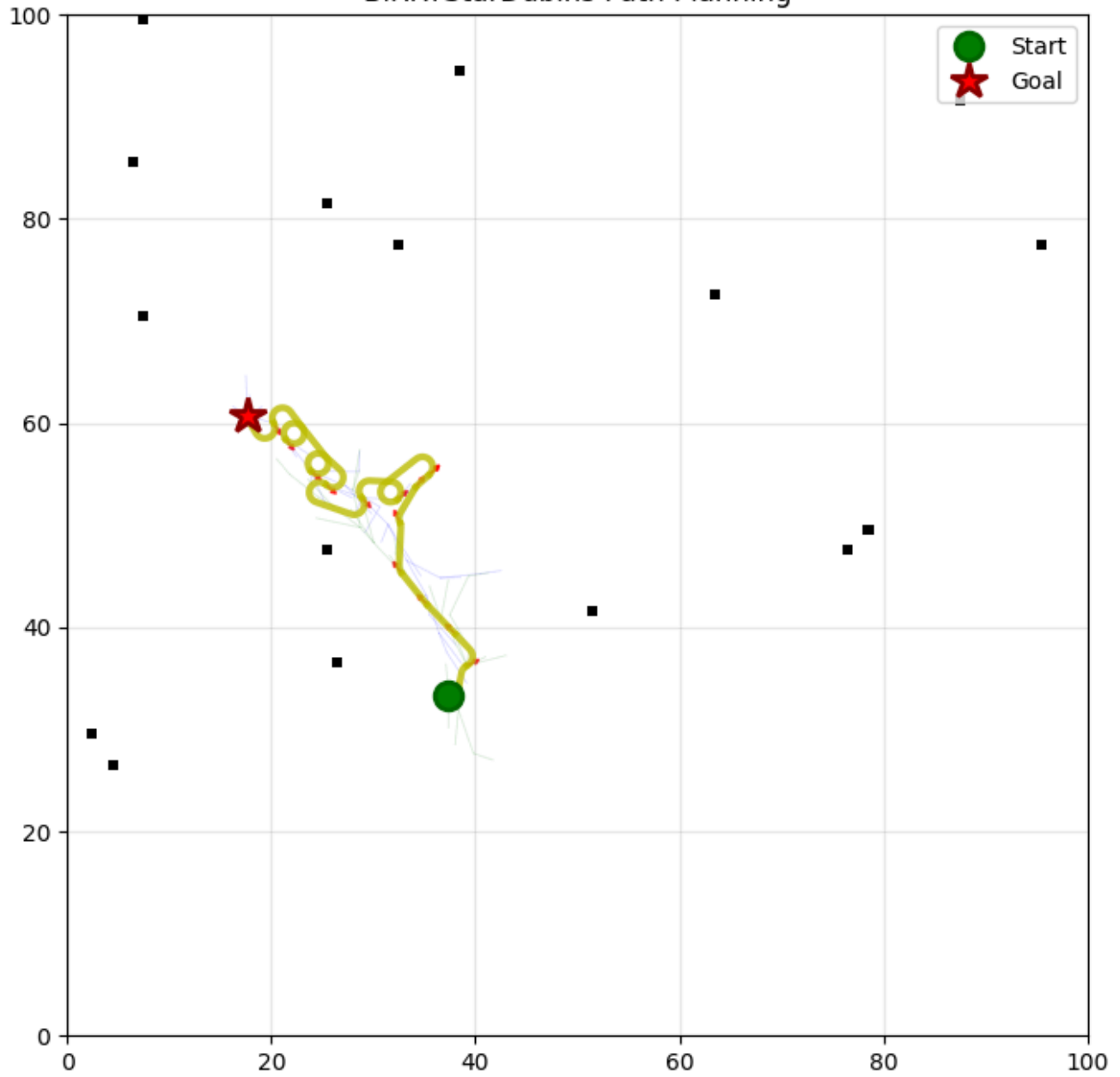
### RRTStarDubins Path Planning



Path Length: 35.23 | Nodes: 56 | Time: 0.00s

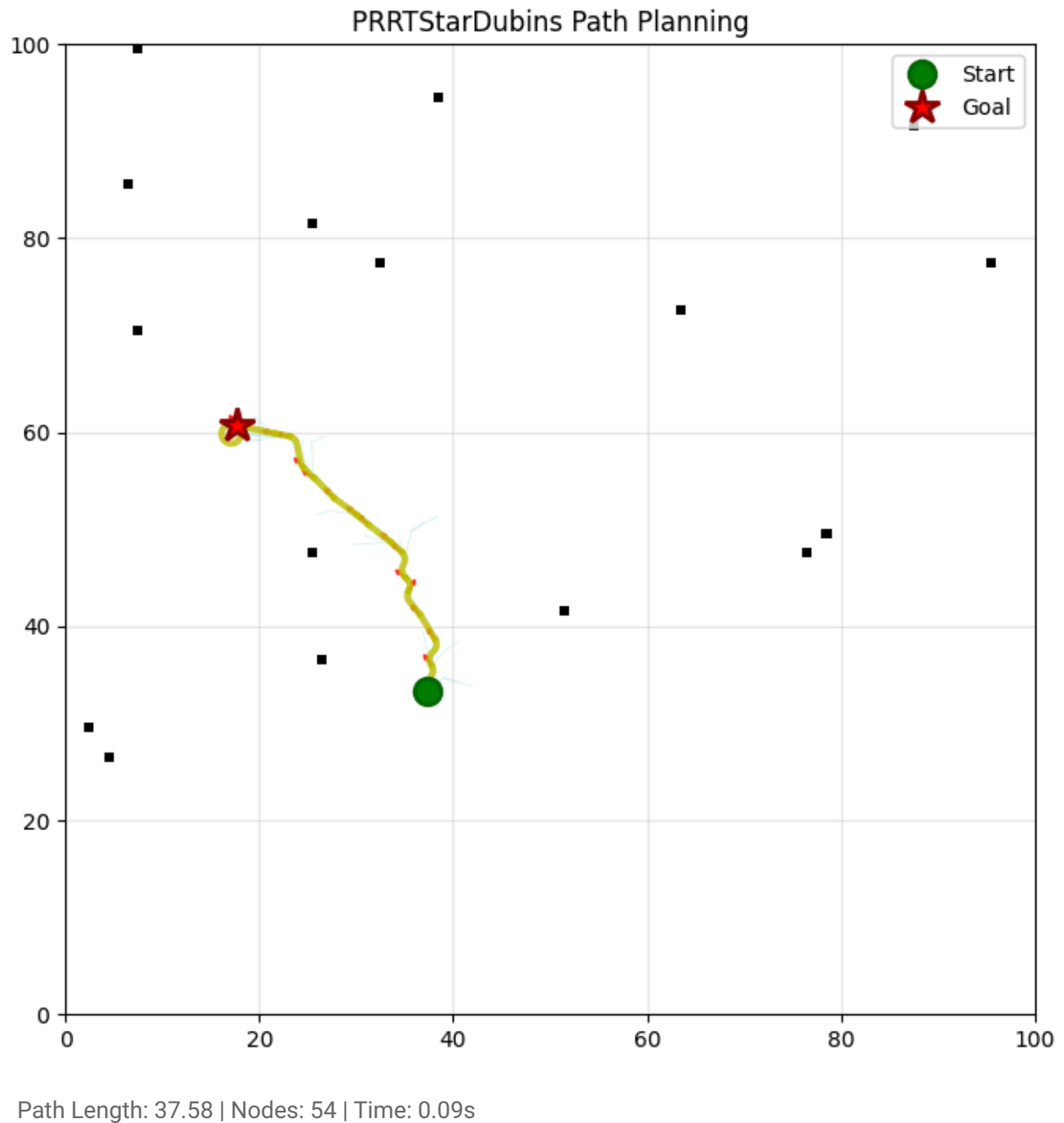
### BiRRTStarDubins [Early Stop]

### BiRRTStarDubins Path Planning



Path Length: 47.08 | Nodes: 86 | Time: 0.00s

### PRRTStarDubins [Early Stop]



## 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)

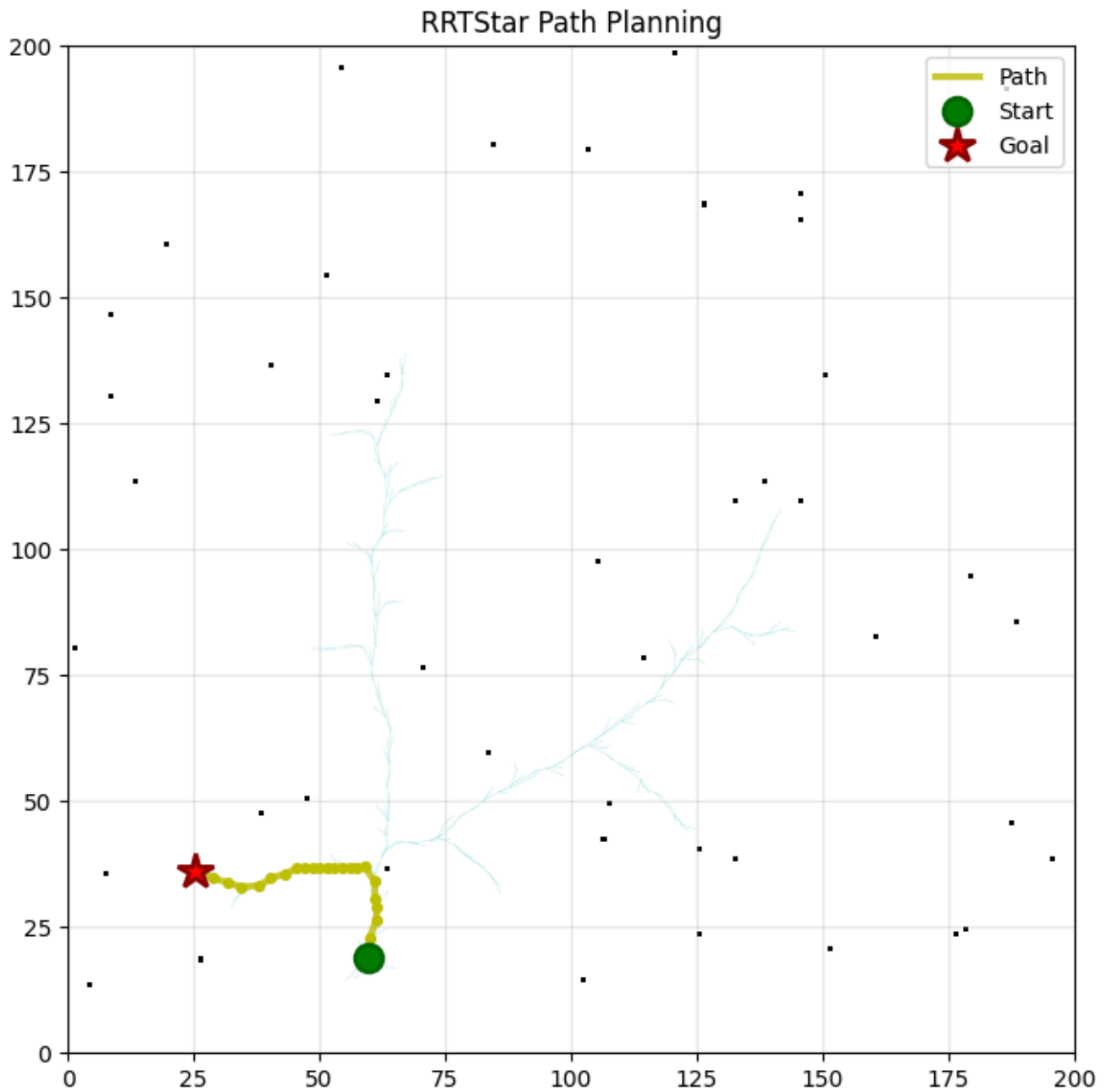
Goal: (25.34657314944875, 36.19809141054817)

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

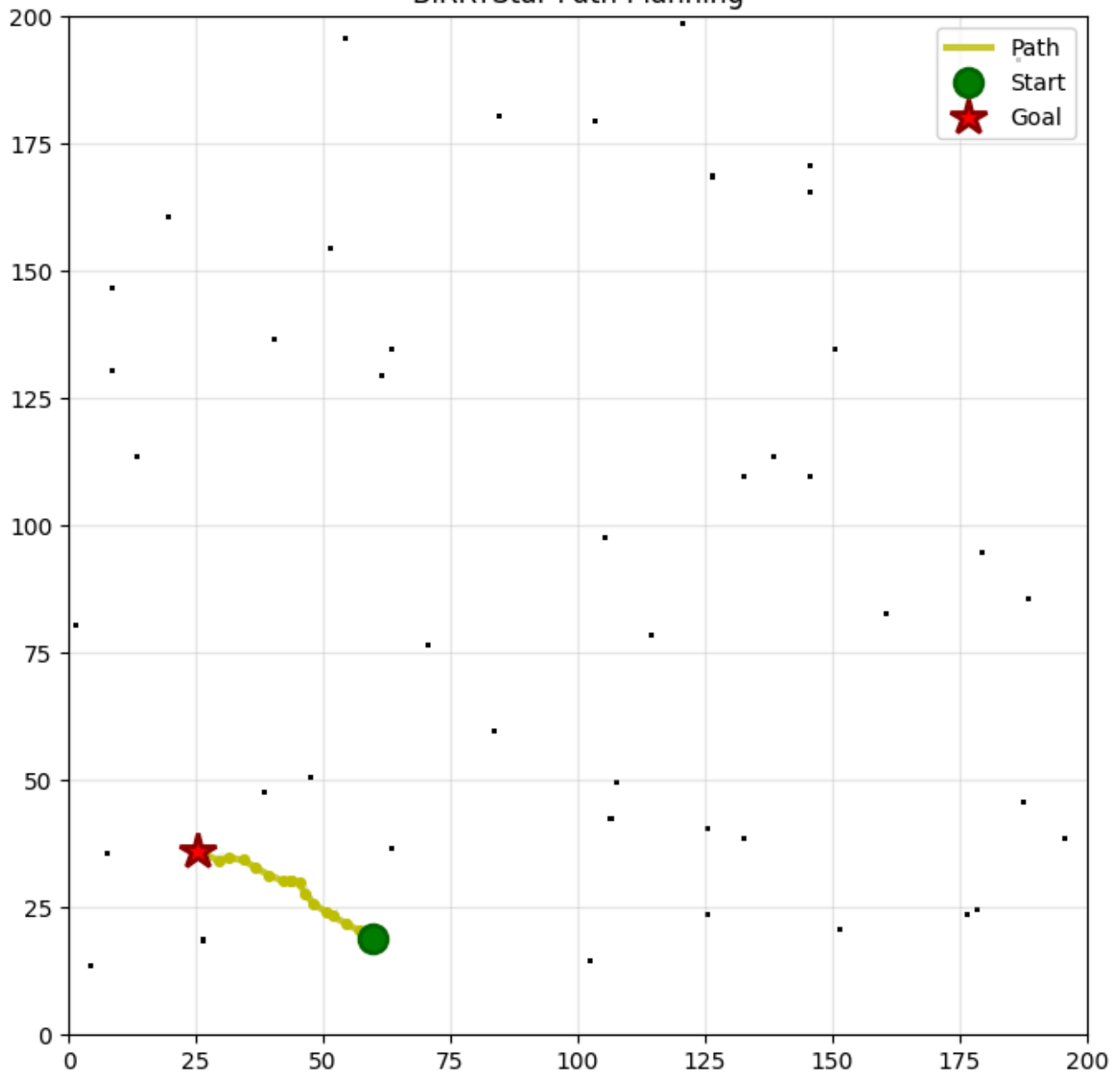
Path Visualizations

RRTStar [Early Stop]



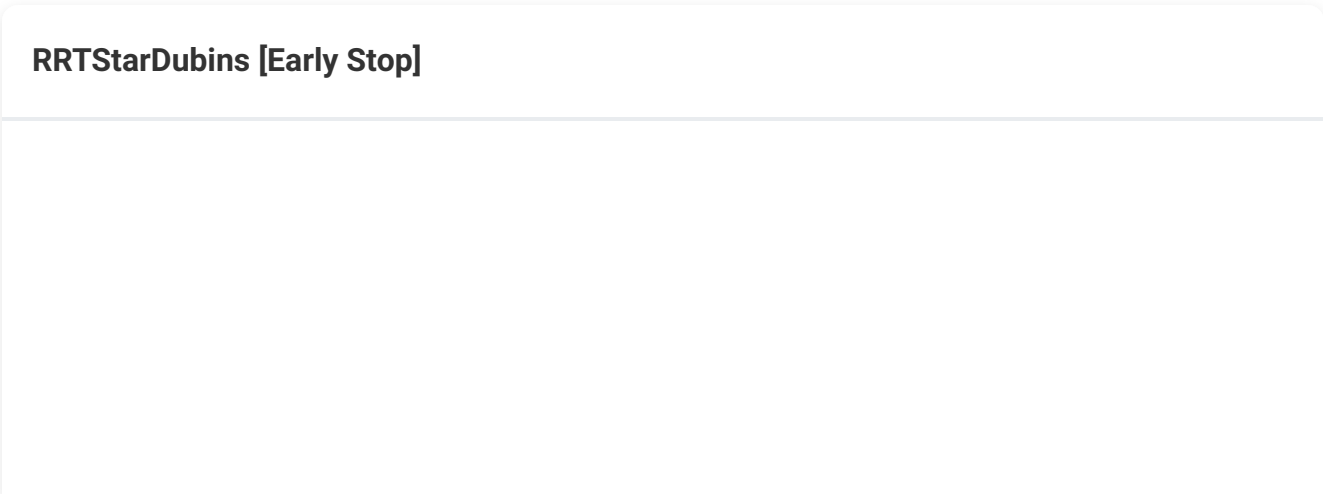
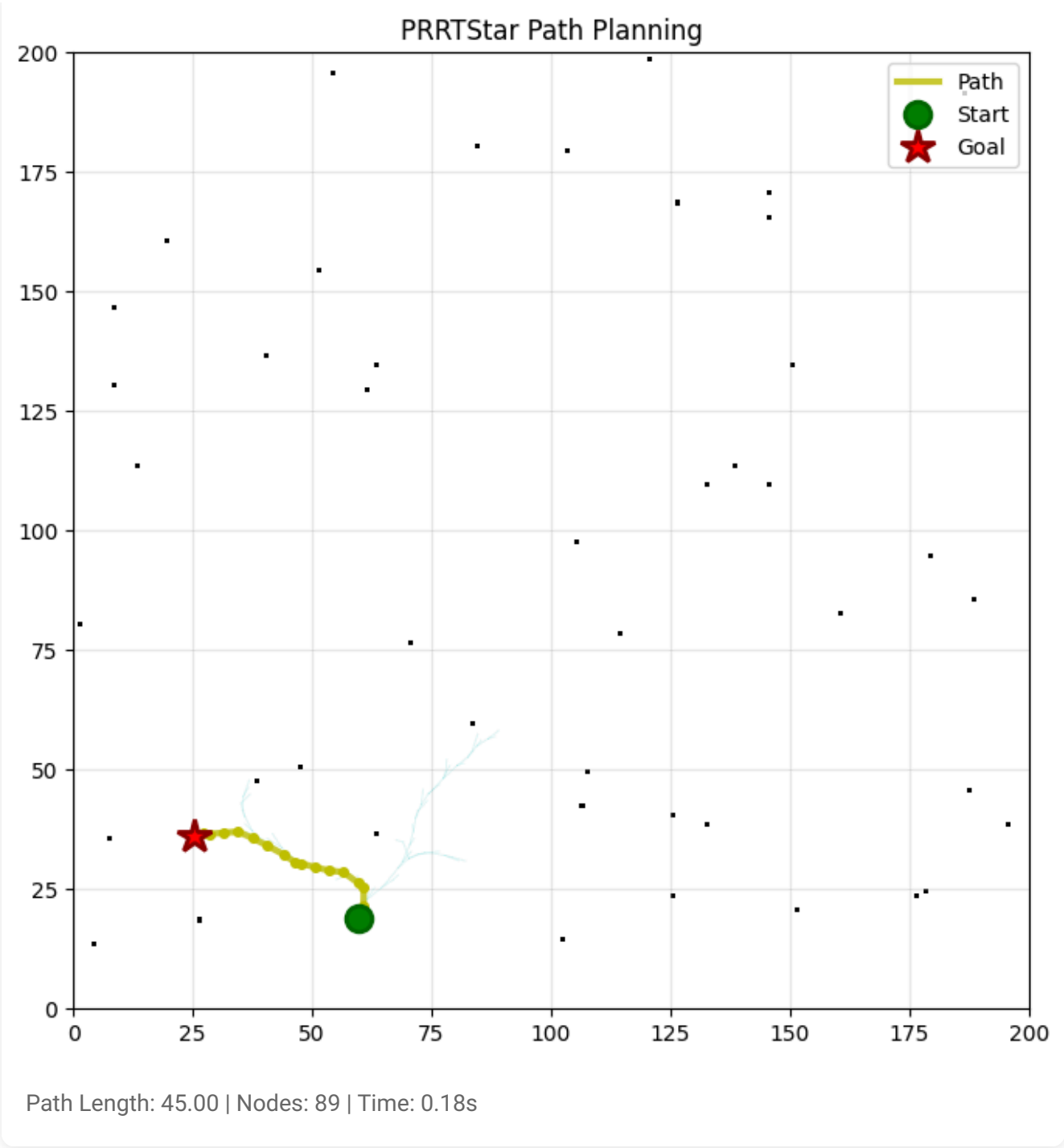
### BiRRTStar [Early Stop]

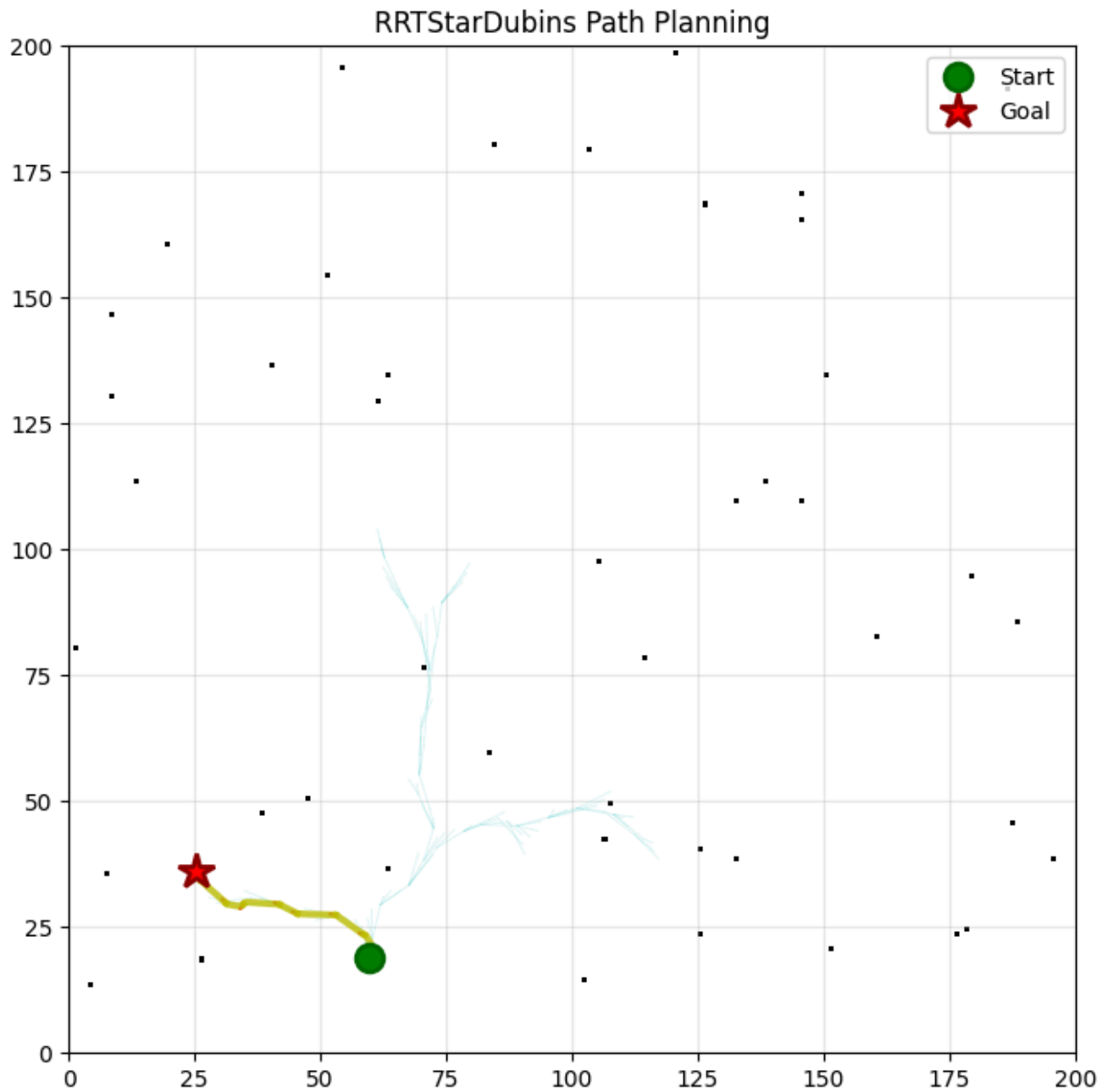
### BiRRTStar Path Planning



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

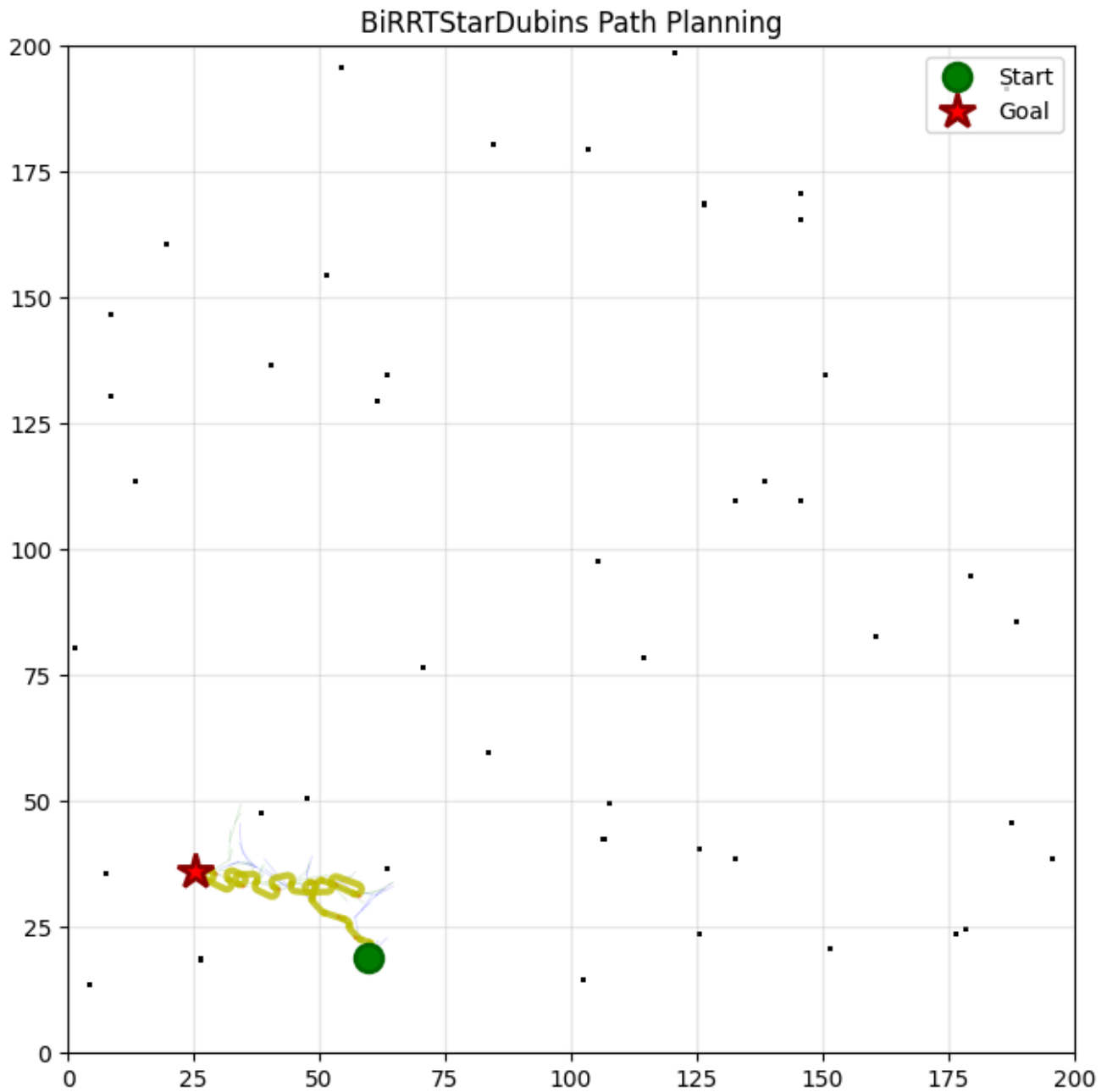
### PRRTStar [Early Stop]





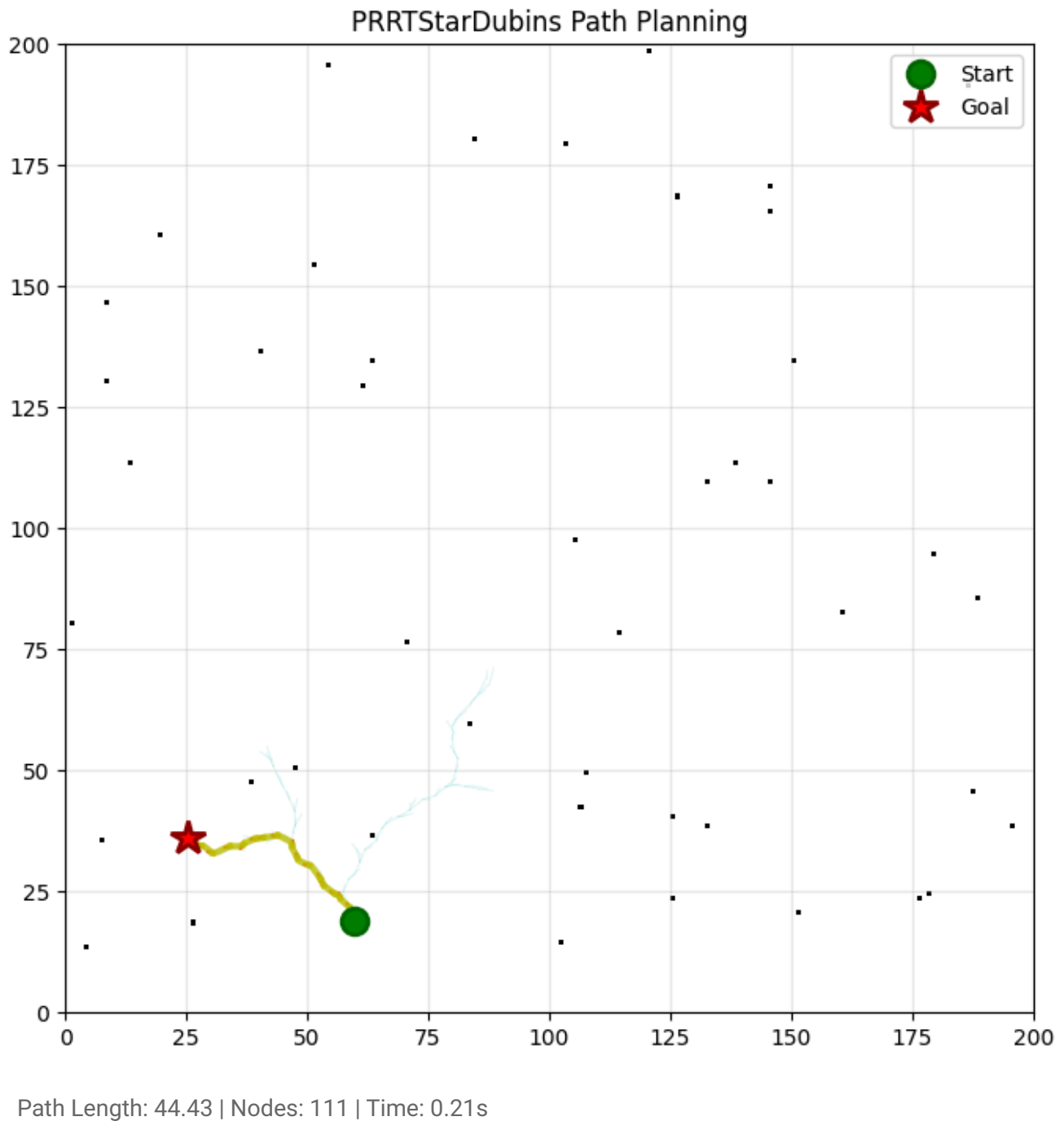
Path Length: 42.53 | Nodes: 122 | Time: 0.02s

### BiRRTStarDubins [Early Stop]



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

### PRRTStarDubins [Early Stop]



## 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)

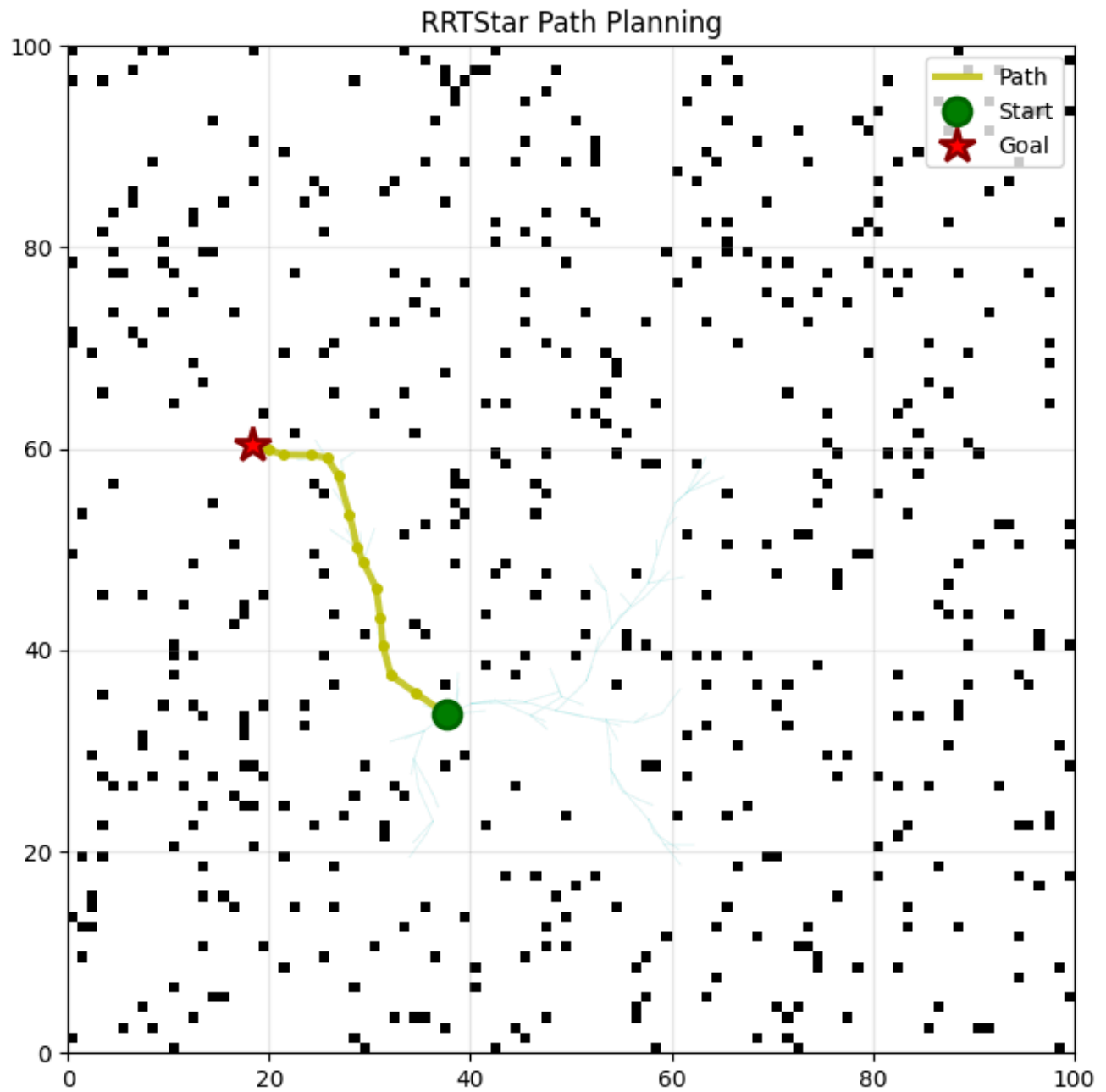
**Goal:** (18.263083425280286, 60.51213366994582)

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

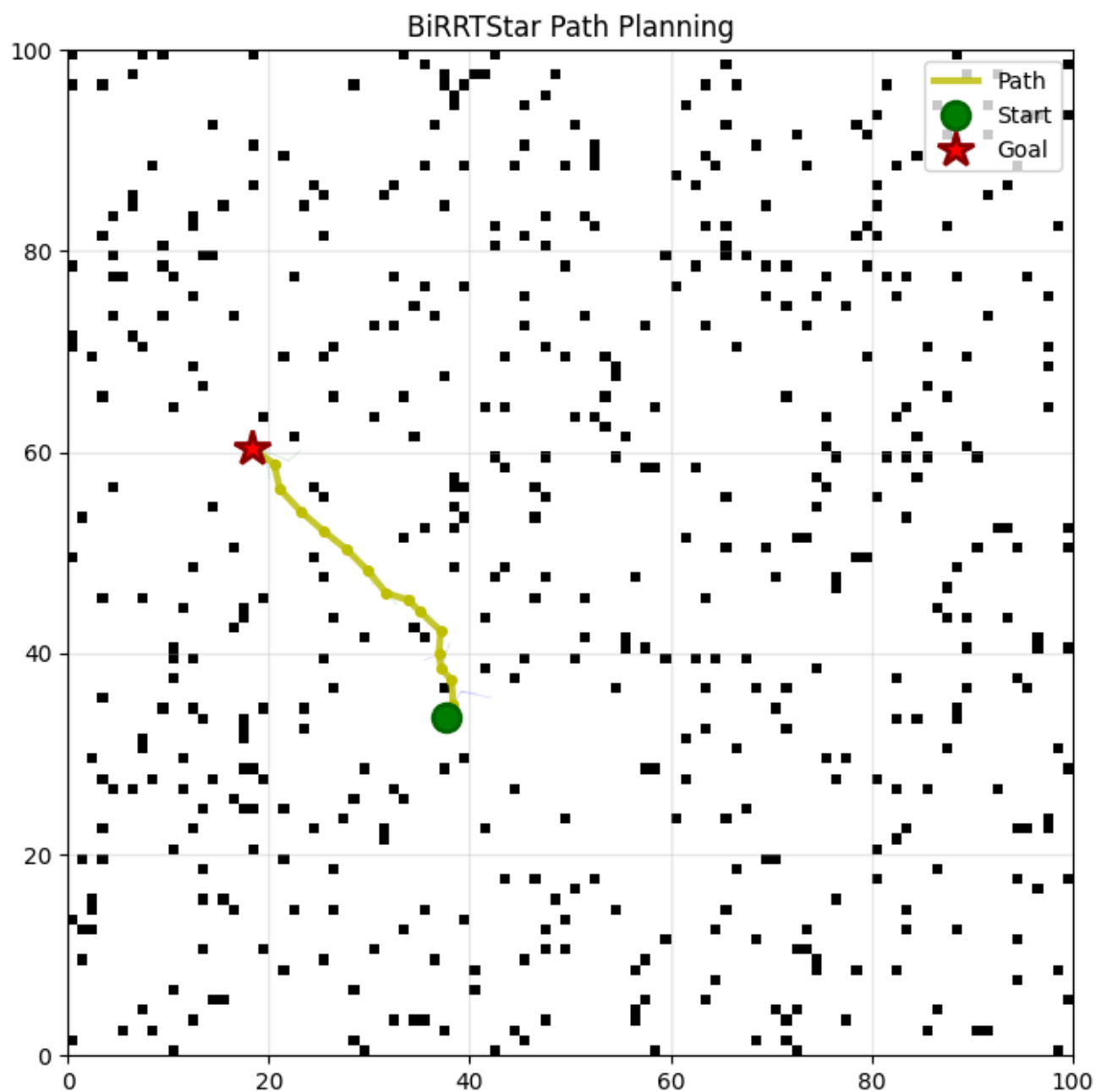
Path Visualizations

RRTStar [Early Stop]



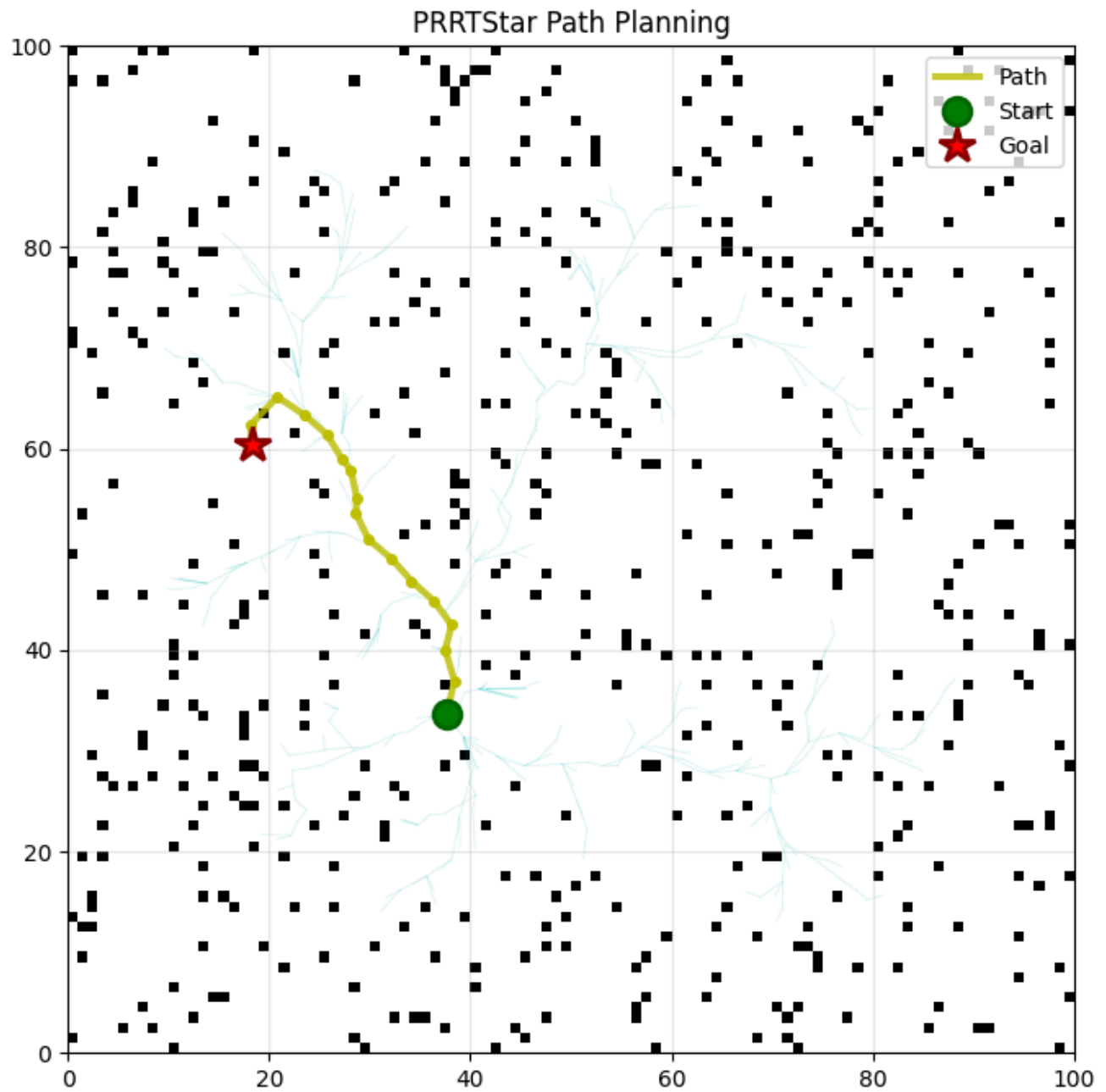
Path Length: 37.17 | Nodes: 116 | Time: 0.03s

### BiRRTStar [Early Stop]



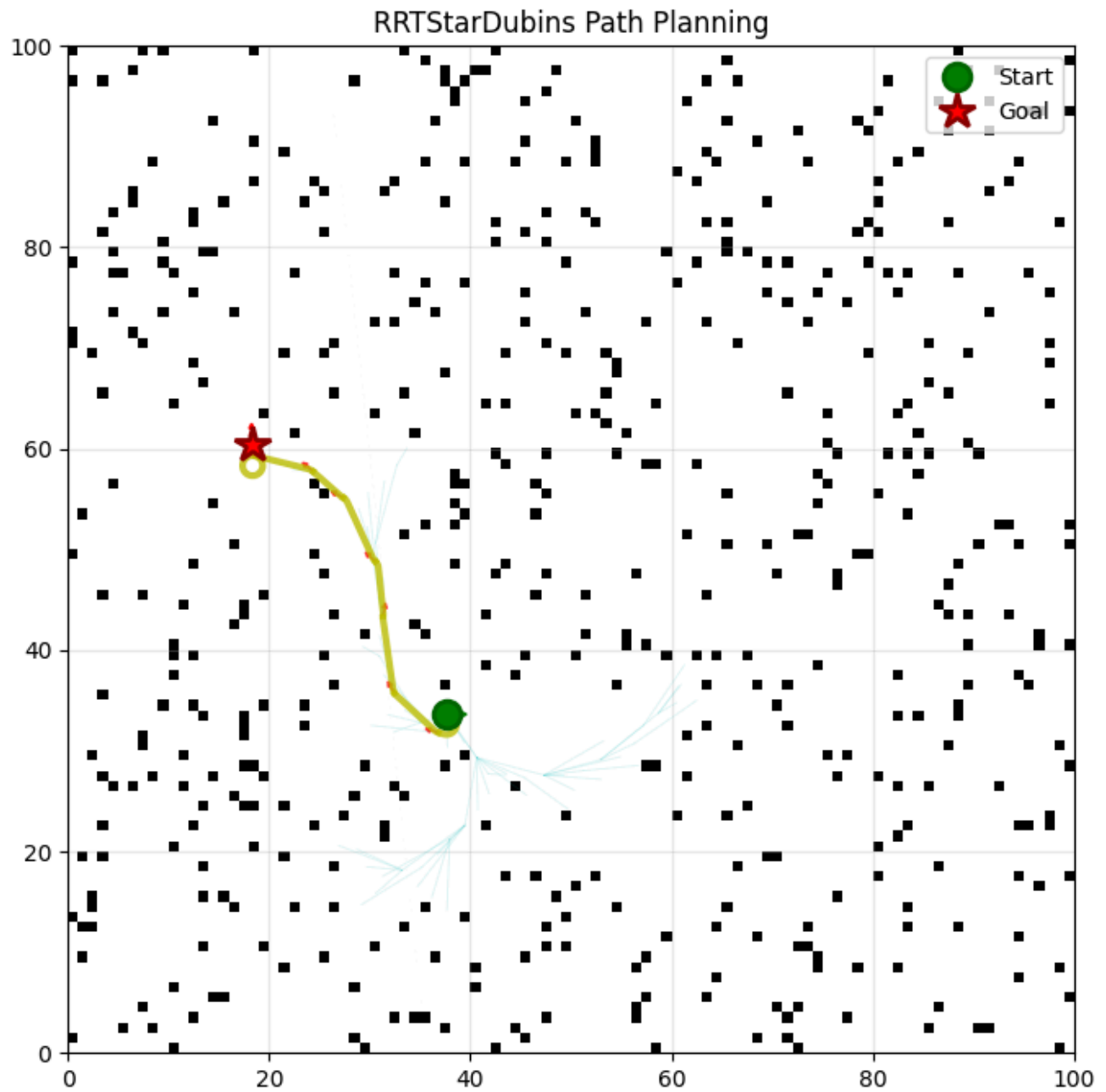
Path Length: 36.20 | Nodes: 34 | Time: 0.00s

## PRRTStar [Early Stop]



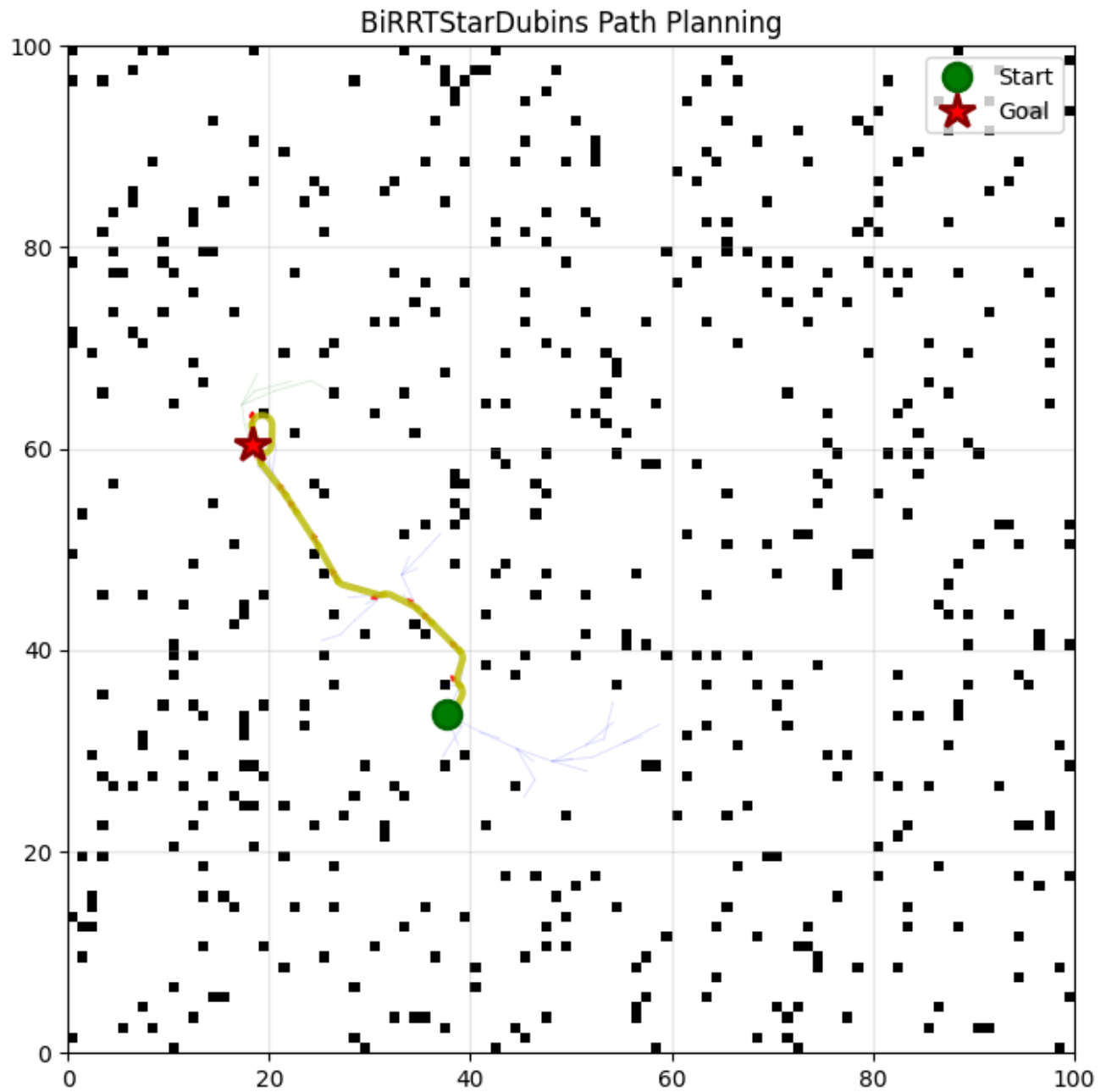
Path Length: 44.48 | Nodes: 402 | Time: 0.53s

### RRTStarDubins [Early Stop]

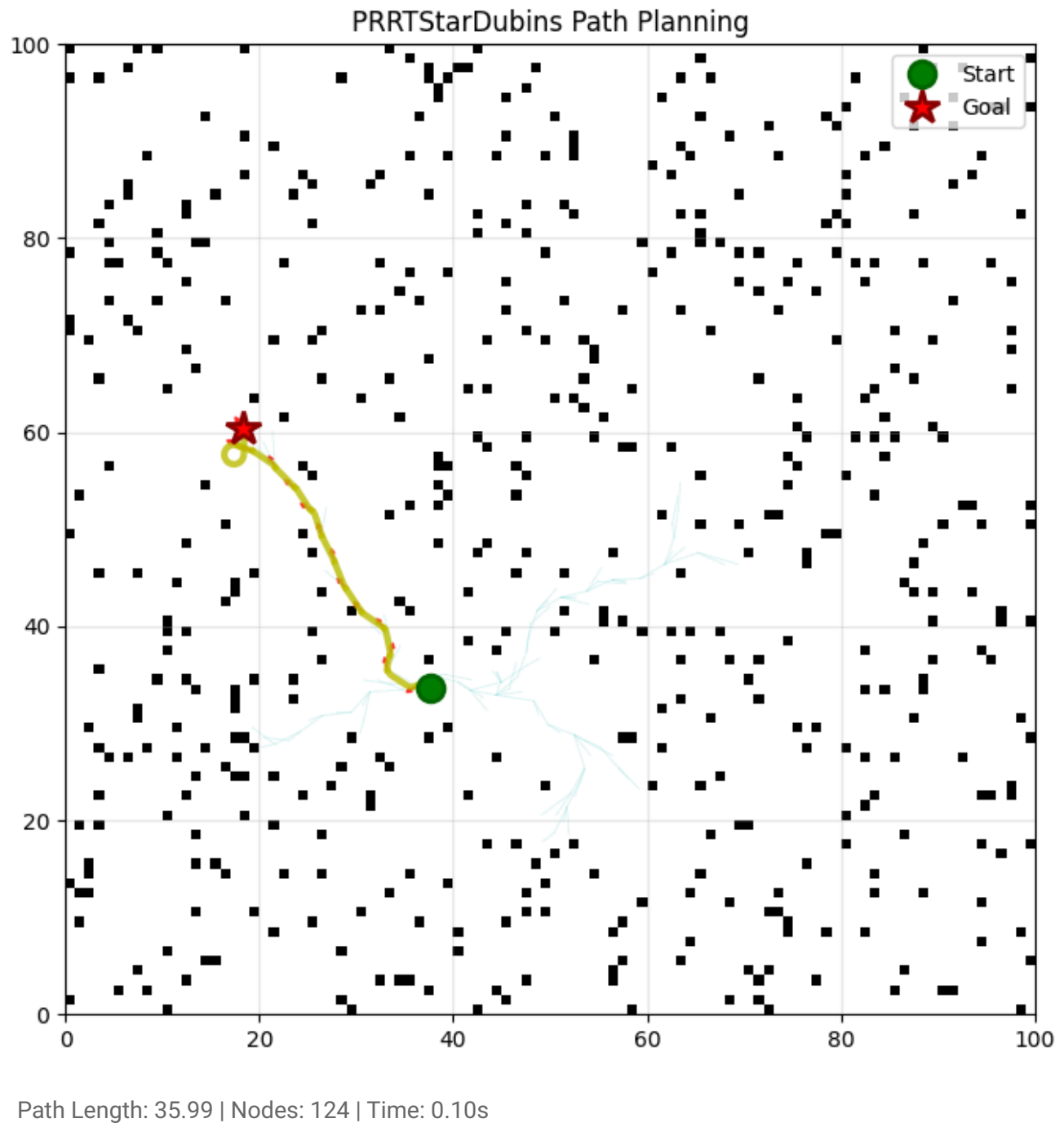


Path Length: 39.28 | Nodes: 76 | Time: 0.02s

### 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)

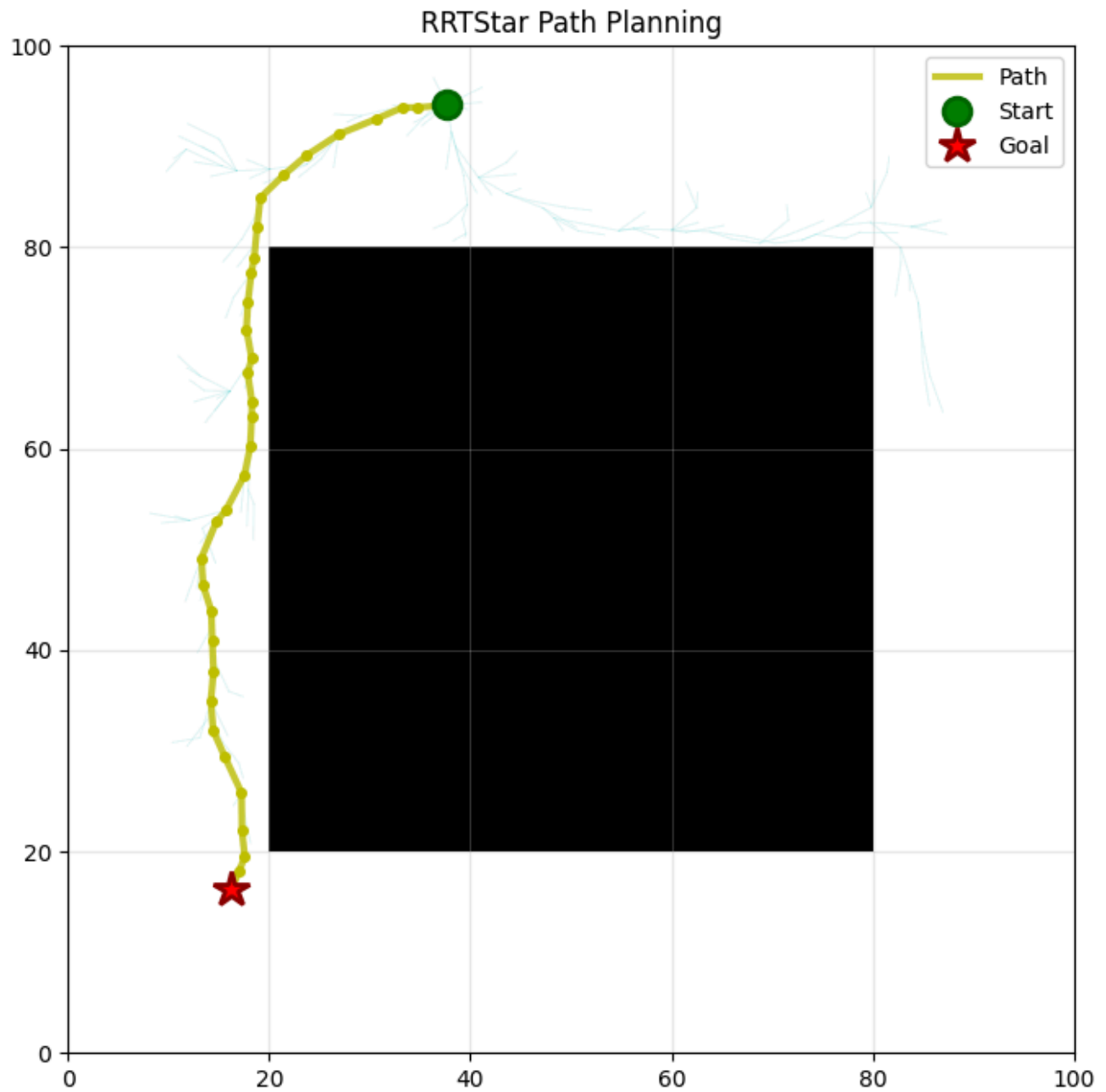
**Goal:** (16.28982676335878, 16.28746299294786)

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

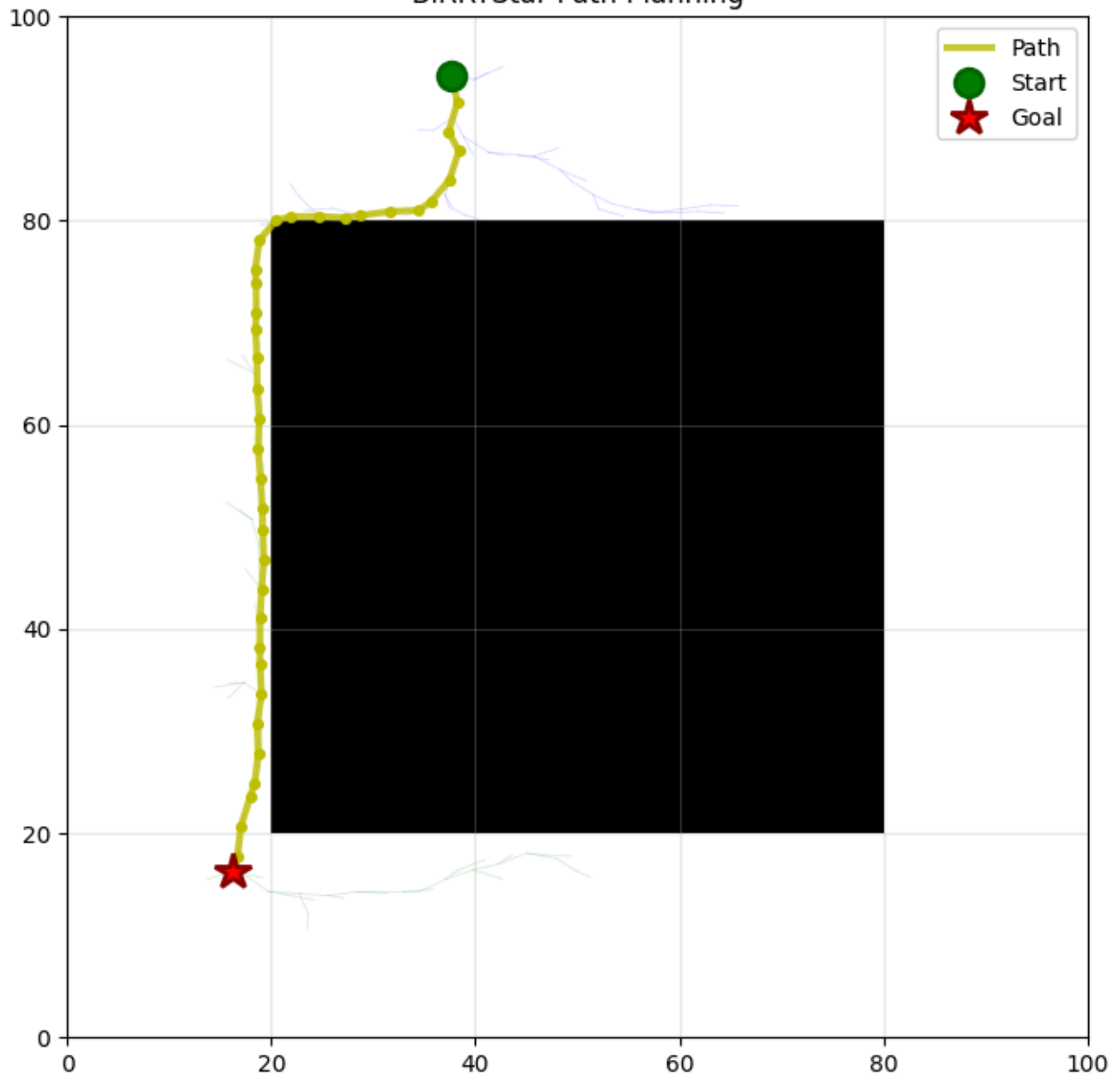
RRTStar [Early Stop]



Path Length: 92.43 | Nodes: 209 | Time: 0.03s

### BiRRTStar [Early Stop]

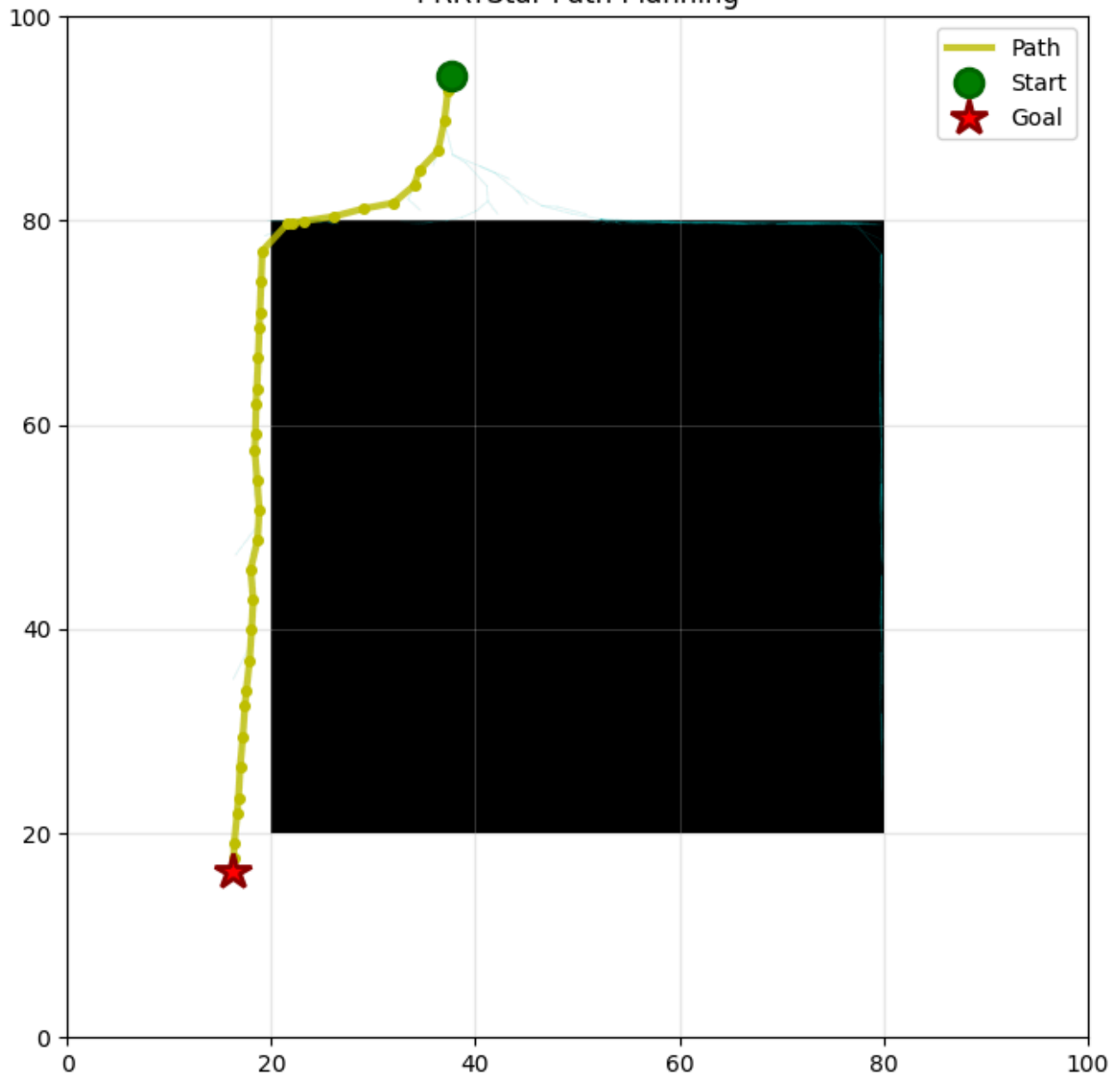
### BiRRTStar Path Planning



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

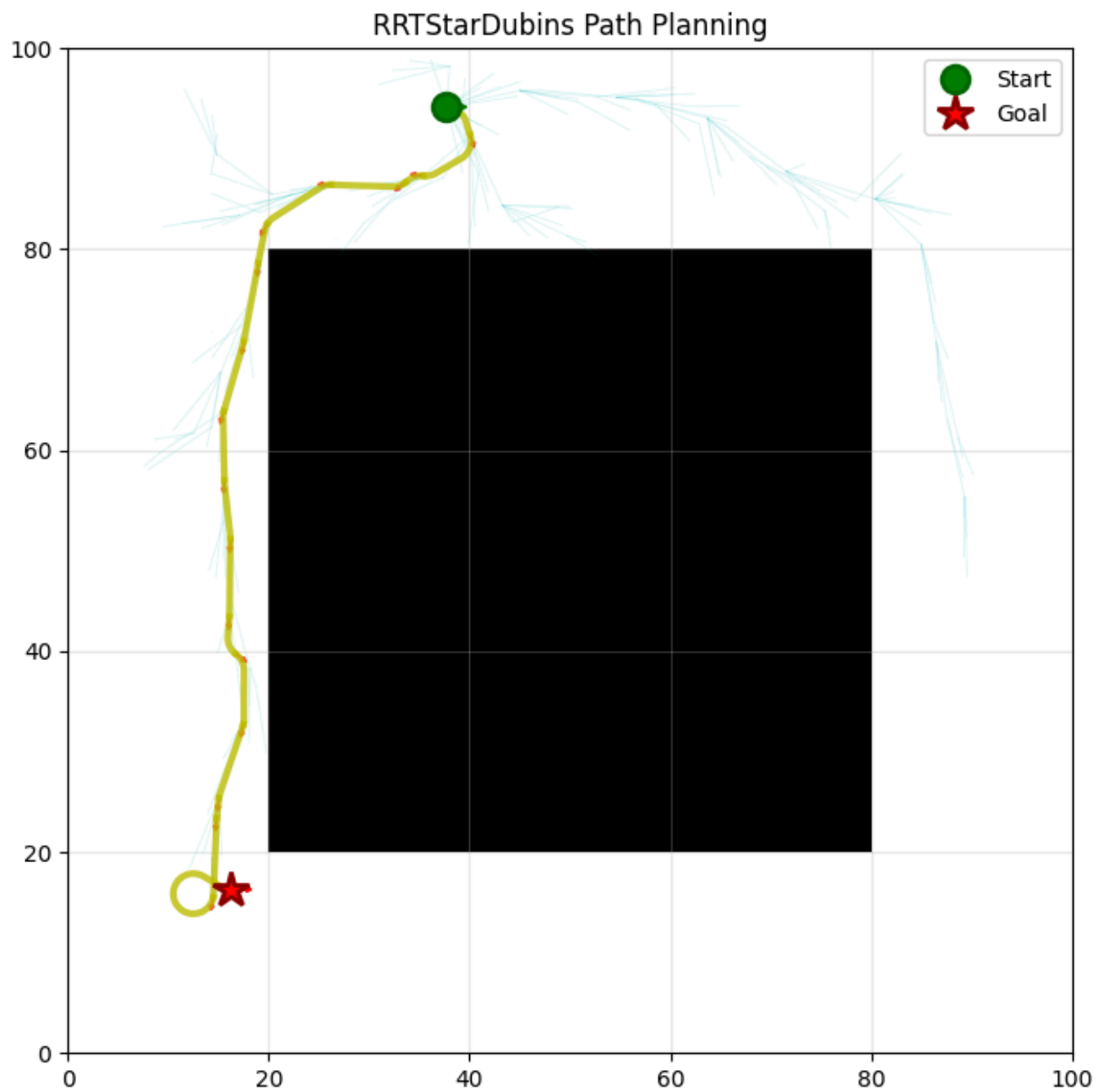
### PRRTStar [Early Stop]

### PRRTStar Path Planning



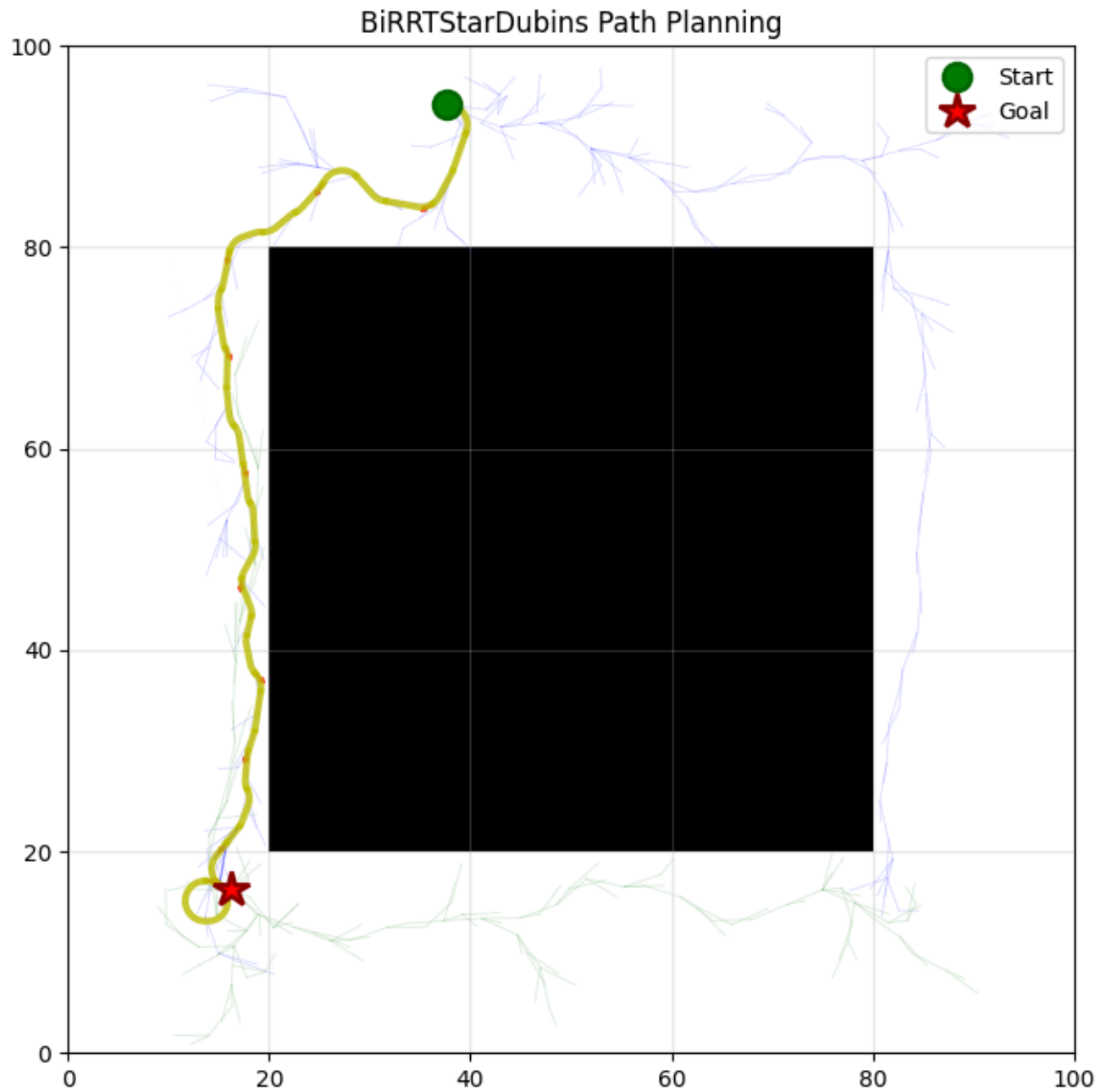
Path Length: 89.51 | Nodes: 348 | Time: 0.62s

### RRTStarDubins [Early Stop]



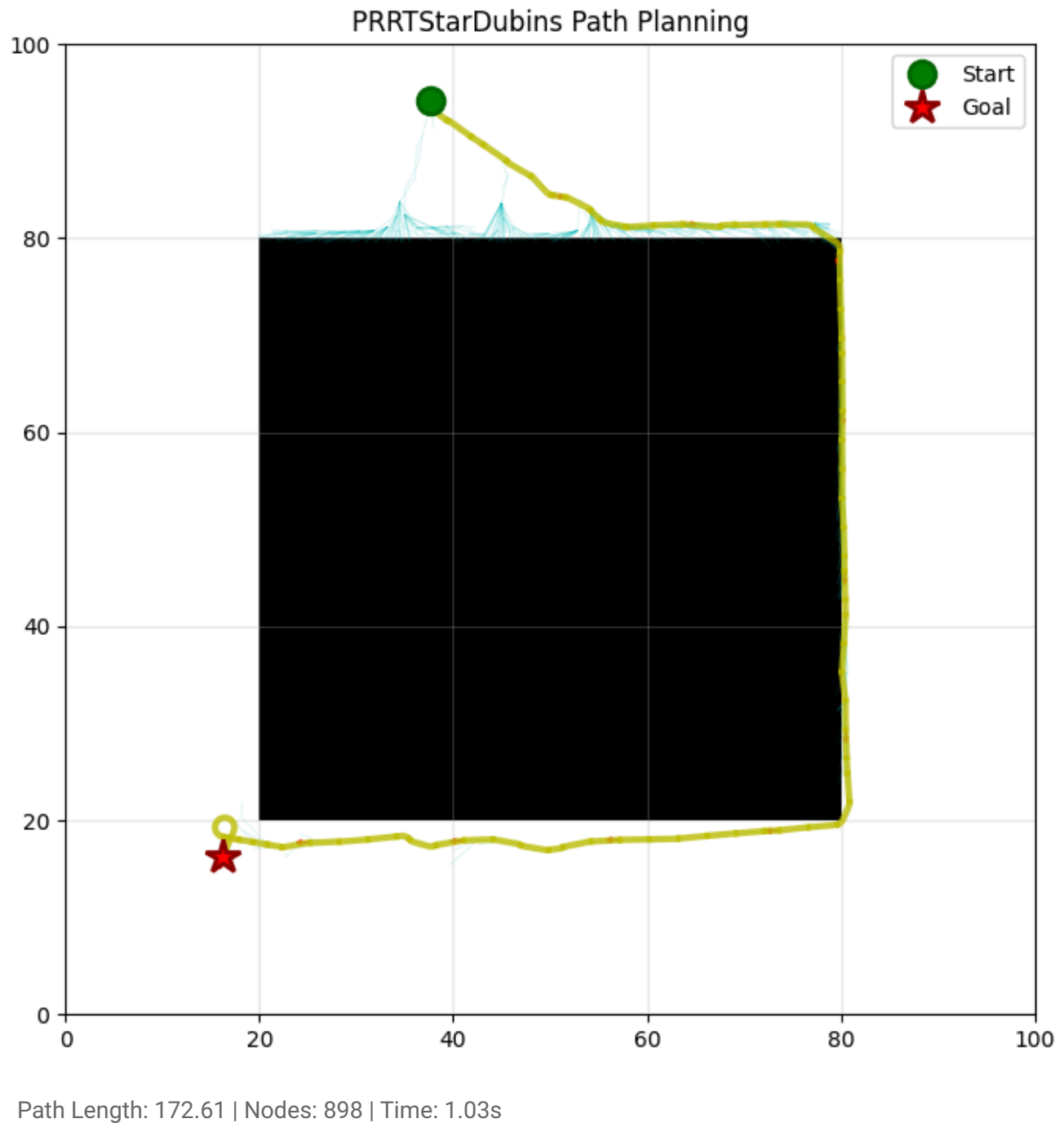
Path Length: 96.65 | Nodes: 207 | Time: 0.02s

### BiRRTStarDubins [Early Stop]



Path Length: 103.37 | Nodes: 493 | Time: 0.09s

### PRRTStarDubins [Early Stop]



## 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)

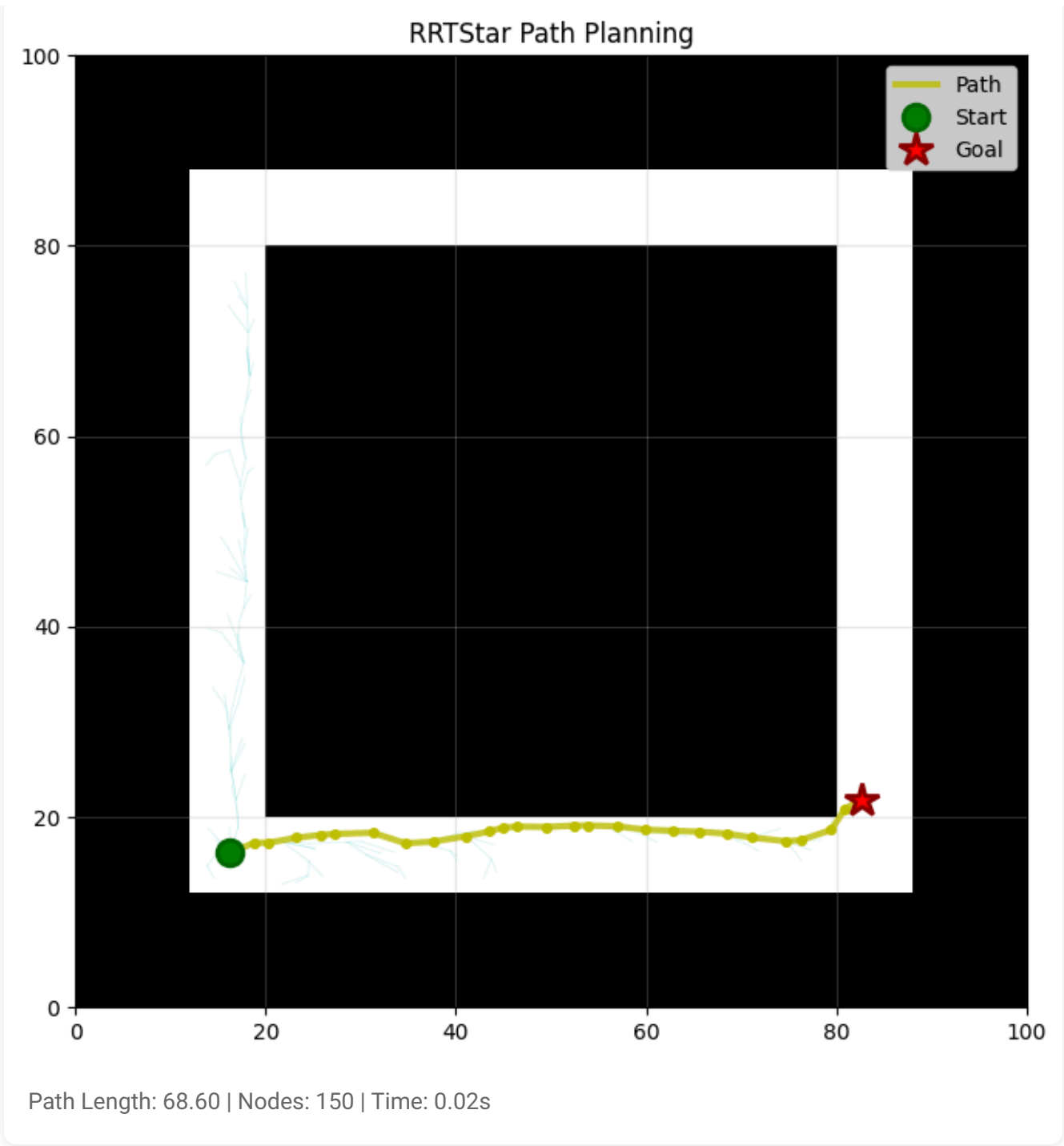
**Goal:** (82.57937879844133, 21.809232846471062)

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

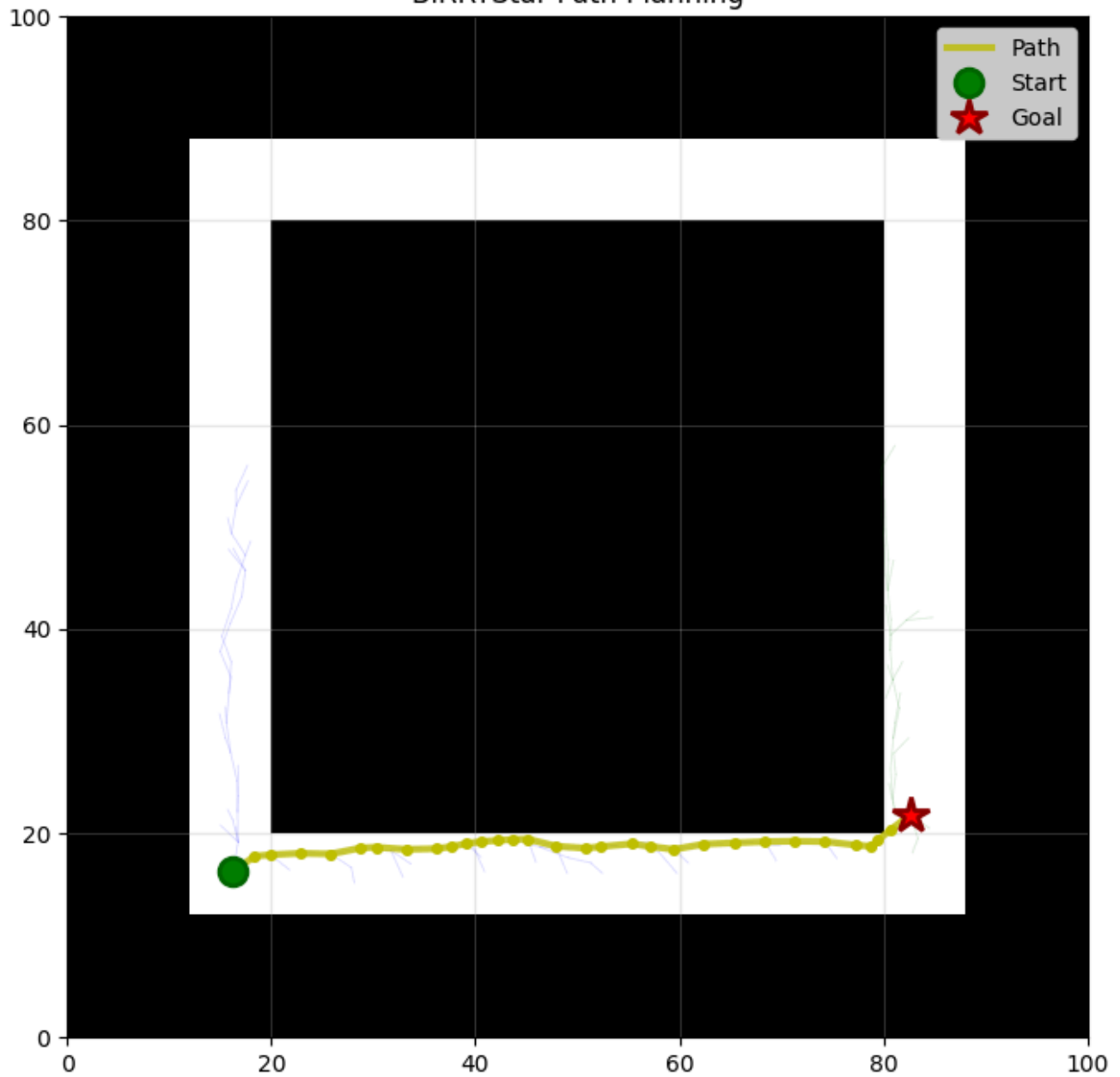
Path Visualizations

RRTStar [Early Stop]



### BiRRTStar [Early Stop]

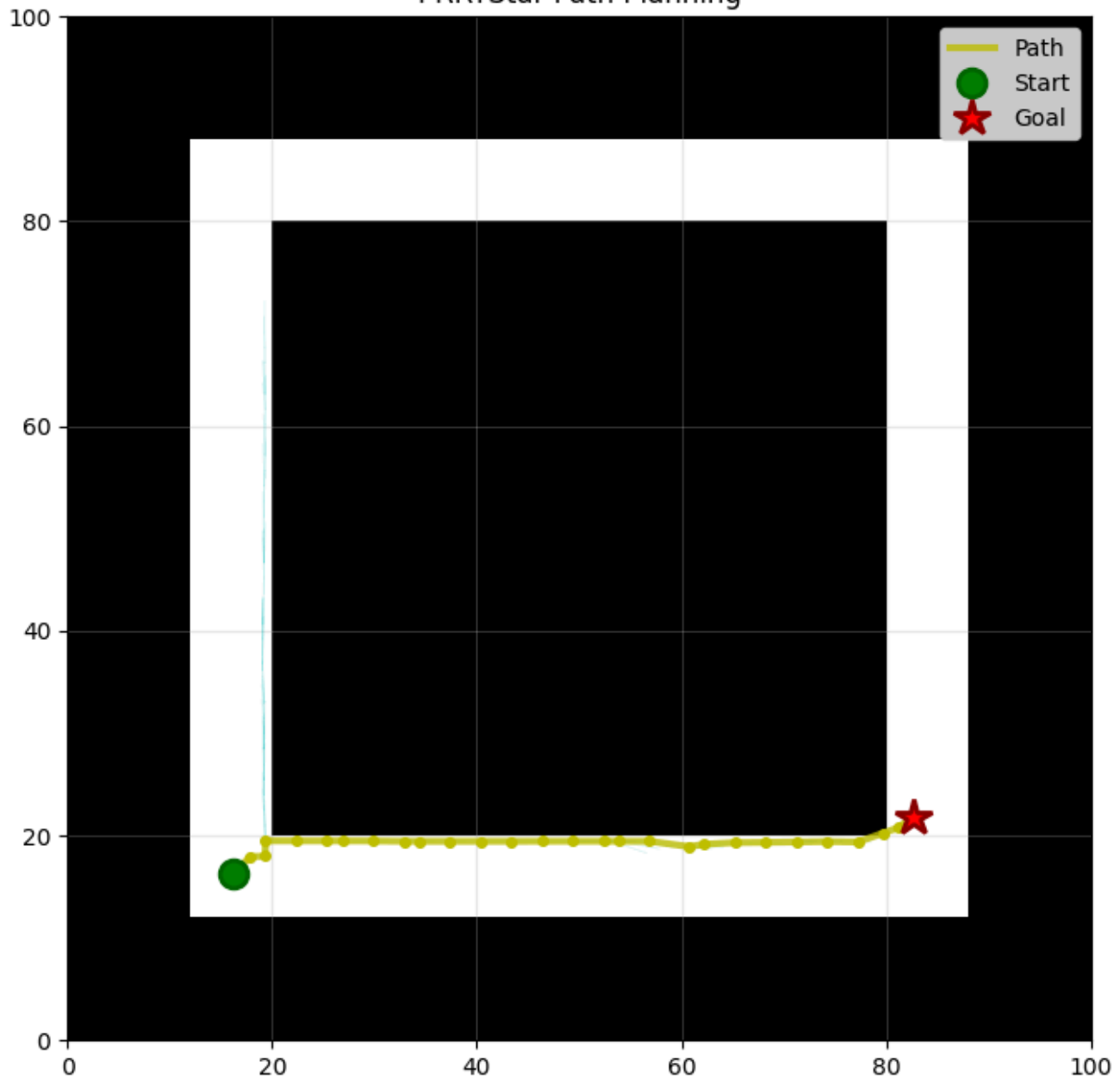
### BiRRTStar Path Planning



Path Length: 68.20 | Nodes: 140 | Time: 0.01s

### PRRTStar [Early Stop]

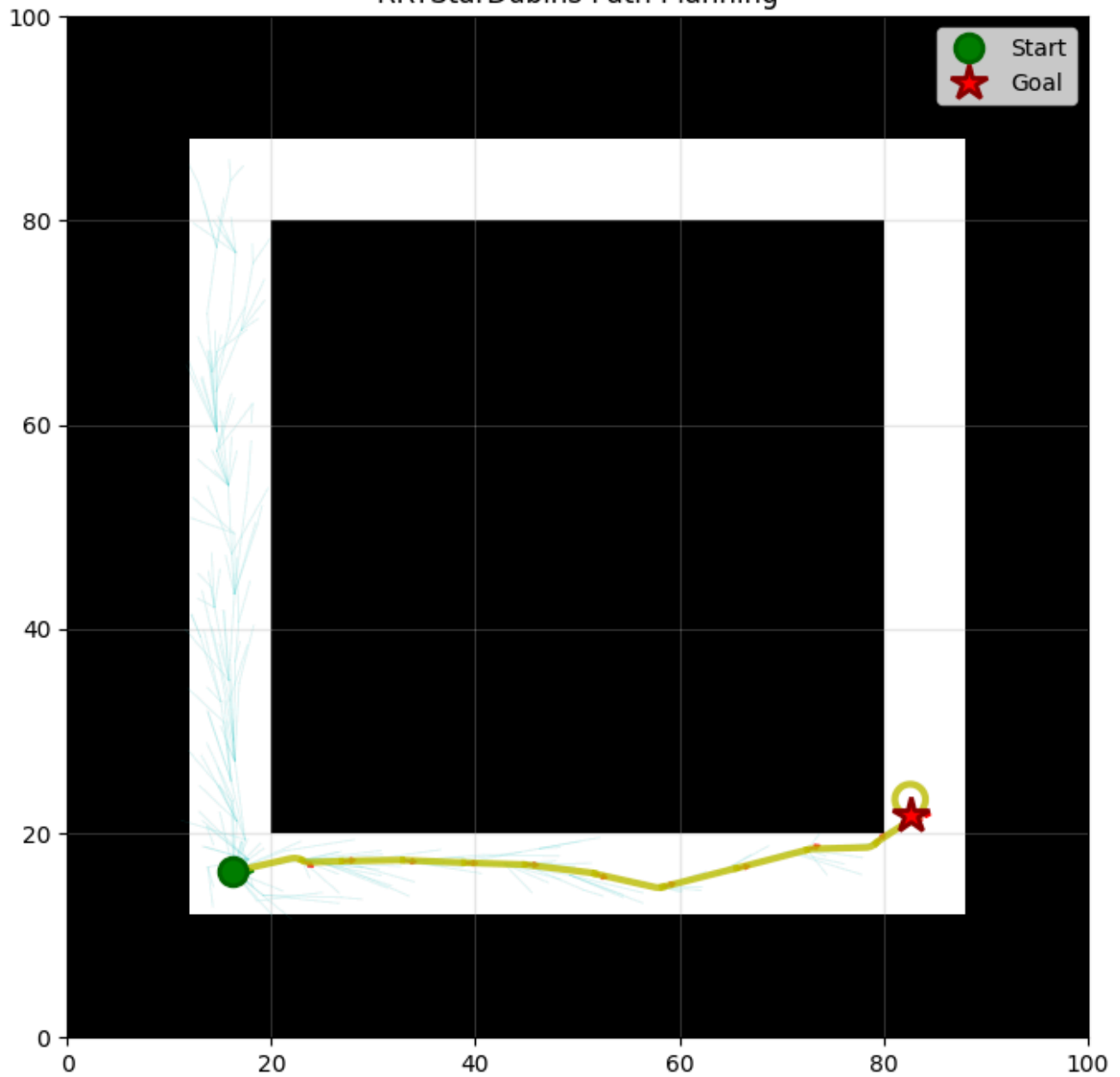
### PRRTStar Path Planning



Path Length: 69.09 | Nodes: 141 | Time: 0.10s

### RRTStarDubins [Early Stop]

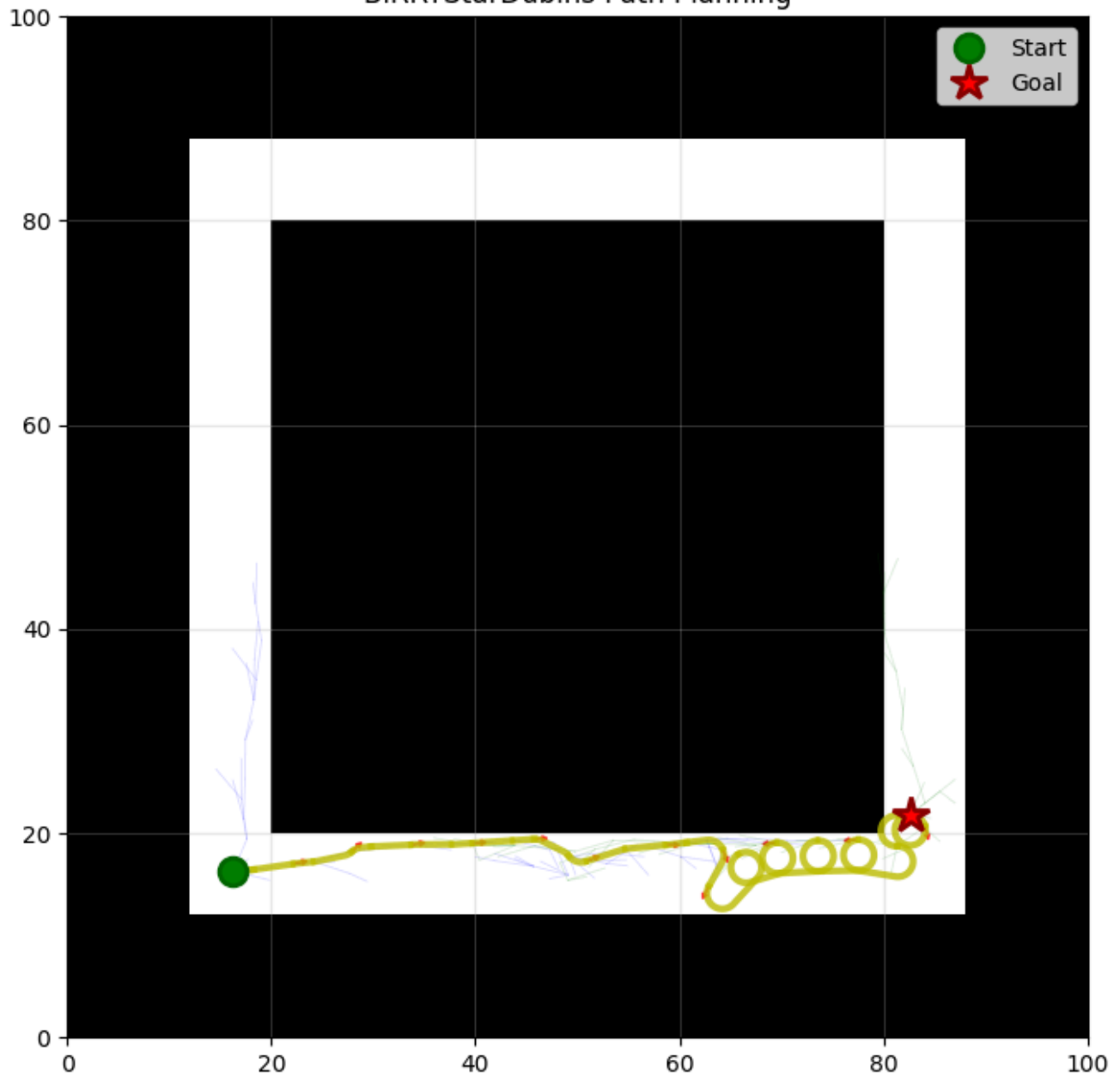
### RRTStarDubins Path Planning



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

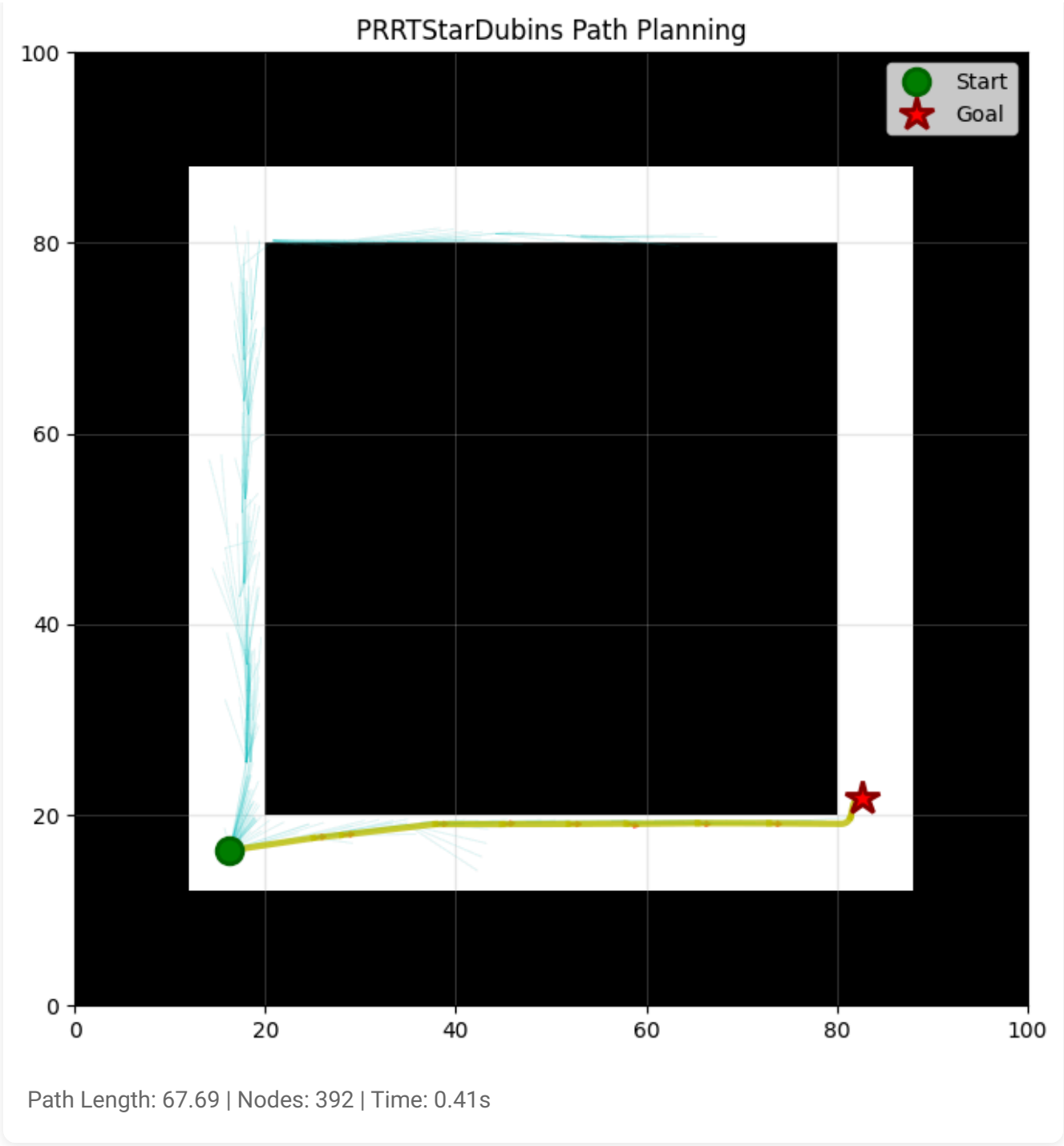
### BiRRTStarDubins [Early Stop]

### BiRRTStarDubins Path Planning



Path Length: 78.09 | Nodes: 164 | Time: 0.01s

### PRRTStarDubins [Early Stop]



## 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