

Narrow_turtlebot3_house_1_v3

Comparsion of controllers

-Global planner: NavFn

Controller type	Trajectory type	Success rate (%)	Average execution time (sec)	CPU(%)		Memory usage(%)		Average number of recoveries	Average path length(m)	Min distance to obstacles(m)	Average Path Deviation
				Mean	Max	Mean	Max				
DWB	single_goal_0	93.33	83.19	20.66	29.1	8.22	8.4	1.13	16.09	0.28	1.07
DWB	waypoints_1	40.0	98.74	20.88	28.9	8.30	8.4	12.53	16.61	0.12	6.85
DWB	circle_2	100.0	48.84	19.58	25.4	8.30	8.3	1.00	8.95	0.48	0.8
DWB	square_3	20.0	206.77	20.07	26.2	8.35	8.5	11.60	37.34	0.3	10.84
RPP	single_goal_0	100.0	73.33	19.88	27.3	8.42	8.5	1.00	16.63	0.27	0.94
RPP	waypoints_1	86.67	106.88	20.21	26.6	8.48	8.5	4.13	22.43	0.24	2.44
RPP	circle_2	100.0	42.57	18.59	26.5	8.44	8.5	0.13	8.91	0.41	0.85
RPP	square_3	100.0	47.49	19.27	24.9	8.44	8.5	0.00	10.55	0.33	2.02
DWB_RSC	single_goal_0	100.0	79.30	21.51	29.7	8.49	8.6	1.67	16.64	0.26	1.04
DWB_RSC	waypoints_1	20.0	95.03	21.72	29.1	8.51	8.6	15.07	13.91	0.12	5.9
DWB_RSC	circle_2	100.0	49.35	20.46	27.0	8.50	8.6	0.80	8.92	0.51	0.83
DWB_RSC	square_3	6.67	231.93	21.14	29.0	8.58	8.7	13.53	29.47	0.2	10.8
RPP_RSC	single_goal_0	100.0	75.19	21.47	28.1	8.60	8.7	1.67	16.70	0.27	1.01
RPP_RSC	waypoints_1	100.0	108.76	21.05	27.8	8.61	8.7	1.73	23.83	0.26	2.23
RPP_RSC	circle_2	100.0	44.44	19.85	25.5	8.60	8.6	0.40	8.96	0.43	0.96
RPP_RSC	square_3	100.0	47.80	20.89	27.0	8.60	8.6	0.00	10.45	0.31	1.89
MPPI	single_goal_0	100.0	70.75	23.90	31.1	8.60	8.7	0.33	16.24	0.33	0.9
MPPI	waypoints_1	86.67	98.10	23.83	30.2	8.64	8.7	3.47	22.16	0.14	2.05
MPPI	circle_2	100.0	35.80	22.32	28.5	8.60	8.7	0.00	8.54	0.48	0.6
MPPI	square_3	100.0	57.36	23.05	28.5	8.60	8.7	0.47	12.15	0.31	1.16
Graceful	single_goal_0	100.0	78.93	22.40	30.1	8.67	8.7	0.87	16.71	0.28	0.93
Graceful	waypoints_1	100.0	126.58	22.22	28.9	8.70	8.8	0.27	24.00	0.28	2.13
Graceful	circle_2	100.0	48.02	21.13	28.9	8.70	8.8	0.13	9.04	0.4	1.12
Graceful	square_3	100.0	55.63	21.55	29.7	8.70	8.9	0.00	10.45	0.39	1.62

-Global planner: smac_planner

Controller type	Trajectory type	Success rate (%)	Average execution time (sec)	CPU(%)		Memory usage(%)		Average number of recoveries	Average path length(m)	Min distance to obstacles(m)	Average Path Deviation
				Mean	Max	Mean	Max				
DWB	single_goal_0	100.0	79.18	23.01	30.5	8.70	8.7	0.60	16.39	0.25	1.1
DWB	waypoints_1	33.33	90.63	22.23	29.3	8.70	8.8	13.07	16.01	0.12	8.41
DWB	circle_2	100.0	46.55	22.28	27.2	8.70	8.8	0.53	8.84	0.47	0.75
DWB	square_3	33.33	170.96	22.39	29.6	8.79	8.9	9.67	30.68	0.31	8.51
RPP	single_goal_0	100.0	74.24	21.70	27.6	8.80	8.8	1.80	16.46	0.22	1.0
RPP	waypoints_1	60.0	95.15	22.25	28.5	8.80	8.9	7.60	18.26	0.23	2.23
RPP	circle_2	100.0	42.46	21.43	26.1	8.80	8.9	0.20	8.89	0.43	0.87
RPP	square_3	100.0	47.52	21.53	28.5	8.80	8.9	0.00	10.50	0.32	1.62
DWB_RSC	single_goal_0	100.0	77.31	23.42	31.1	8.85	9.0	1.73	16.37	0.23	0.89
DWB_RSC	waypoints_1	53.33	133.52	23.81	31.2	8.89	9.0	8.93	19.43	0.12	5.18
DWB_RSC	circle_2	100.0	51.23	23.40	30.3	8.89	8.9	1.07	8.93	0.46	0.86
DWB_RSC	square_3	6.67	213.67	23.25	30.0	8.93	9.1	13.53	26.29	0.24	7.68
RPP_RSC	single_goal_0	93.33	71.18	23.29	30.7	8.96	9.0	2.67	15.40	0.23	0.93
RPP_RSC	waypoints_1	66.67	101.15	22.80	29.1	8.98	9.1	8.87	19.05	0.12	3.64
RPP_RSC	circle_2	100.0	42.58	22.73	28.5	8.97	9.0	0.20	8.90	0.46	0.83
RPP_RSC	square_3	100.0	47.10	22.99	28.4	8.99	9.0	0.00	10.47	0.33	1.61
MPPI	single_goal_0	100.0	67.07	25.59	32.9	9.00	9.1	0.00	16.09	0.32	0.95
MPPI	waypoints_1	86.67	92.65	24.98	30.3	9.01	9.1	2.27	21.26	0.15	1.89
MPPI	circle_2	100.0	36.44	24.93	29.3	9.00	9.0	0.00	8.55	0.52	0.65
MPPI	square_3	100.0	63.47	25.05	31.8	9.02	9.1	0.67	12.97	0.32	1.49
Graceful	single_goal_0	100.0	77.84	24.55	31.9	9.02	9.1	0.47	16.52	0.27	0.95
Graceful	waypoints_1	93.33	121.00	23.80	34.7	9.05	9.2	1.40	21.89	0.2	1.98
Graceful	circle_2	100.0	50.14	23.44	28.3	9.02	9.1	0.20	9.06	0.41	1.24
Graceful	square_3	100.0	54.30	23.25	28.4	9.07	9.1	0.00	10.60	0.33	1.38

-Global planner: ThetaStar

Controller type	Trajectory type	Success rate (%)	Average execution time (sec)	CPU(%)		Memory usage(%)		Average number of recoveries	Average path length(m)	Min distance to obstacles(m)	Average Path Deviation
				Mean	Max	Mean	Max				
DWB	single_goal_0	93.33	78.33	25.25	32.5	9.10	9.1	1.87	15.71	0.25	0.98
DWB	waypoints_1	73.33	115.30	24.54	31.9	9.10	9.2	7.13	20.49	0.12	3.7
DWB	circle_2	100.0	50.04	24.33	29.4	9.10	9.2	1.07	8.94	0.48	0.79
DWB	square_3	33.33	160.27	24.66	31.9	9.14	9.2	9.67	28.74	0.25	7.81
RPP	single_goal_0	80.0	71.72	23.55	31.1	9.14	9.2	5.27	14.54	0.21	1.25
RPP	waypoints_1	73.33	94.36	23.57	31.3	9.18	9.2	7.40	18.51	0.2	2.05

RPP	circle_2	100.0	43.50	23.21	28.5	9.14	9.2	0.20	8.93	0.44	0.79
RPP	square_3	86.67	109.29	23.37	28.7	9.19	9.3	1.93	17.69	0.31	2.38
DWB_RSC	single_goal_0	93.33	89.15	24.92	31.6	9.20	9.2	4.87	15.85	0.23	1.31
DWB_RSC	waypoints_1	73.33	126.34	25.04	32.4	9.21	9.3	7.33	18.94	0.18	2.74
DWB_RSC	circle_2	100.0	49.92	24.81	31.5	9.20	9.2	1.07	8.92	0.5	0.79
DWB_RSC	square_3	53.33	129.24	24.54	30.8	9.25	9.3	6.73	17.96	0.31	4.31
RPP_RSC	single_goal_0	60.0	63.90	24.31	30.6	9.28	9.3	9.53	10.32	0.24	1.03
RPP_RSC	waypoints_1	80.0	92.10	23.56	31.8	9.29	9.3	5.00	19.07	0.21	2.03
RPP_RSC	circle_2	100.0	43.25	23.91	29.0	9.29	9.3	0.13	8.93	0.46	0.81
RPP_RSC	square_3	100.0	53.63	23.97	29.9	9.29	9.4	0.47	10.75	0.33	1.54
MPPI	single_goal_0	100.0	78.38	25.98	31.8	9.30	9.4	2.87	15.88	0.31	1.19
MPPI	waypoints_1	100.0	87.04	26.16	32.9	9.30	9.4	0.80	21.05	0.3	1.75
MPPI	circle_2	100.0	36.06	23.82	29.3	9.30	9.3	0.00	8.52	0.53	0.61
MPPI	square_3	100.0	62.27	24.71	30.8	9.31	9.4	0.80	12.51	0.34	1.3
Graceful	single_goal_0	100.0	80.12	23.71	34.7	9.34	9.4	1.13	16.15	0.2	1.05
Graceful	waypoints_1	100.0	110.35	22.78	32.0	9.38	9.4	0.73	21.71	0.2	1.86
Graceful	circle_2	100.0	48.59	23.13	27.4	9.32	9.4	0.13	9.02	0.41	1.15
Graceful	square_3	100.0	52.83	22.79	27.9	9.36	9.4	0.00	10.56	0.33	1.24

-Global planner: Lattice

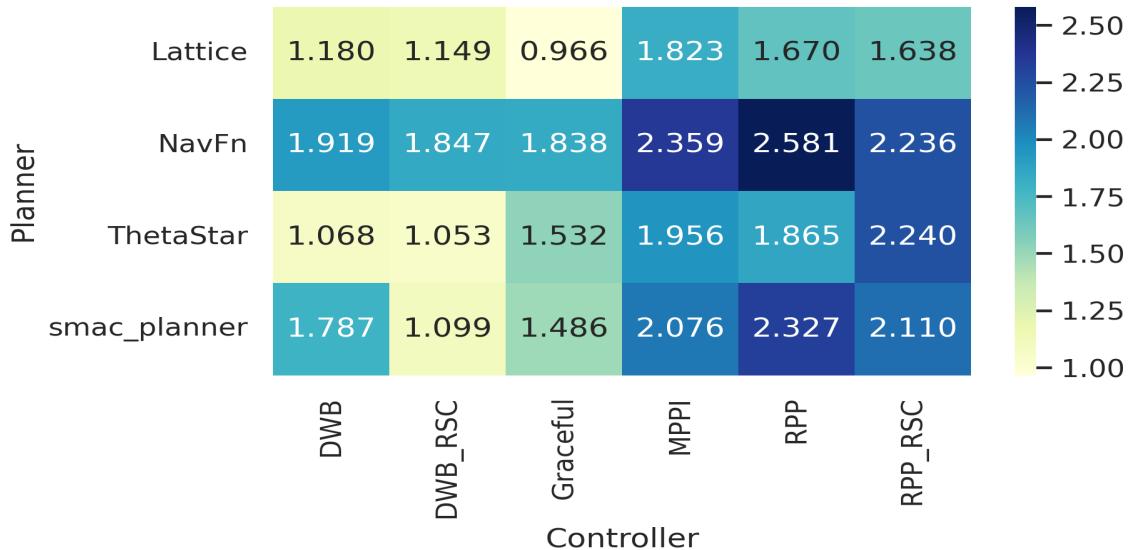
Controller type	Trajectory type	Success rate (%)	Average execution time (sec)	CPU(%)		Memory usage(%)		Average number of recoveries	Average path length(m)	Min distance to obstacles(m)	Average Path Deviation
				Mean	Max	Mean	Max				
DWB	single_goal_0	100.0	74.11	24.49	33.2	9.40	9.5	0.47	16.34	0.25	1.13
DWB	waypoints_1	40.0	143.49	24.27	34.9	9.44	9.5	11.87	18.64	0.2	4.93
DWB	circle_2	100.0	48.84	23.74	29.7	9.40	9.5	0.87	8.88	0.46	0.88
DWB	square_3	66.67	108.49	23.85	29.9	9.45	9.5	5.60	20.00	0.19	4.07
RPP	single_goal_0	100.0	76.65	23.66	35.5	9.50	9.6	3.53	16.45	0.22	1.26
RPP	waypoints_1	60.0	93.85	22.95	32.4	9.50	9.6	9.27	17.51	0.21	2.09
RPP	circle_2	100.0	42.59	23.18	34.4	9.49	9.7	0.33	9.30	0.34	0.88
RPP	square_3	100.0	49.38	23.30	34.1	9.54	9.8	0.67	10.78	0.23	1.51
DWB_RSC	single_goal_0	100.0	75.70	24.73	35.9	9.74	9.9	1.67	16.40	0.25	1.15
DWB_RSC	waypoints_1	66.67	143.38	23.76	37.1	9.79	9.9	6.93	19.85	0.2	3.33
DWB_RSC	circle_2	100.0	48.99	24.22	28.8	9.78	9.9	0.87	8.91	0.43	0.88
DWB_RSC	square_3	86.67	62.81	23.92	29.2	9.78	9.8	3.20	11.36	0.2	1.85
RPP_RSC	single_goal_0	100.0	72.92	23.52	35.9	9.81	9.9	1.60	16.38	0.22	1.11
RPP_RSC	waypoints_1	46.67	91.97	23.53	30.7	9.84	10.0	11.20	15.74	0.12	2.28
RPP_RSC	circle_2	100.0	43.25	22.83	27.6	9.89	9.9	0.27	9.25	0.35	0.89

RPP_RSC	square_3	100.0	50.04	23.10	27.6	9.85	9.9	1.20	10.77	0.21	1.45
MPPI	single_goal_0	100.0	66.52	26.08	32.9	9.87	9.9	0.00	16.15	0.32	0.98
MPPI	waypoints_1	100.0	88.65	24.88	31.1	9.90	10.0	0.87	21.54	0.14	1.82
MPPI	circle_2	100.0	36.58	24.87	29.5	9.90	9.9	0.40	8.54	0.4	0.85
MPPI	square_3	100.0	44.98	24.57	30.0	9.90	10.0	0.33	10.53	0.32	1.27
Graceful	single_goal_0	100.0	79.82	23.79	29.1	9.91	10.0	0.00	16.56	0.28	1.19
Graceful	waypoints_1	100.0	125.25	23.47	40.5	9.93	10.1	1.20	22.32	0.24	2.4
Graceful	circle_2	100.0	54.57	23.13	27.6	9.90	9.9	0.13	9.31	0.35	1.31
Graceful	square_3	100.0	69.17	22.98	29.1	9.90	10.0	0.80	10.82	0.24	1.81

Performance analysis

Based on the criteria: Time, path_length, CPU, Memory, Safety

The score of each controller and planner combinations are:



Success rate

Planners' success rate are:

Planner: Lattice, Success Rate: 90.28%

Planner: ThetaStar, Success Rate: 87.50%

Planner: smac_planner, Success Rate: 84.44%

Planner: NavFn, Success Rate: 85.56%

Controllers' success rate are:

Controller: Graceful, Success Rate: 99.58%

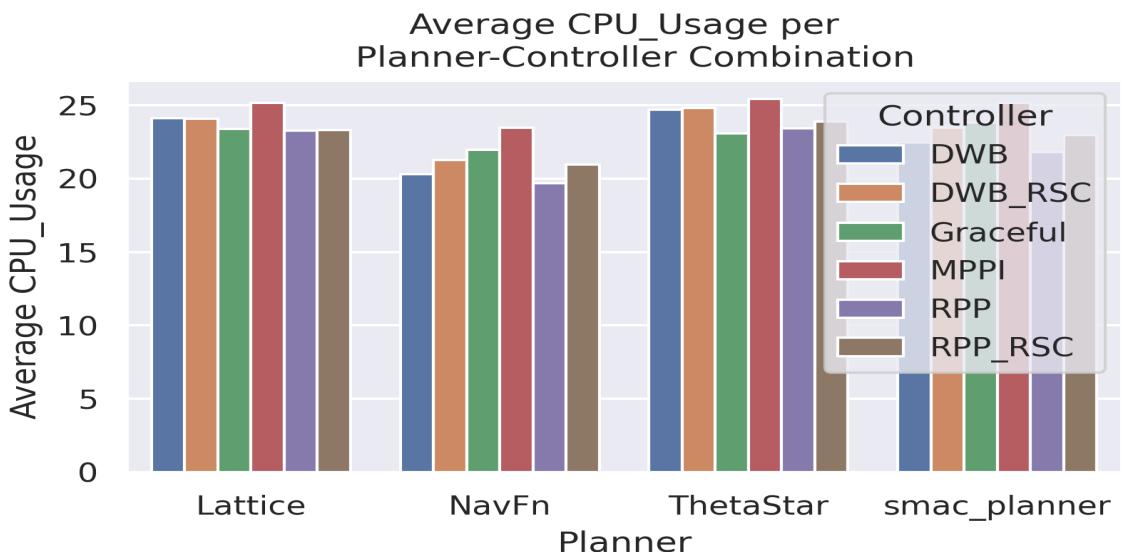
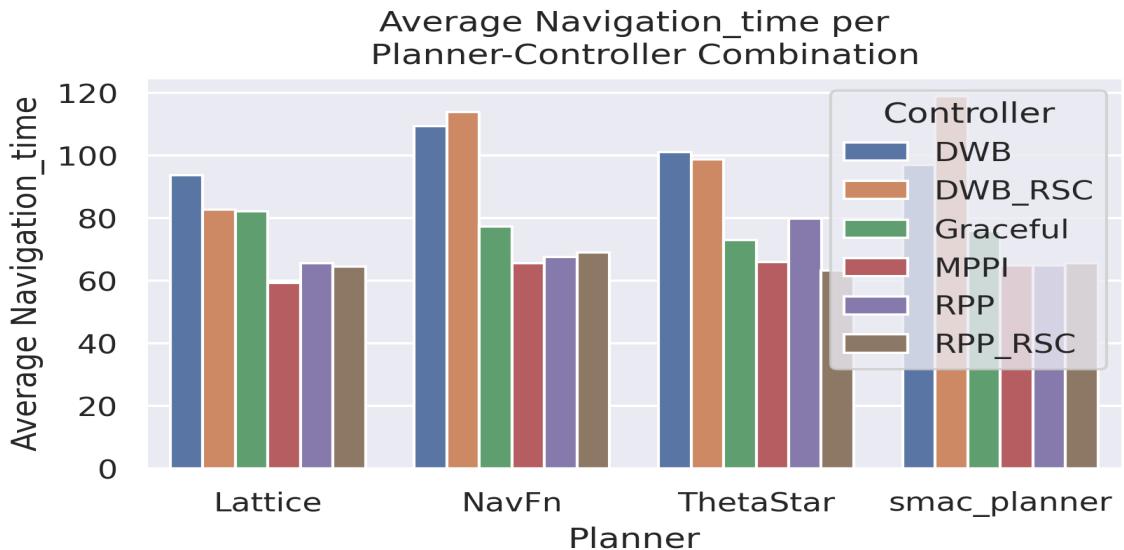
Controller: MPPI, Success Rate: 98.33%

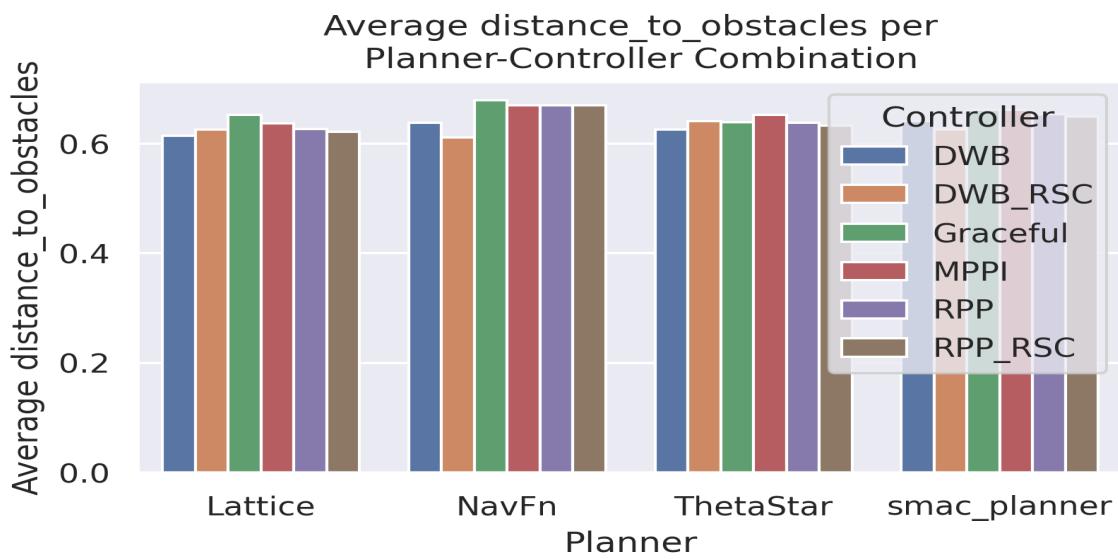
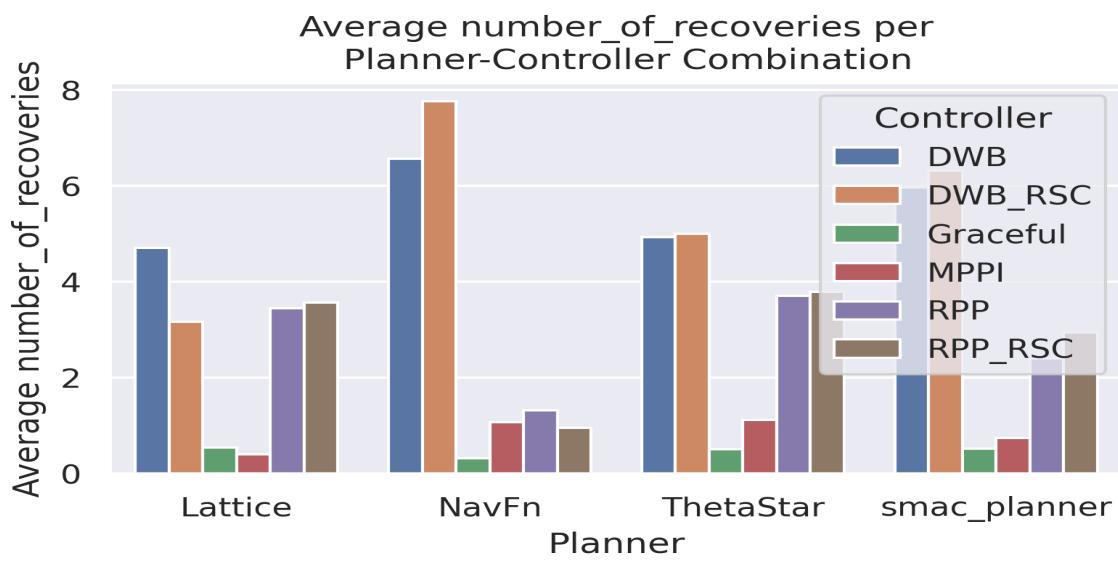
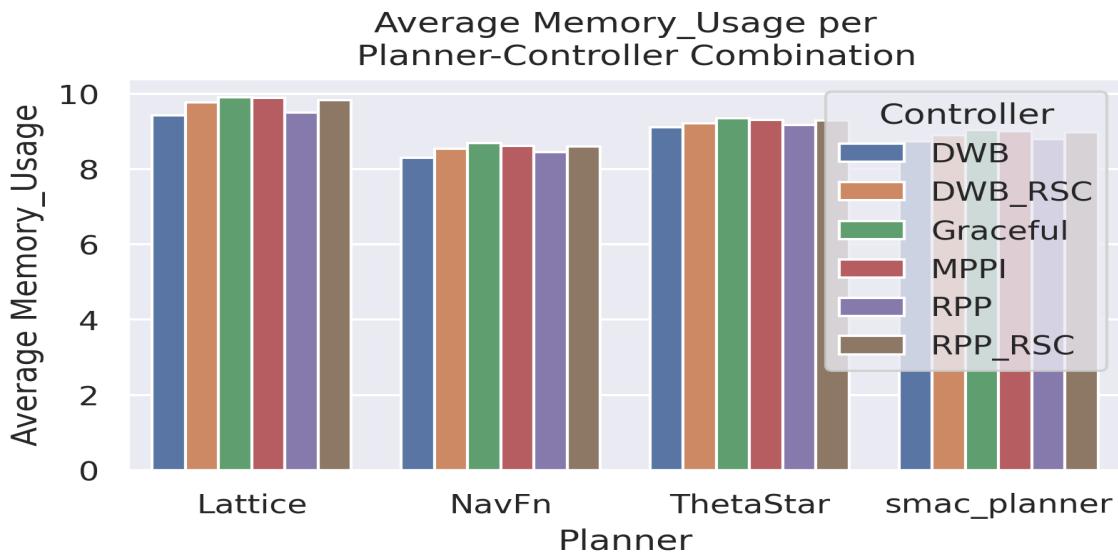
Controller: RPP_RSC, Success Rate: 90.42%

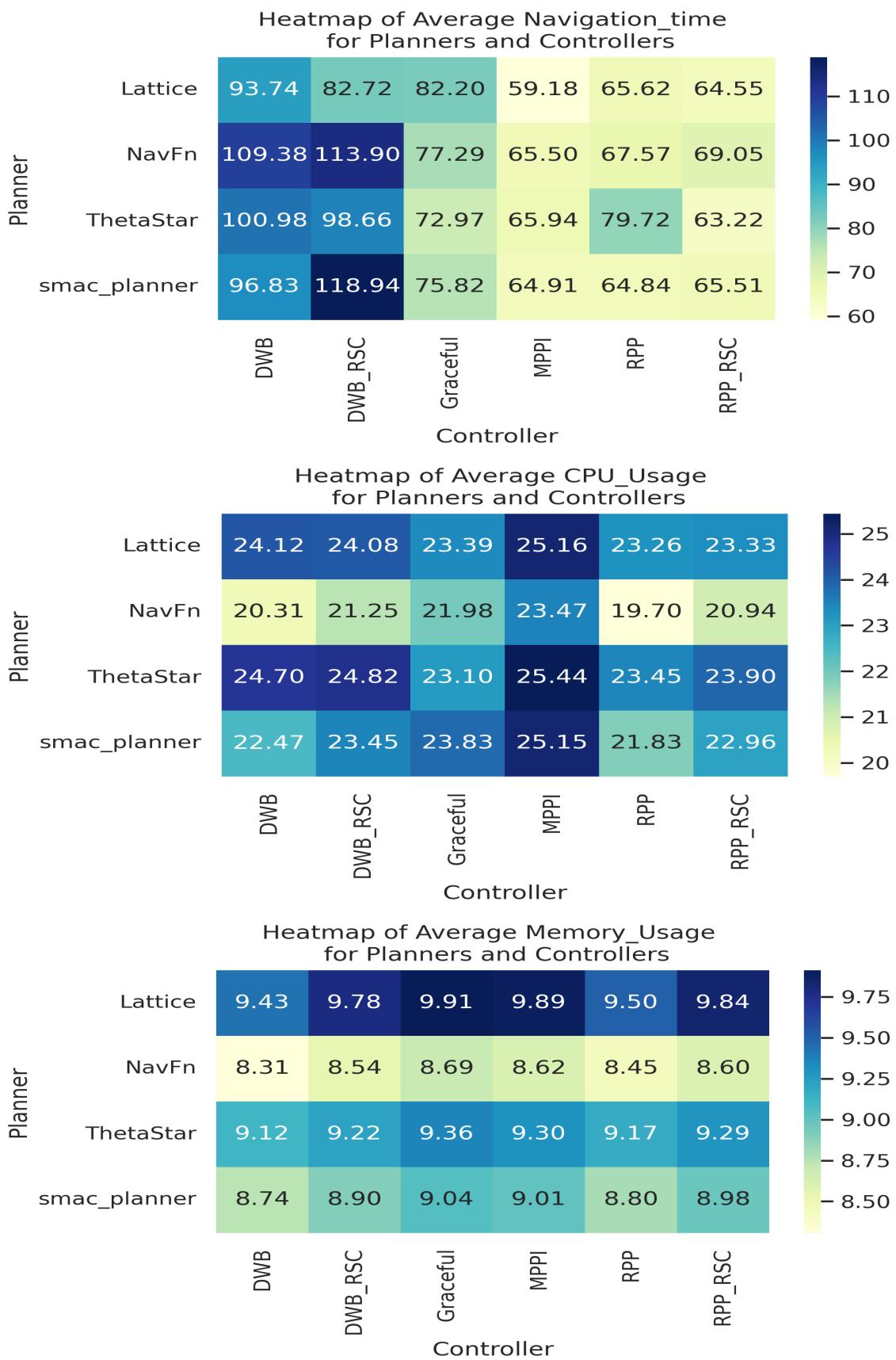
Controller: DWB_RSC, Success Rate: 72.50%

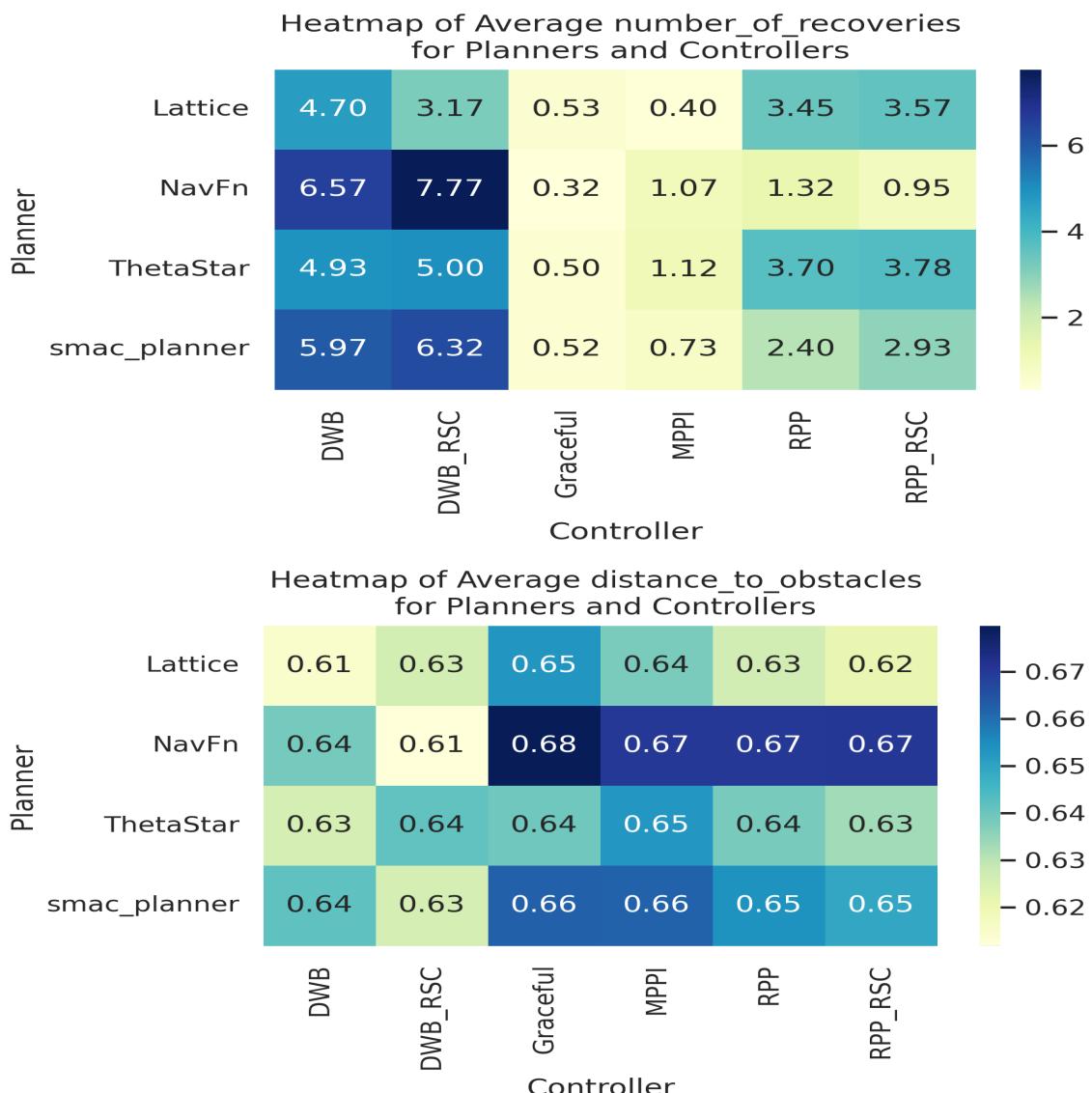
Controller: RPP, Success Rate: 90.42%

Controller: DWB, Success Rate: 70.42%

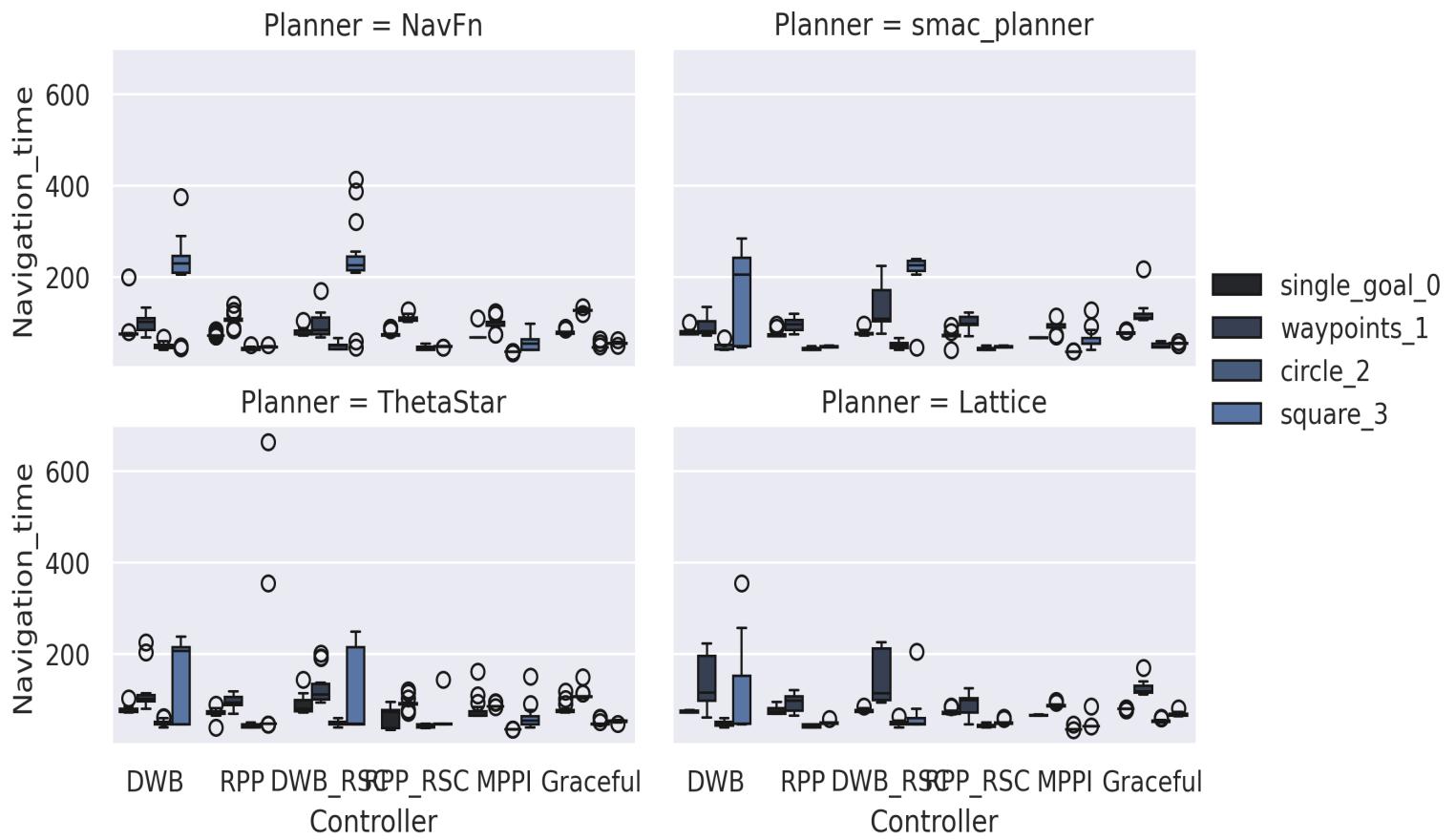




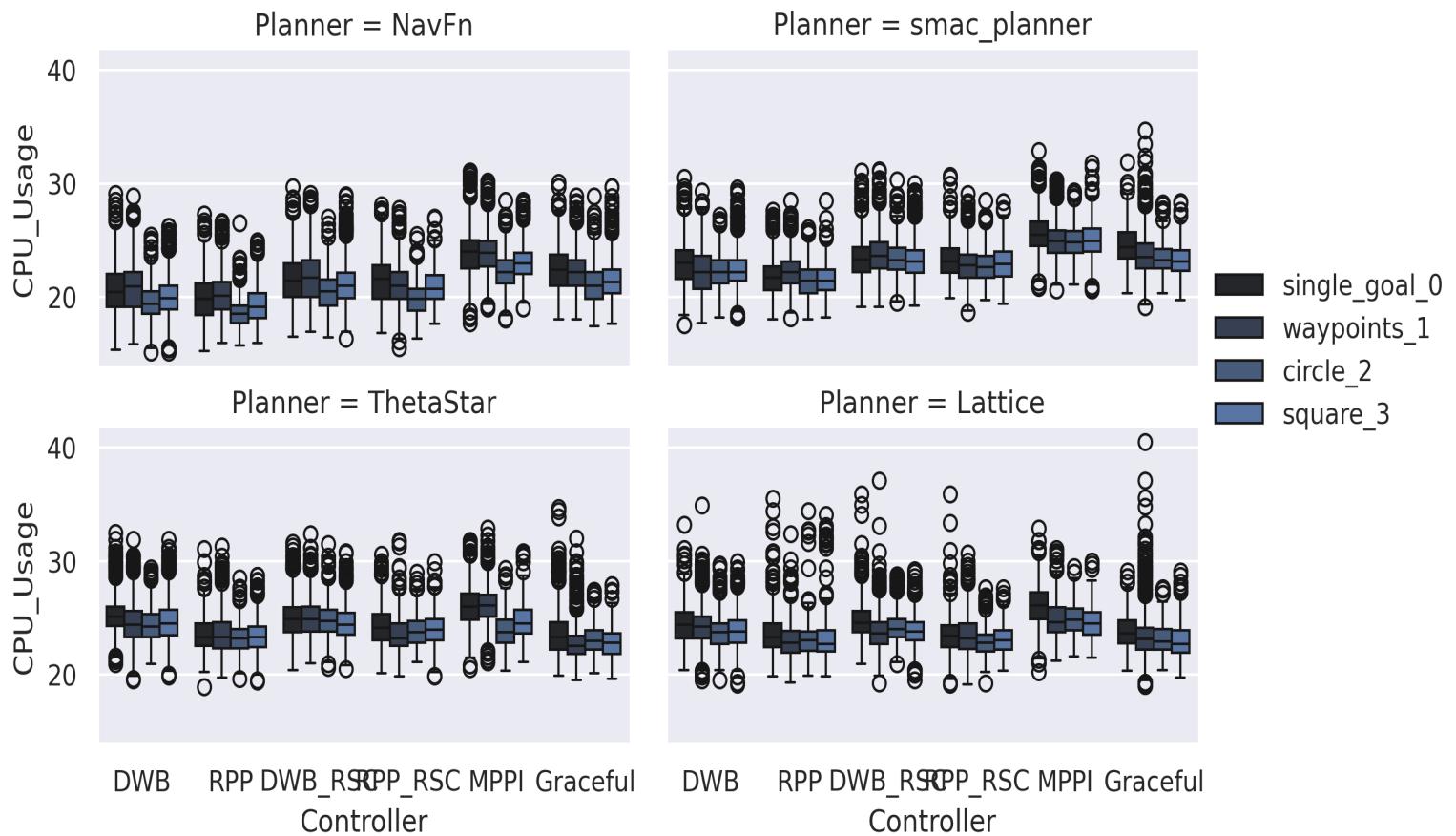




Complex Distribution of Navigation_time by Planner, Controller, and Trajectory Type



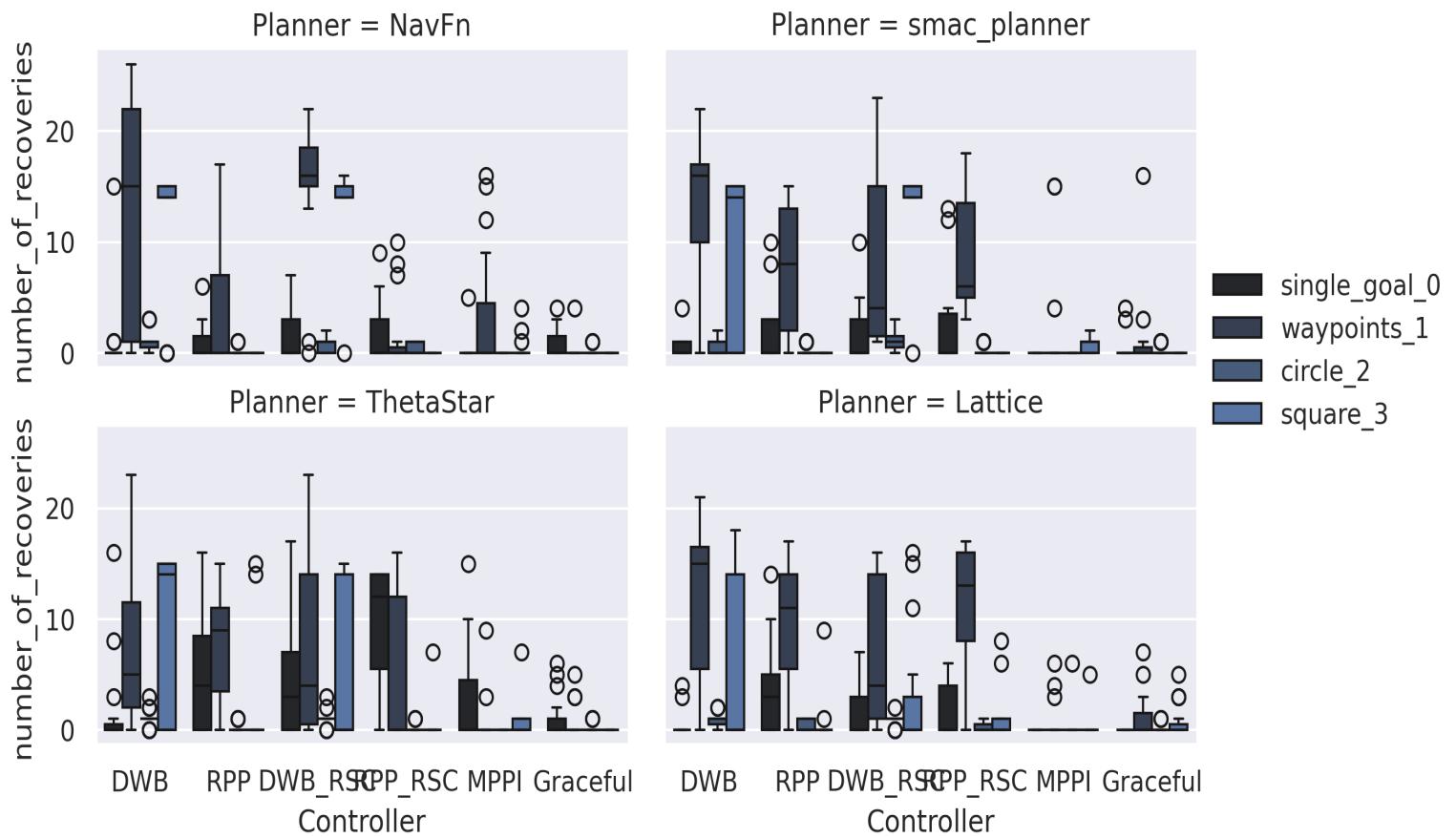
Complex Distribution of CPU_Usage by Planner, Controller, and Trajectory Type



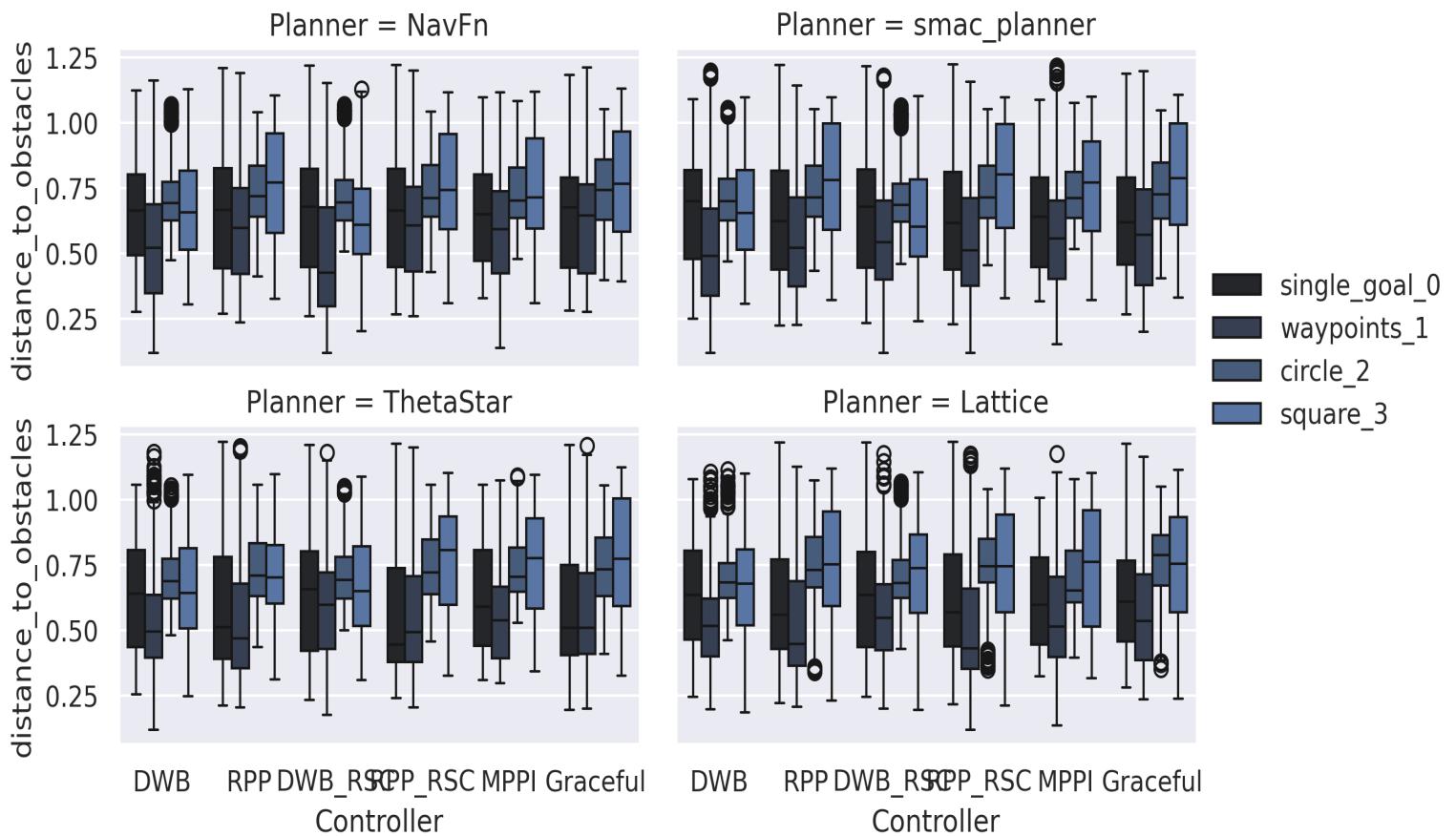
Complex Distribution of Memory_Usage by Planner, Controller, and Trajectory Type



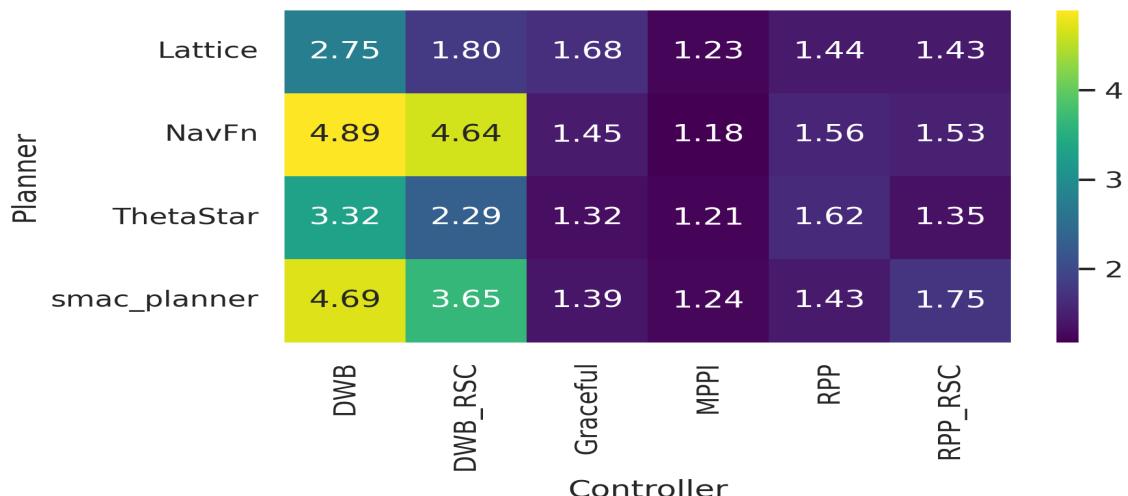
Complex Distribution of number_of_recoveries by Planner, Controller, and Trajectory Type

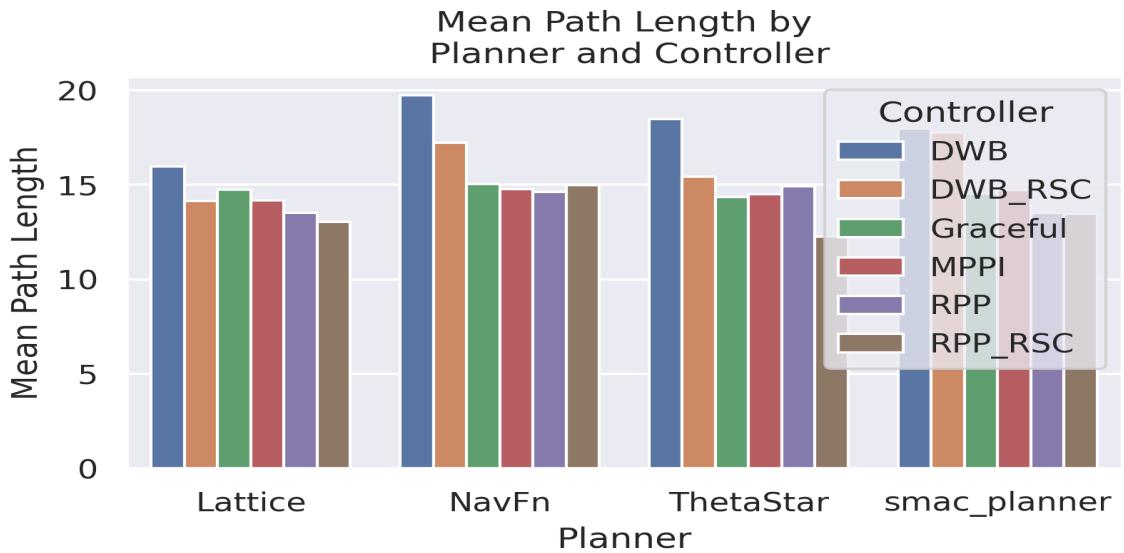


Complex Distribution of distance_to_obstacles by Planner, Controller, and Trajectory Type



Path Deviation Heatmap by
Controller and Planner



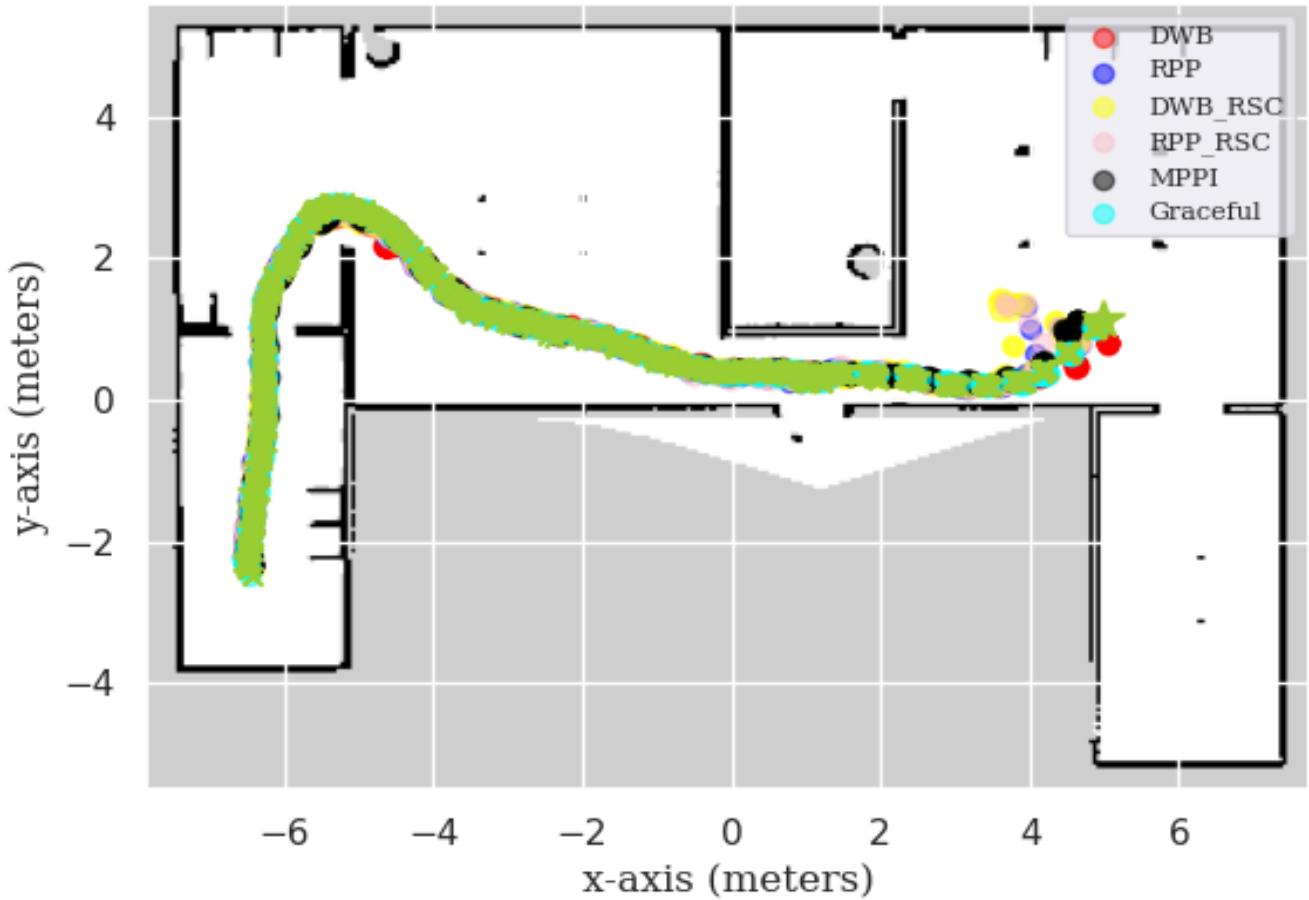


-Global planner: NavFn

Traveled path

-Trajectory type: single_goal_0

✖ Global planner path * Waypoints ★ Initial pose



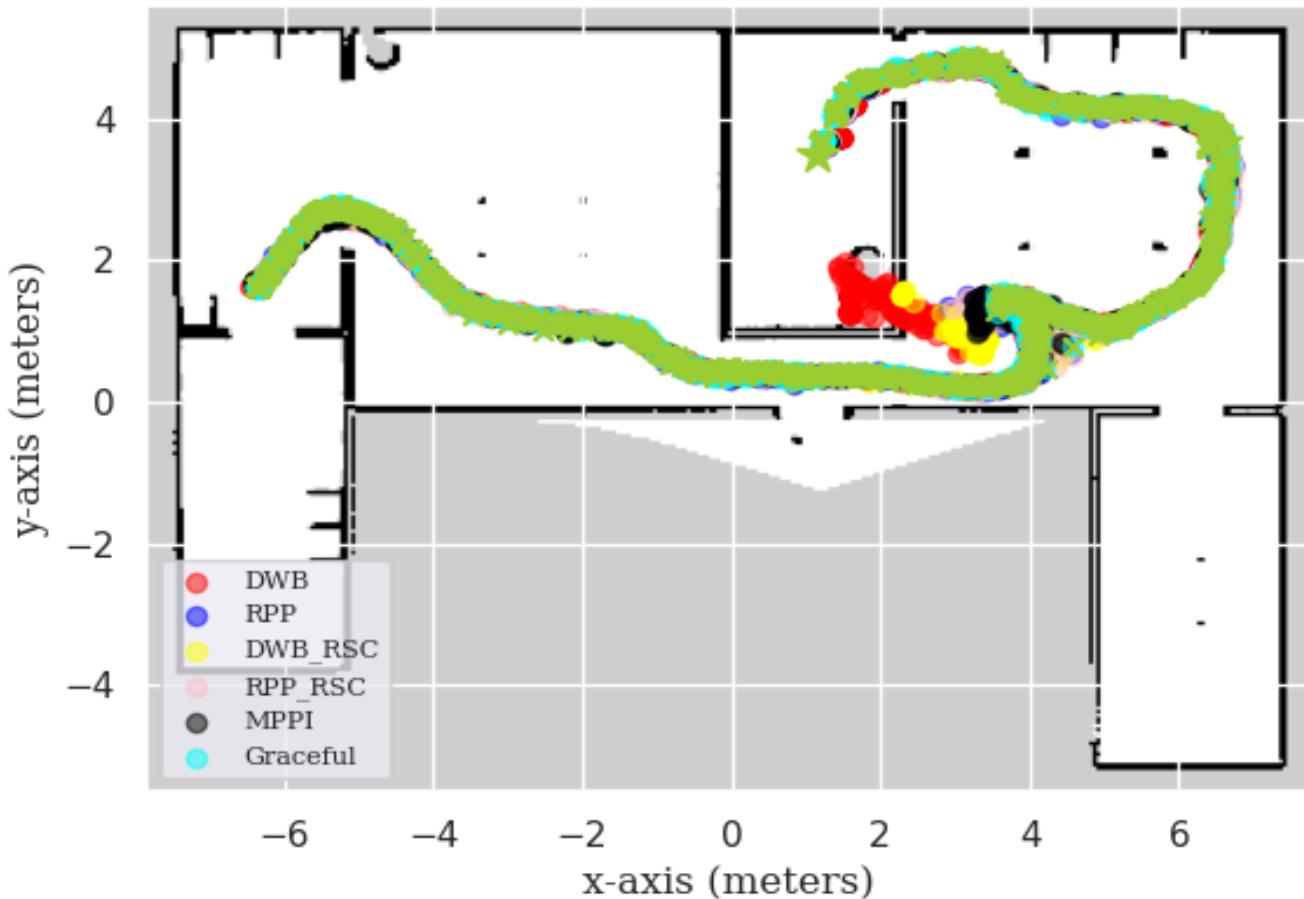
-Global planner: NavFn

Traveled path

-Trajectory type: waypoints_1

x Global planner path * Waypoints

★ Initial pose



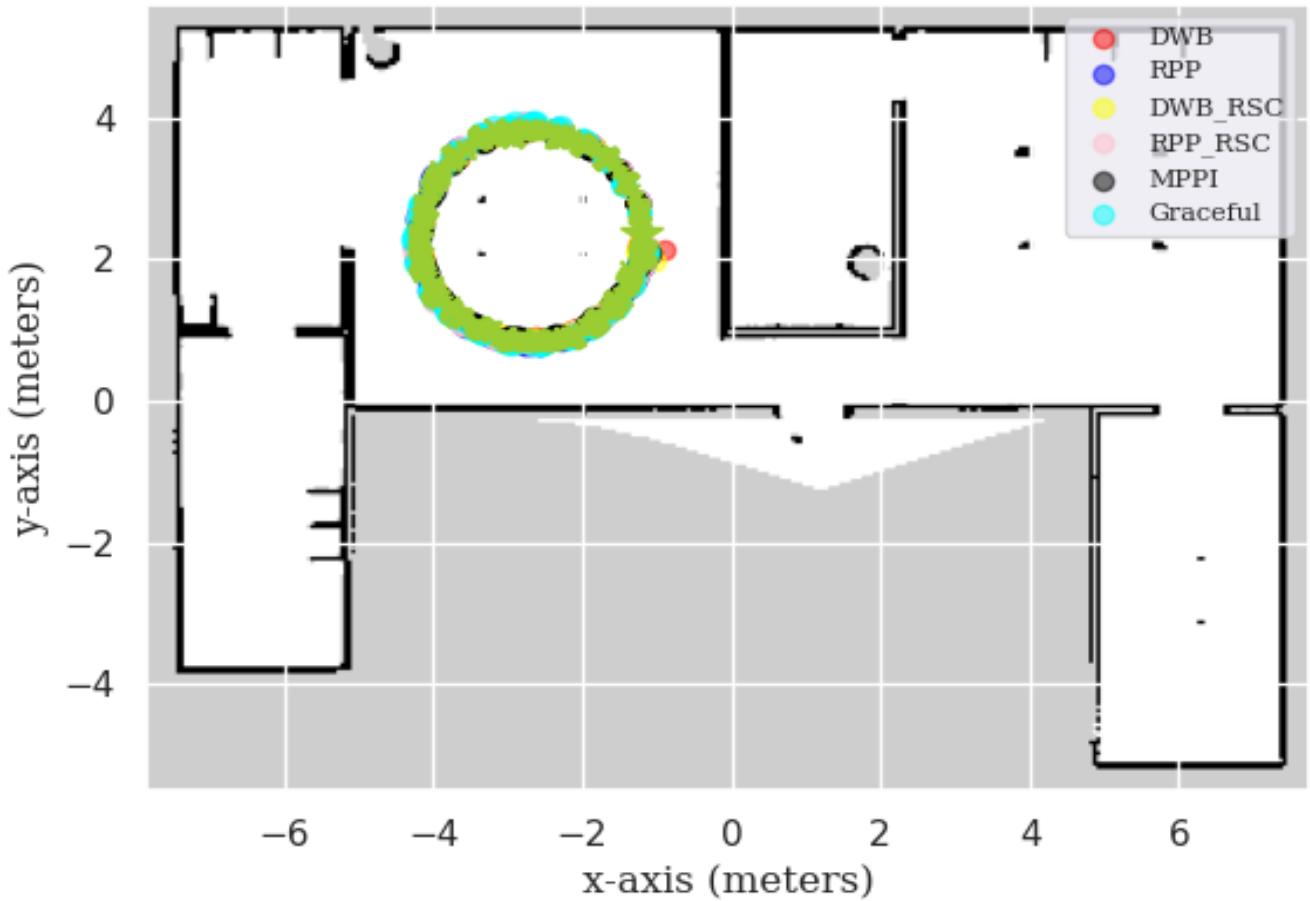
-Global planner: NavFn

Traveled path

-Trajectory type: circle_2

x Global planner path * Waypoints

★ Initial pose



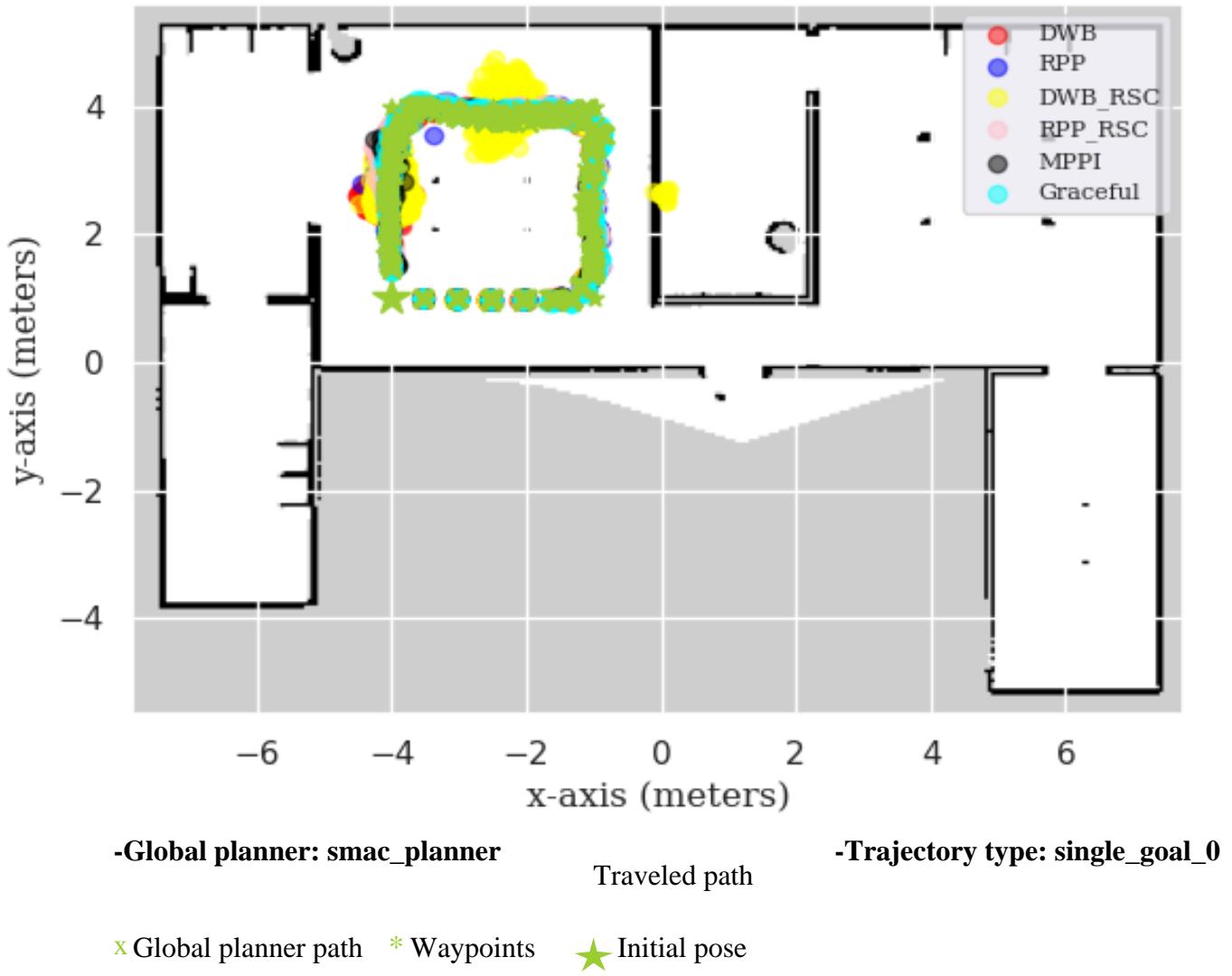
-Global planner: NavFn

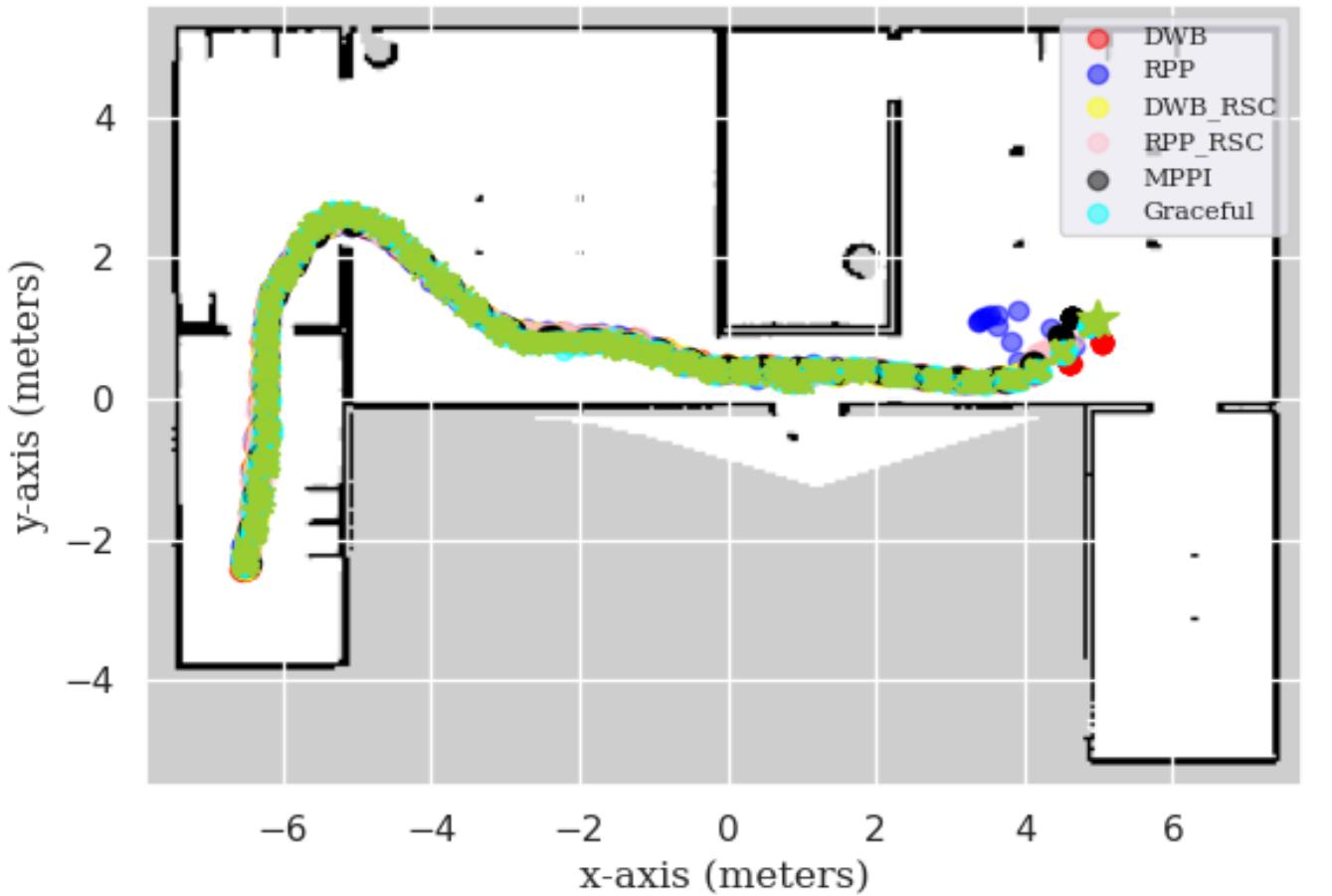
Traveled path

-Trajectory type: square_3

✖ Global planner path * Waypoints

★ Initial pose





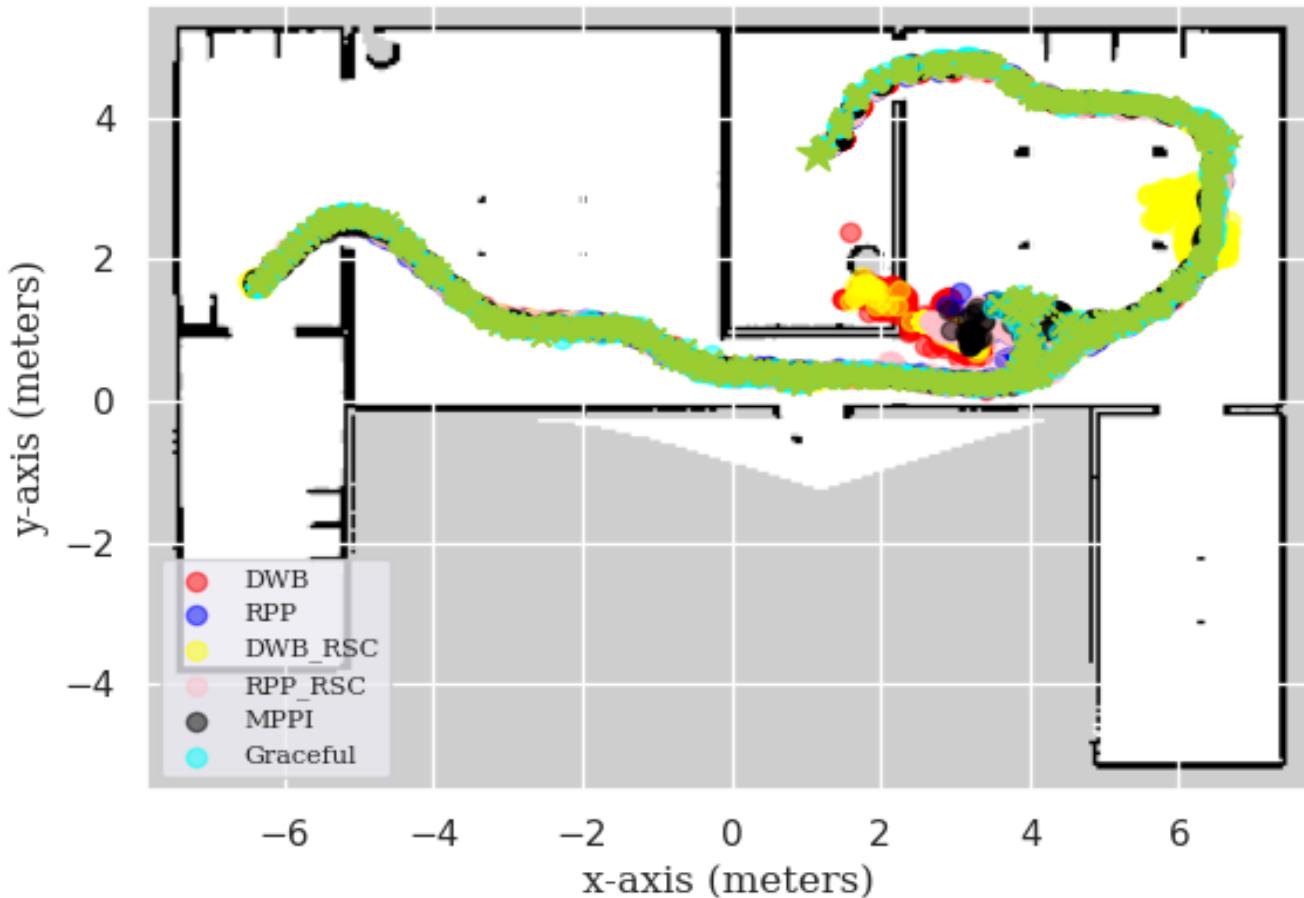
-Global planner: smac_planner

Traveled path

-Trajectory type: waypoints_1

✖ Global planner path * Waypoints

★ Initial pose



-Global planner: smac_planner

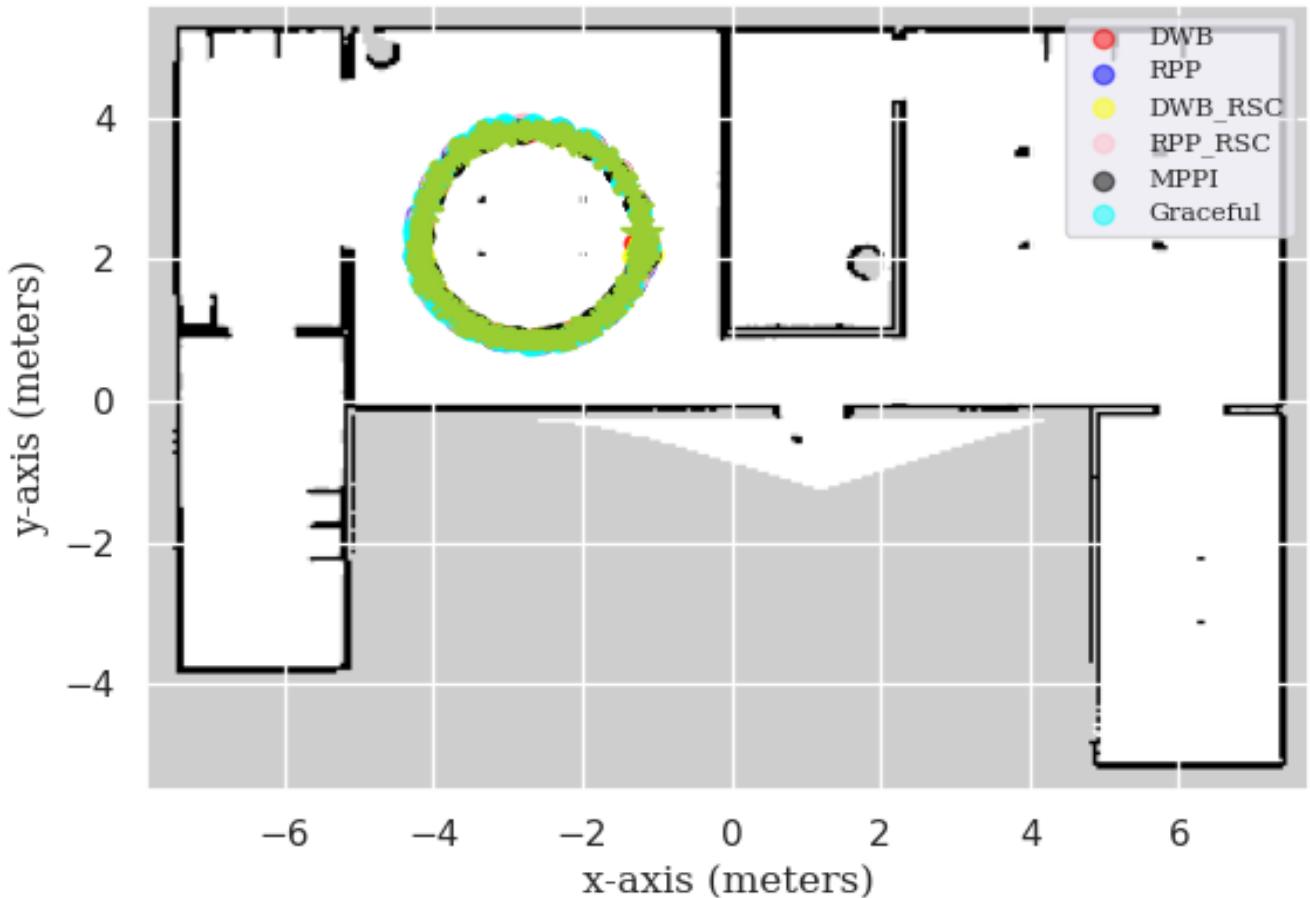
-Trajectory type: circle_2

Traveled path

Global planner path

Waypoints

Initial pose



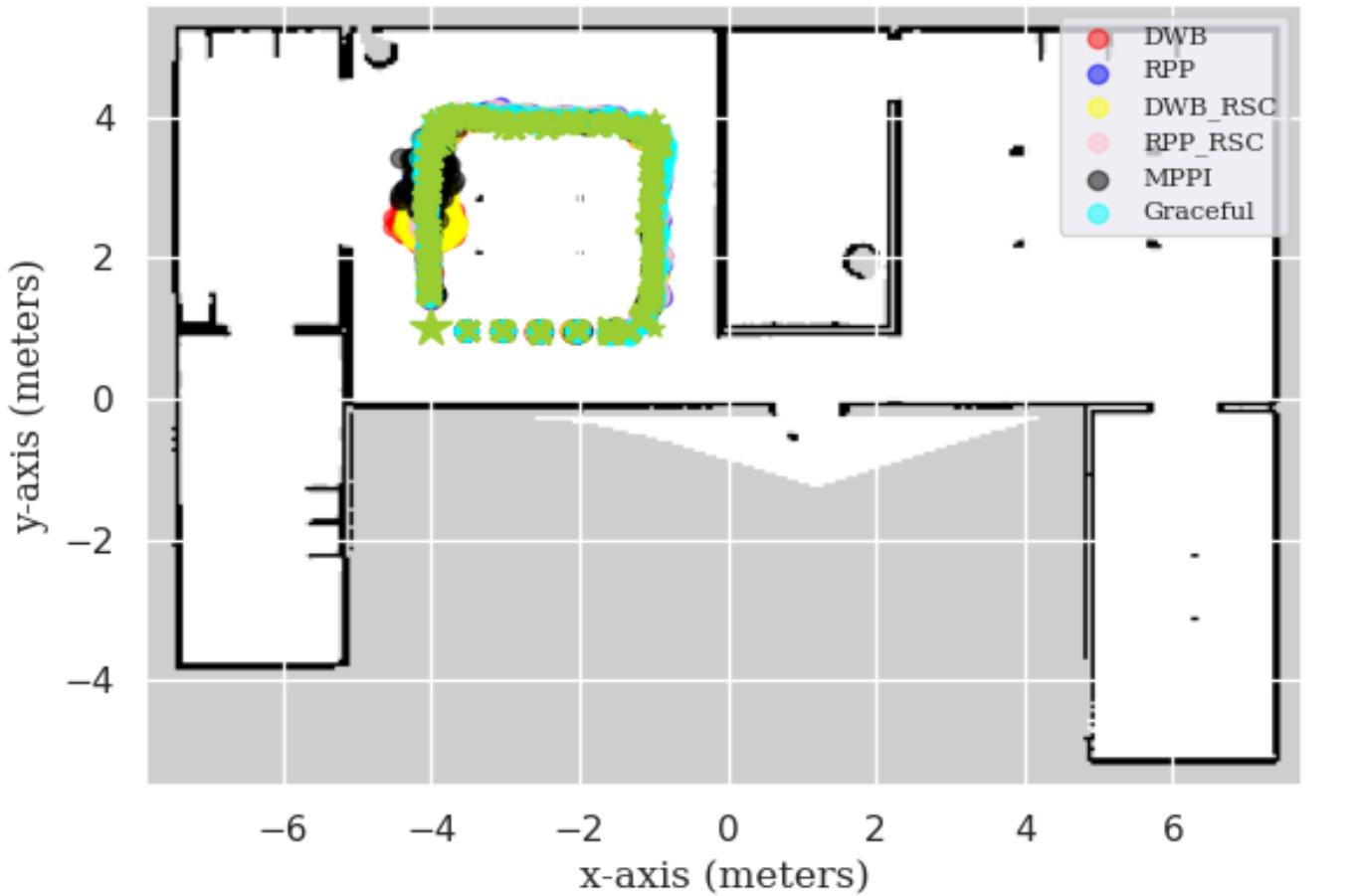
-Global planner: smac_planner

Traveled path

-Trajectory type: square_3

✖ Global planner path * Waypoints

★ Initial pose



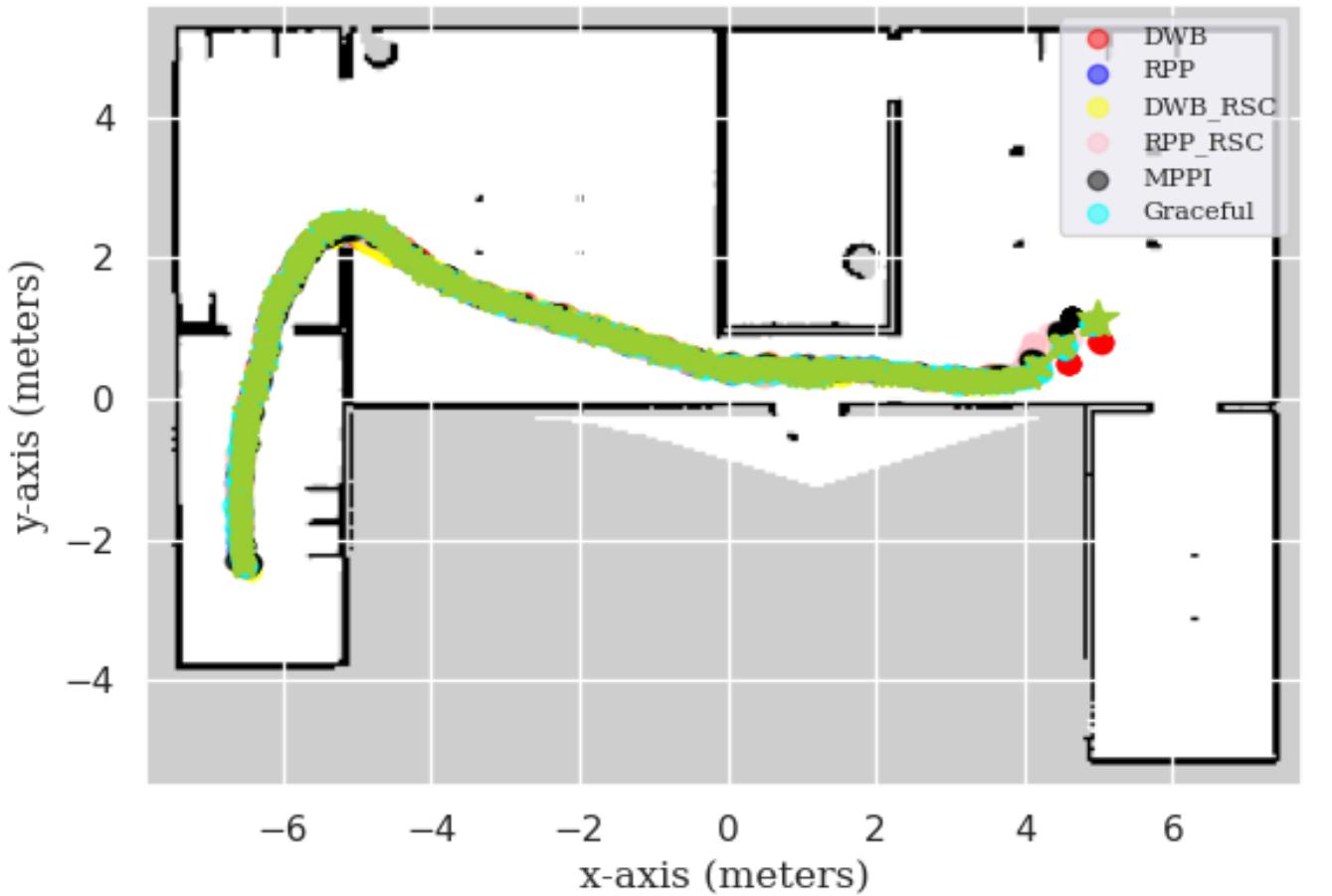
-Global planner: ThetaStar

Traveled path

-Trajectory type: single_goal_0

✖ Global planner path * Waypoints

★ Initial pose



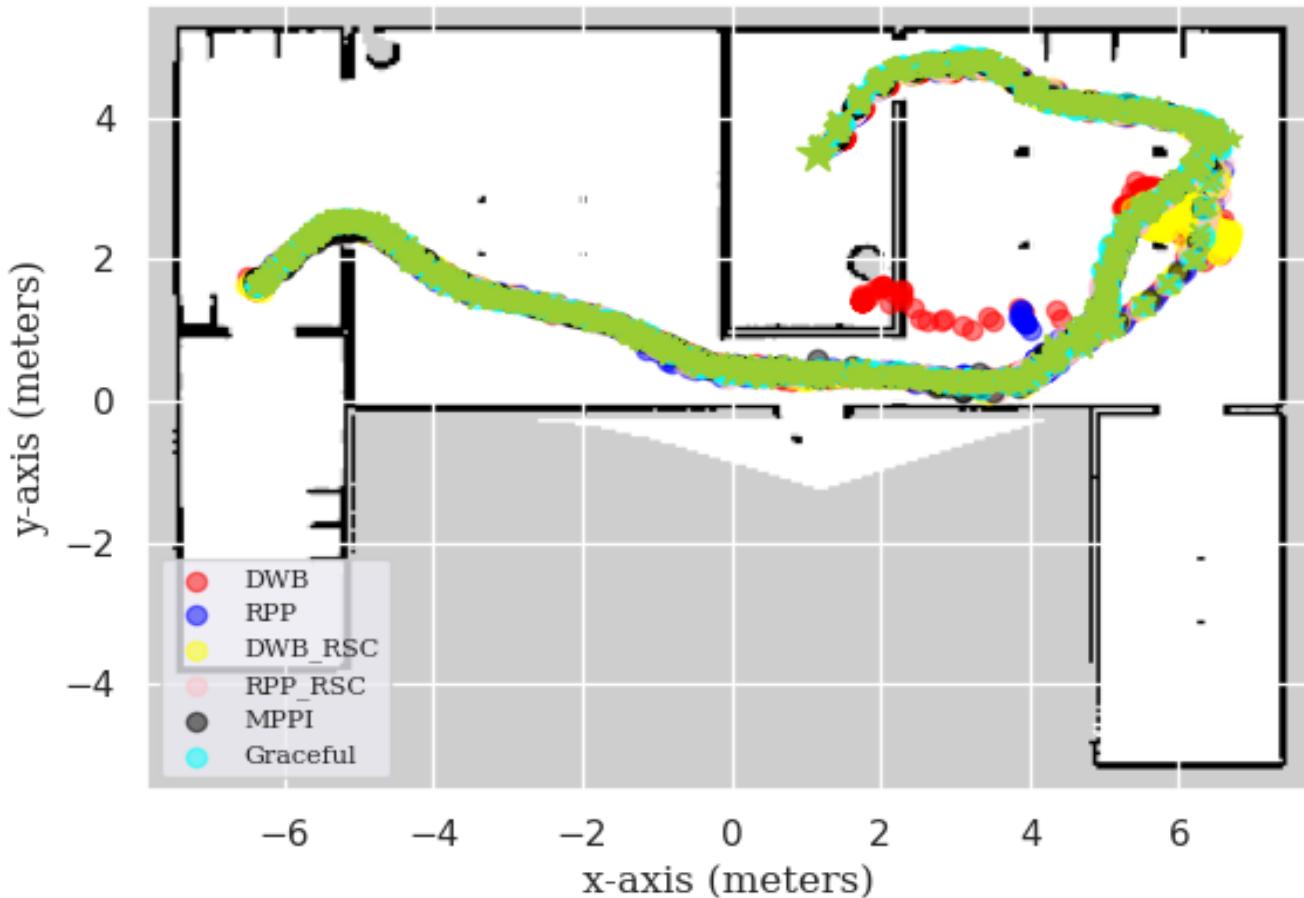
-Global planner: ThetaStar

Traveled path

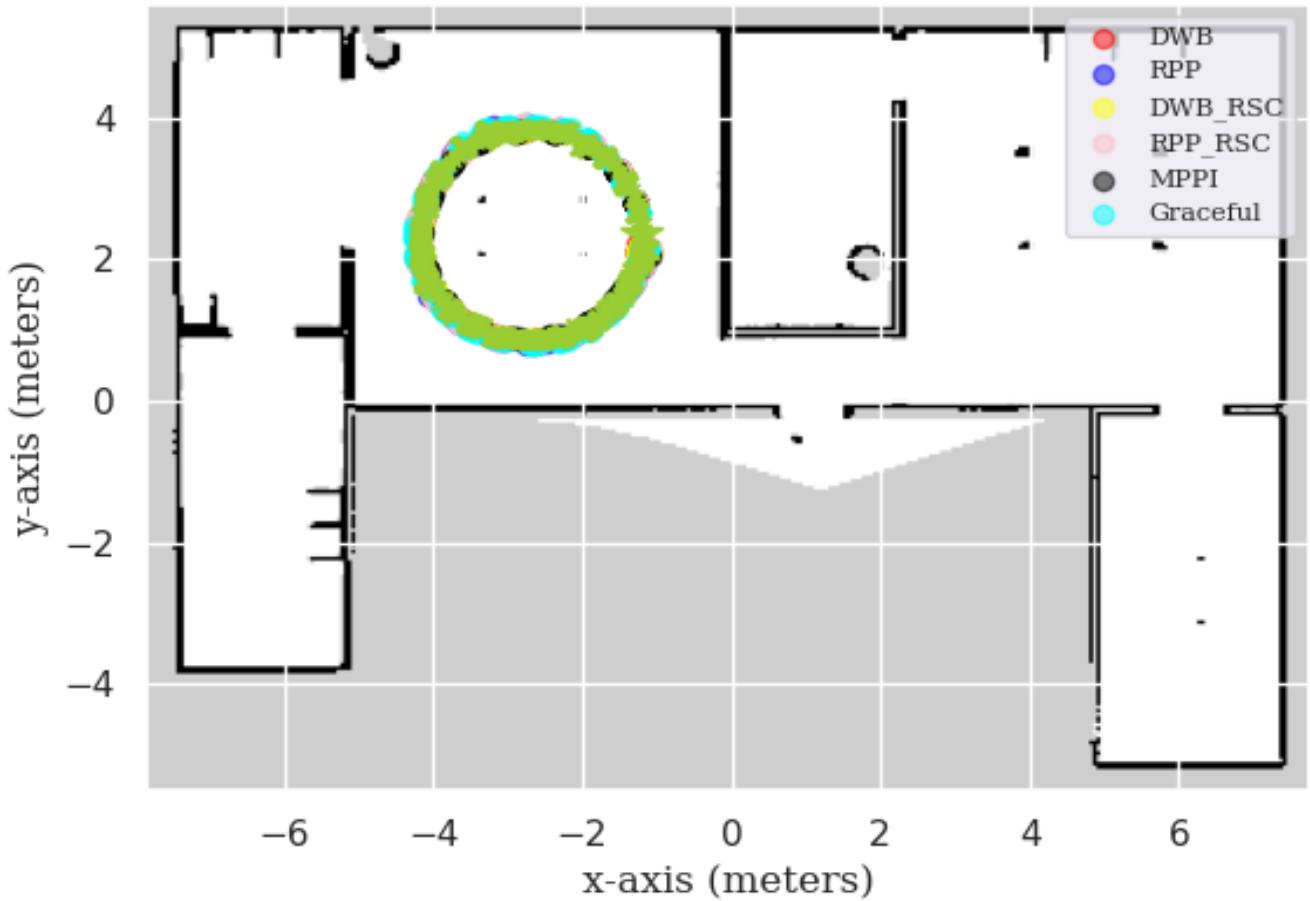
-Trajectory type: waypoints_1

✗ Global planner path * Waypoints

★ Initial pose



Global planner path * Waypoints ★ Initial pose



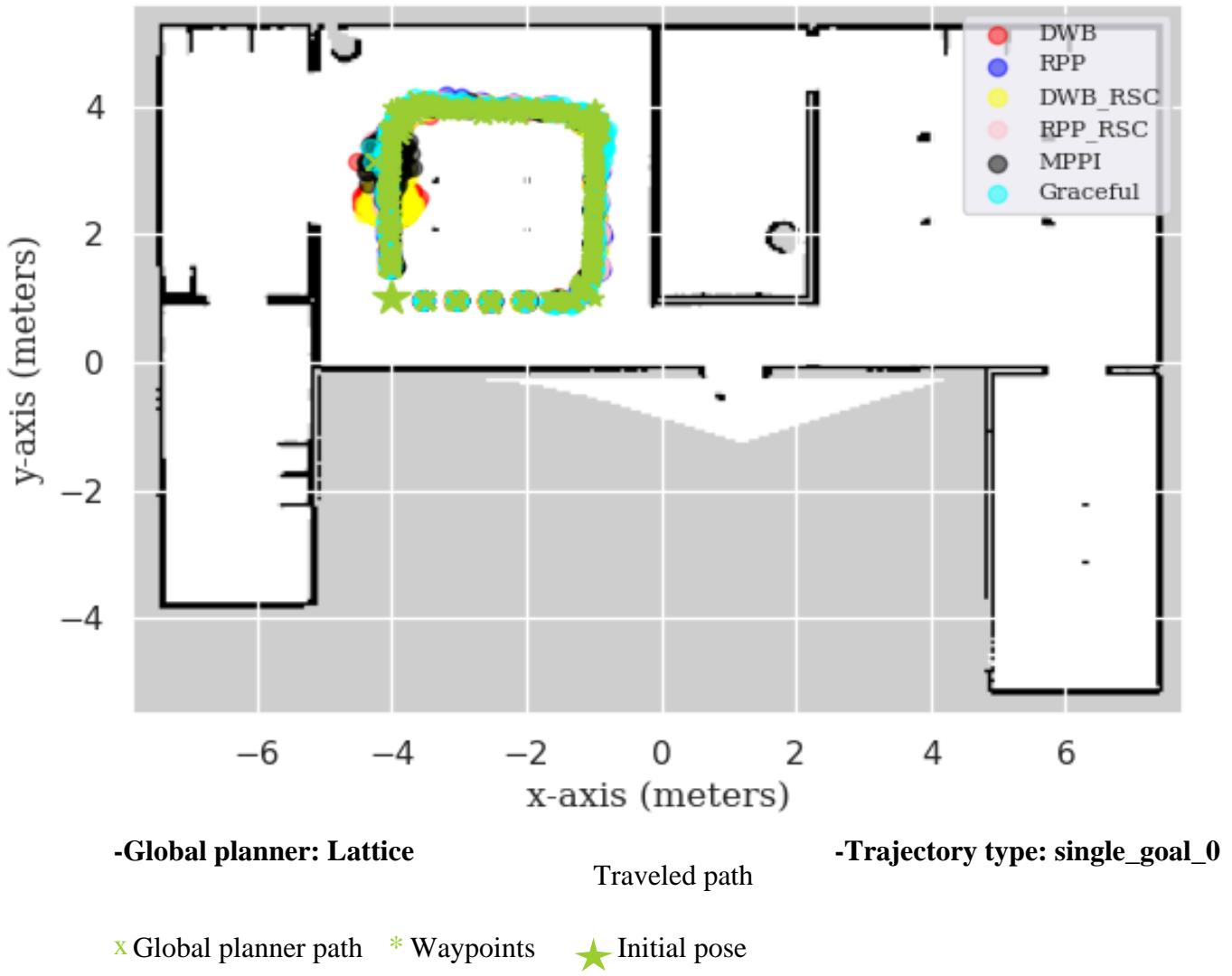
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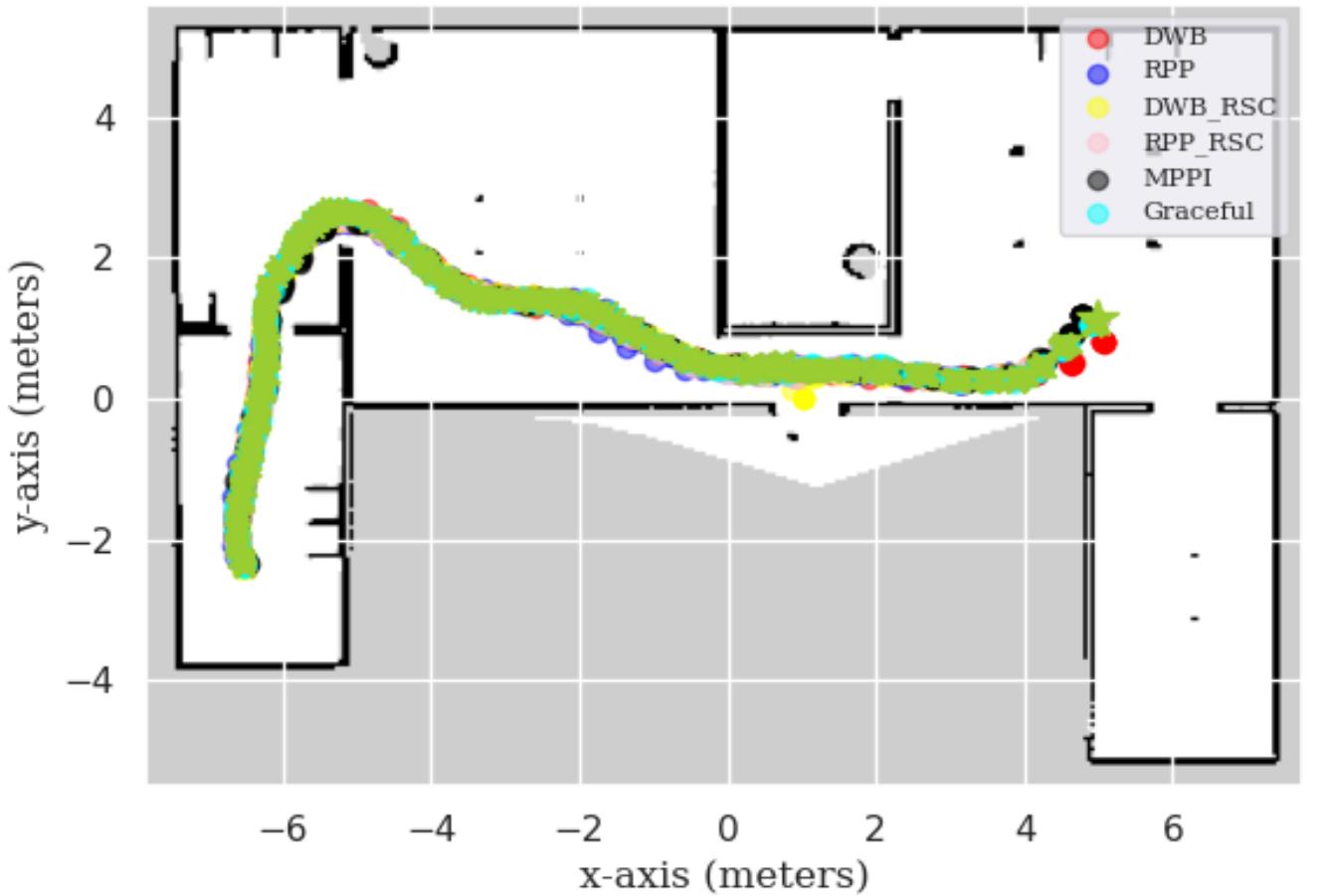
Traveled path

-Trajectory type: square_3

x Global planner path * Waypoints

★ Initial pose





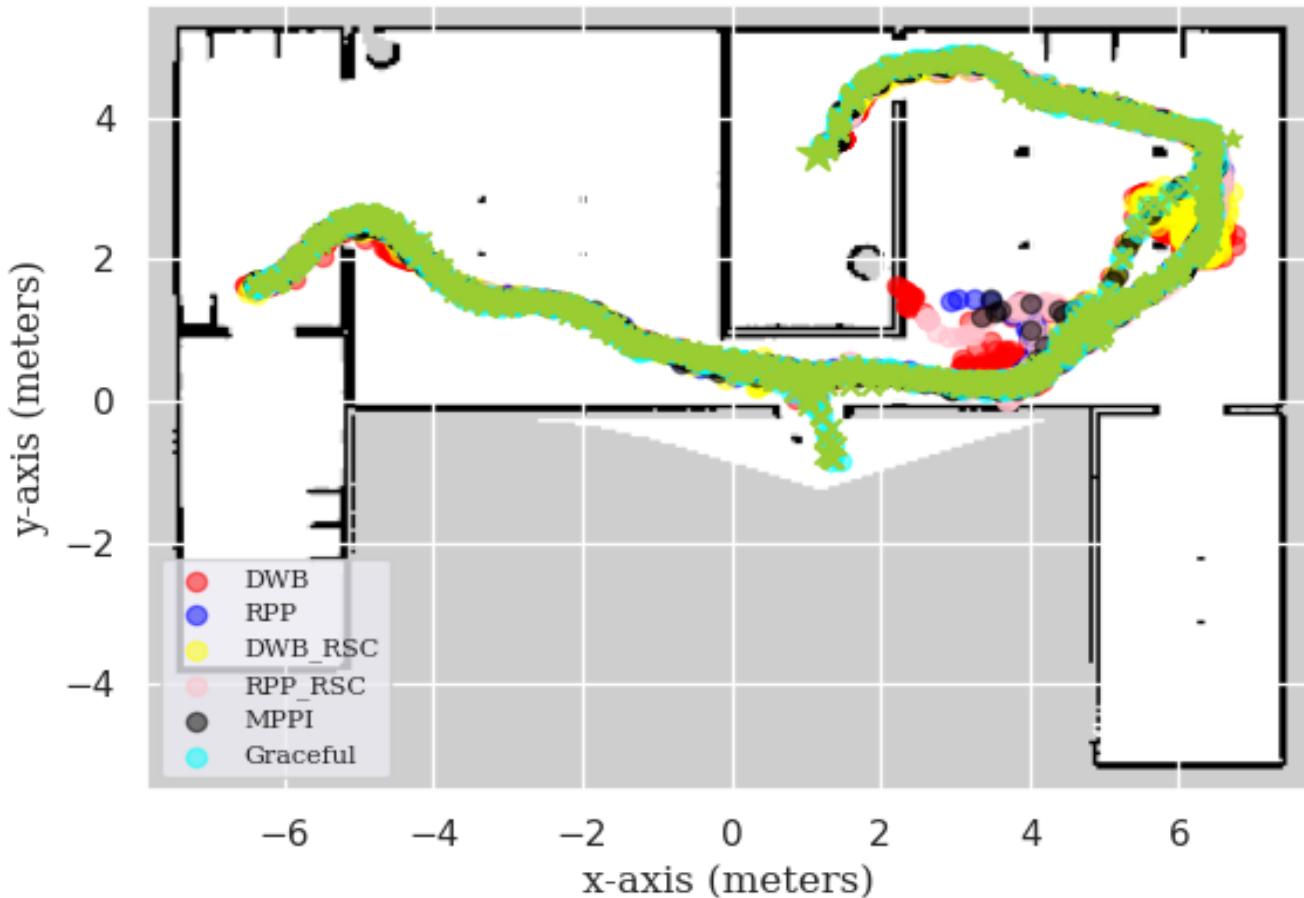
-Global planner: Lattice

Traveled path

-Trajectory type: waypoints_1

✖ Global planner path * Waypoints

★ Initial pose



-Global planner: Lattice

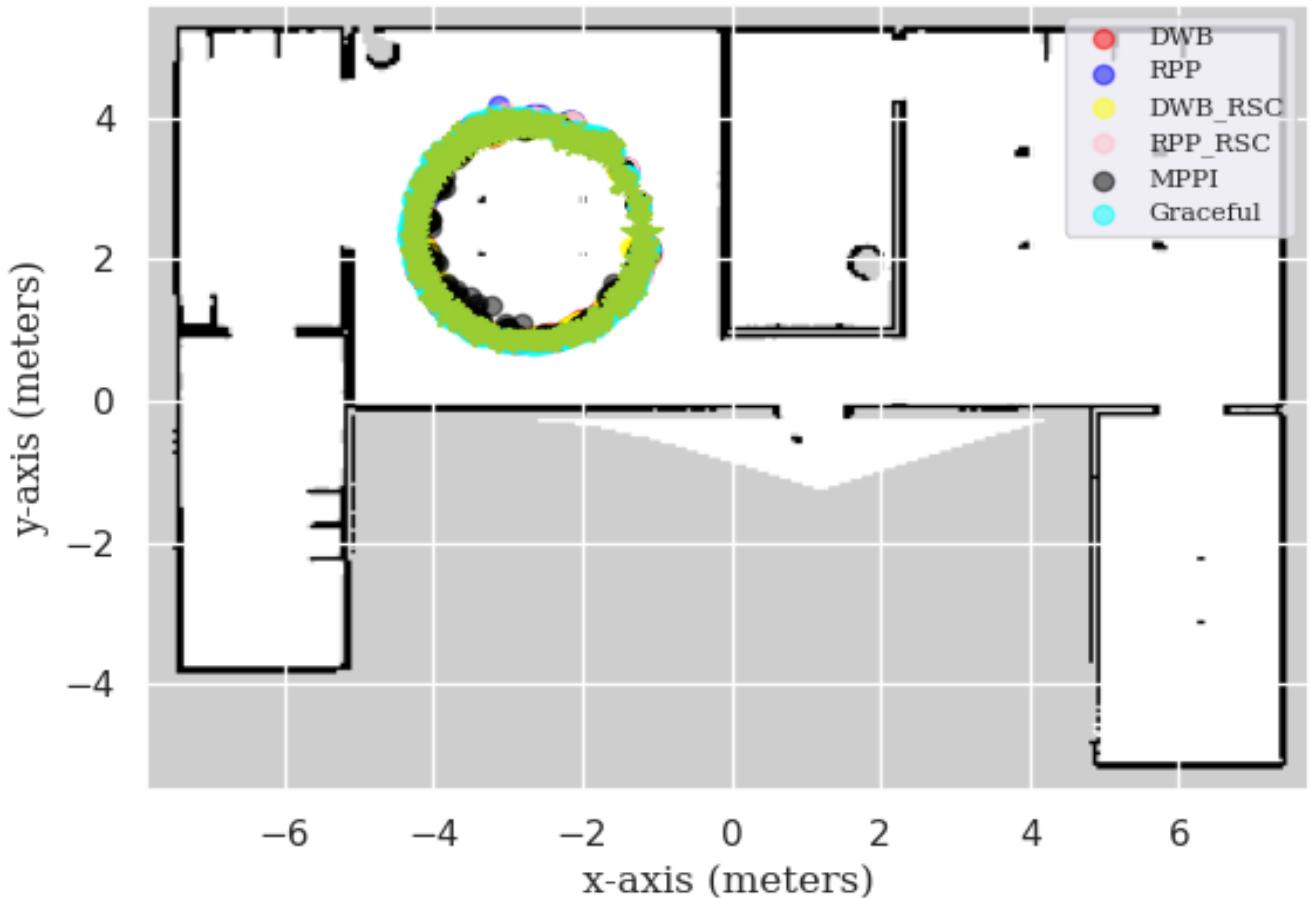
Traveled path

-Trajectory type: circle_2

Global planner path

Waypoints

Initial pose



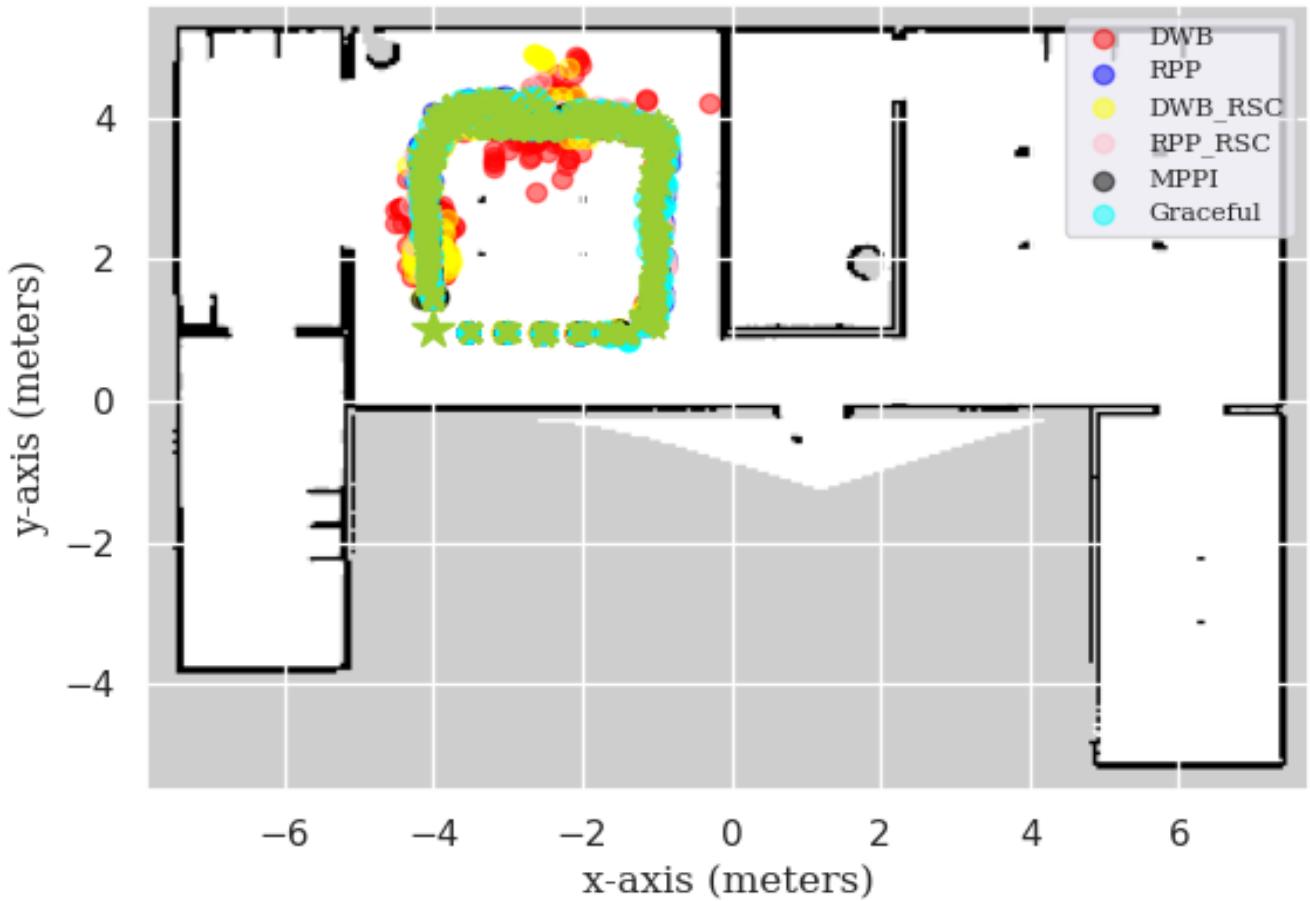
-Global planner: Lattice

Traveled path

-Trajectory type: square_3

✖ Global planner path * Waypoints

★ Initial pose



Failure report

Recorded log messages of navigation nodes, if any message is recorded

Global planner: NavFn		
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Controller: DWB_RSC experiment#:12 iteration#:9		
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Logger_name	Level	Message
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controller_server	ERROR	Failed to make progress
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Global planner: Lattice		
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Controller: DWB experiment#:76 iteration#:14		
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Logger_name	Level	Message
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controller_server	ERROR	Failed to make progress
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