Description of Testing

This experiment can be broken into four sections, each containing seven runs. In each section we ran either GPOPS Planner or Backman Planner with either reverse motion allowed or forward motion only. The starting pose was initialized to [0.0 ,0.0, pi/2] while the goal pose was iterated through the following list. The constraints on all parameters (curvature and its derivatives and speed and its derivatives) were the same across all runs. The MPC cost function was also held the same across all runs.

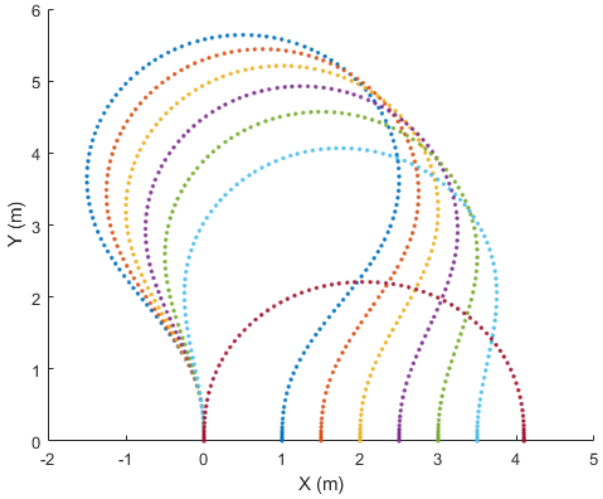
Goal States:

1. [1.0, 0.0, -pi/2]
2. [1.5, 0.0, -pi/2]
3. [2.0, 0.0, -pi/2]
4. [2.5, 0.0, -pi/2]
5. [3.0, 0.0, -pi/2]
6. [3.5, 0.0, -pi/2]
7. [4.0, 0.0, -pi/2]

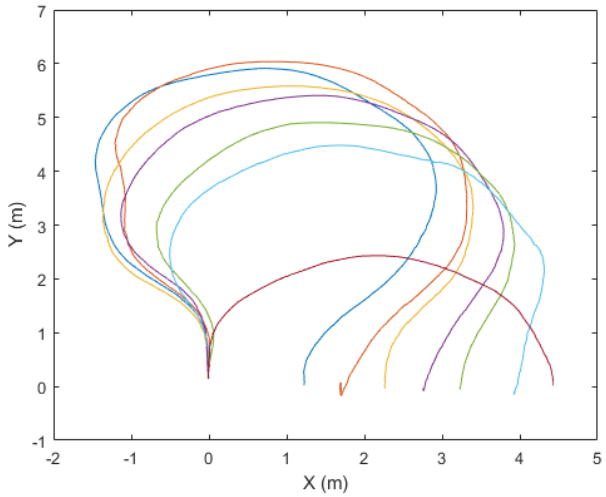
Experiments

Section 1: GPOPS Planner, Forward motion only

Planned Paths

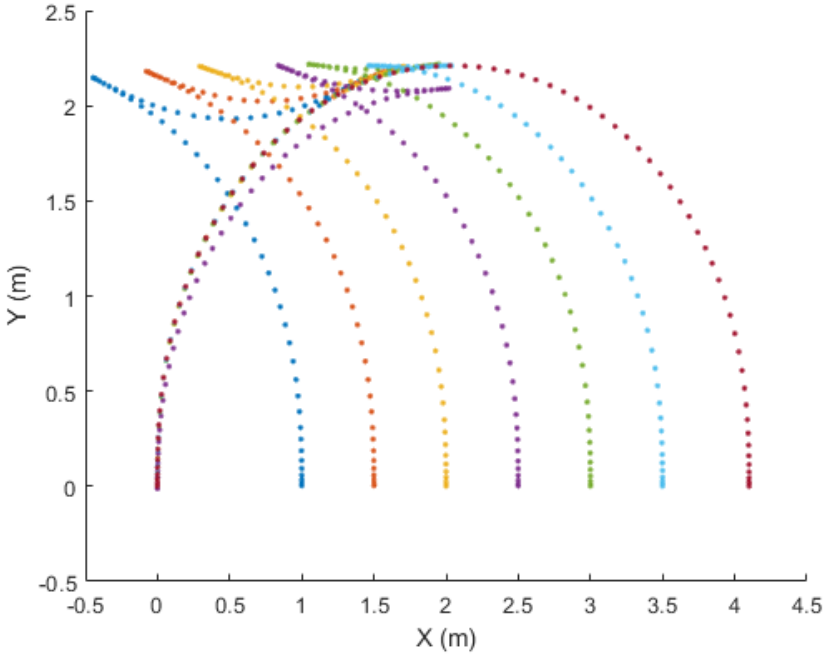


Tracked Paths

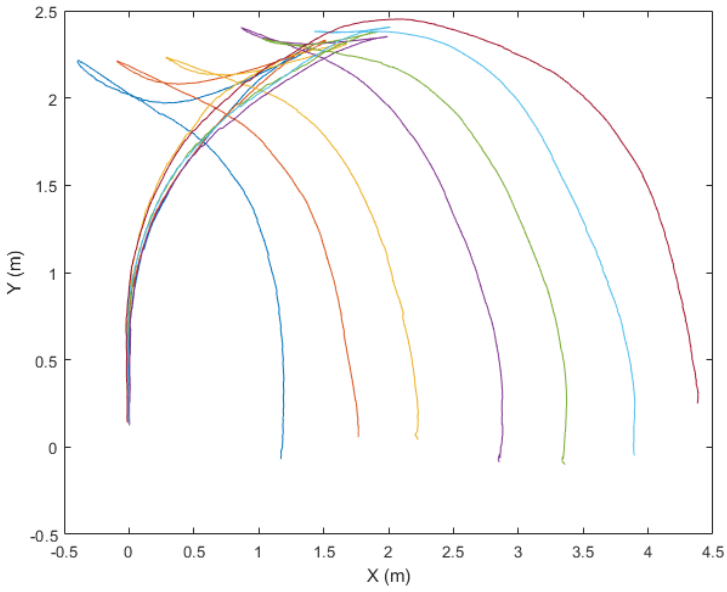


Section 2: GPOPS Planner, Reverse Motion Allowed

Planned Paths

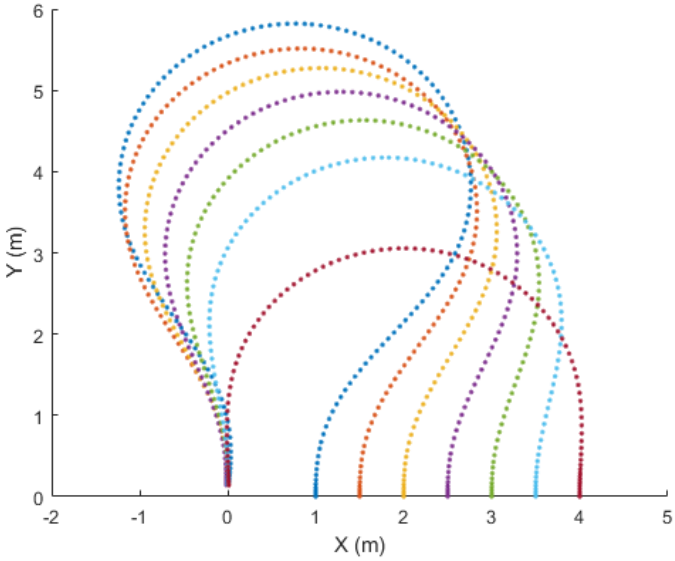


Tracked Paths

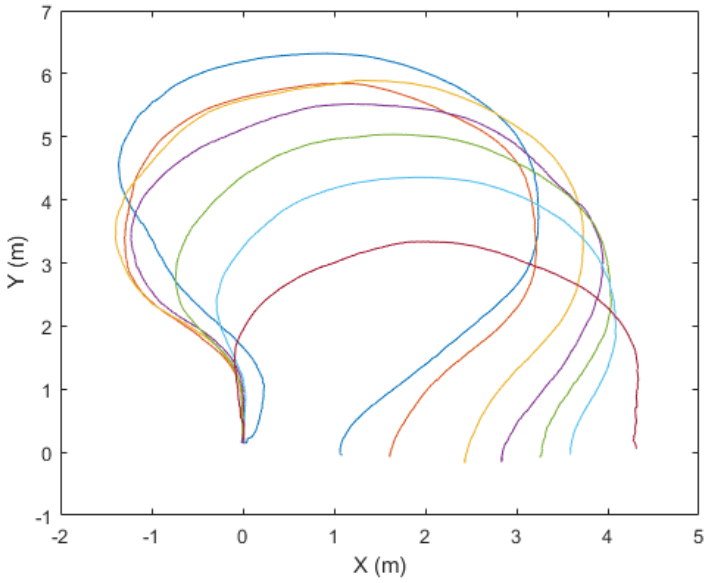


Section 3: Backman Planner, Forward Motion Only

Planned Paths

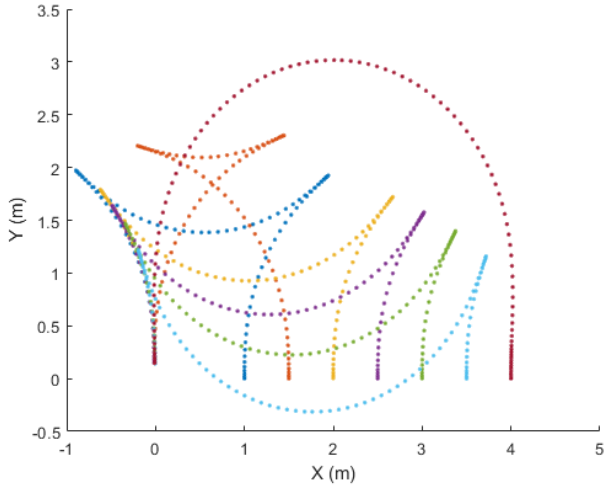


Tracked Paths

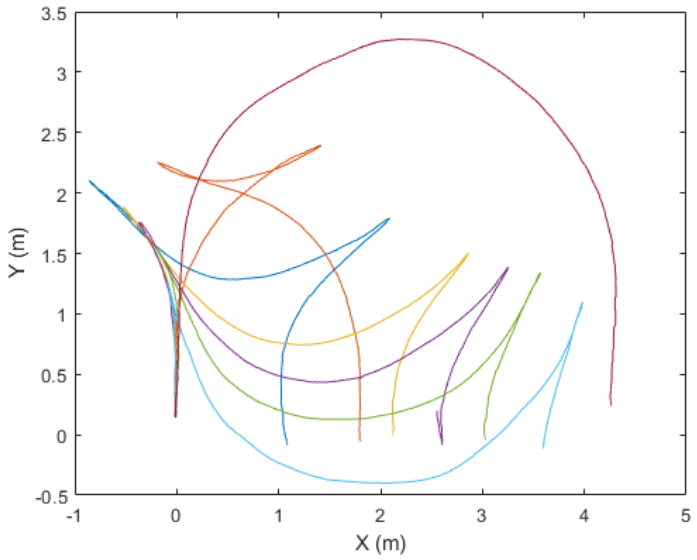


Section 4: Backman Planner, Reverse Motion Allowed

Planned Paths



Tracked Paths



Analysis

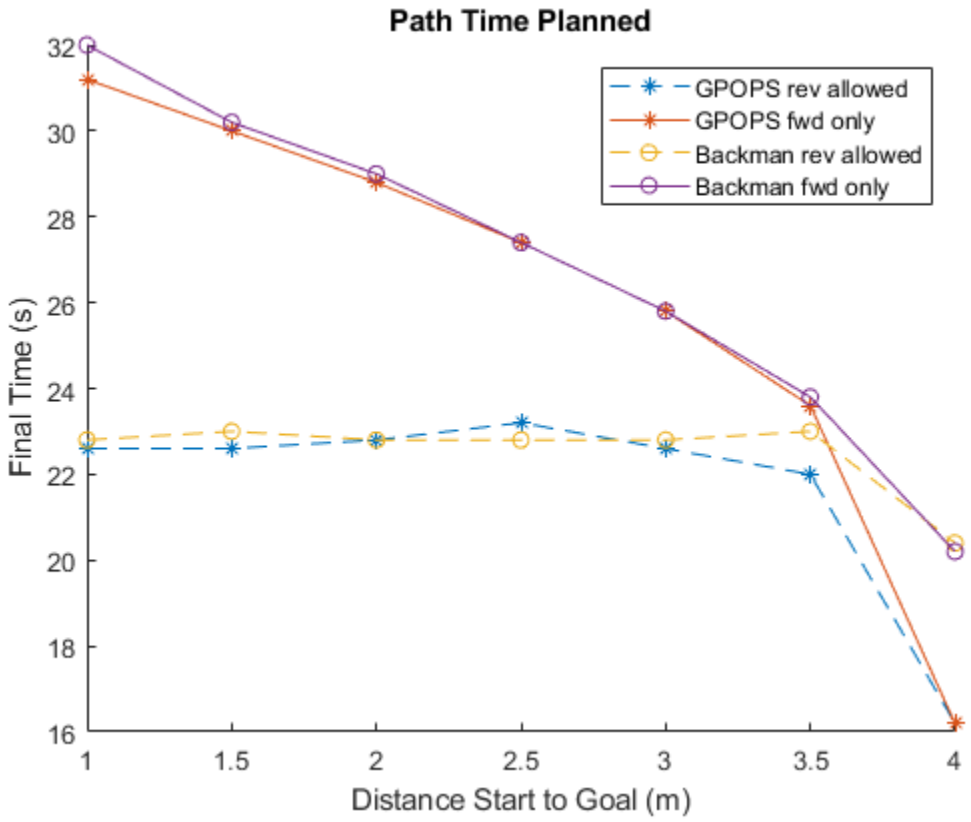
Metrics Averaged over Each Set of Runs

	Mean Lateral Error (m)	Max Lateral Error (m)	Mean Heading Error (rad)	Max Heading Error (rad)
GPOPS - Forward Motion Only	0.2984	0.4840	0.0996	0.4021
GPOPS - Reverse Motion Allowed	0.1732	0.3220	0.1279	0.9329
Backman - Forward Motion Only	0.3045	0.5172	0.0937	0.3657
Backman - Reverse Motion Allowed	0.1225	0.2860	0.1254	0.8442

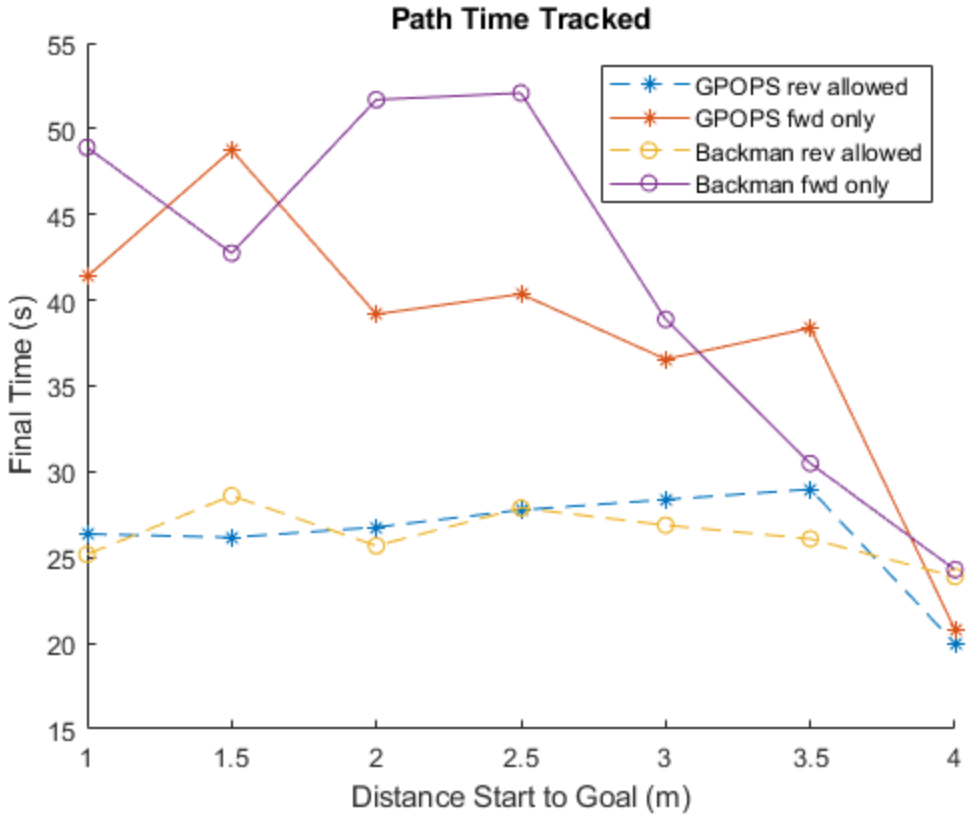
Planning Times

Note that planning times go down because it is faster to make maneuvers with larger turns.

Final Time for Planned Paths

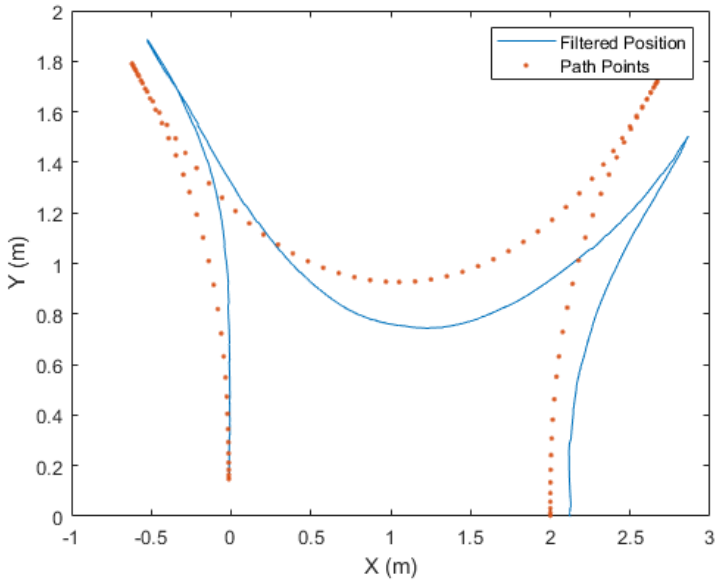


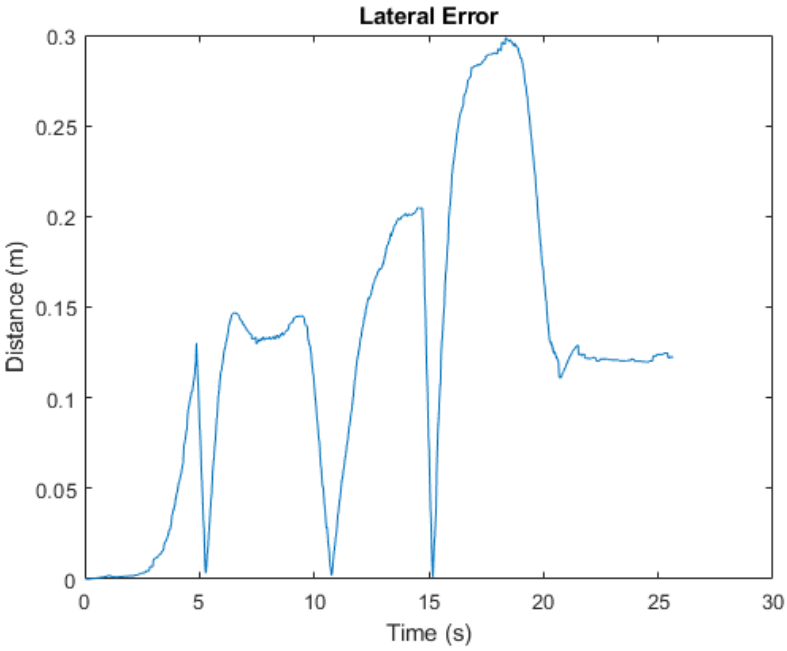
Final Time for Actual (Tracked) Paths

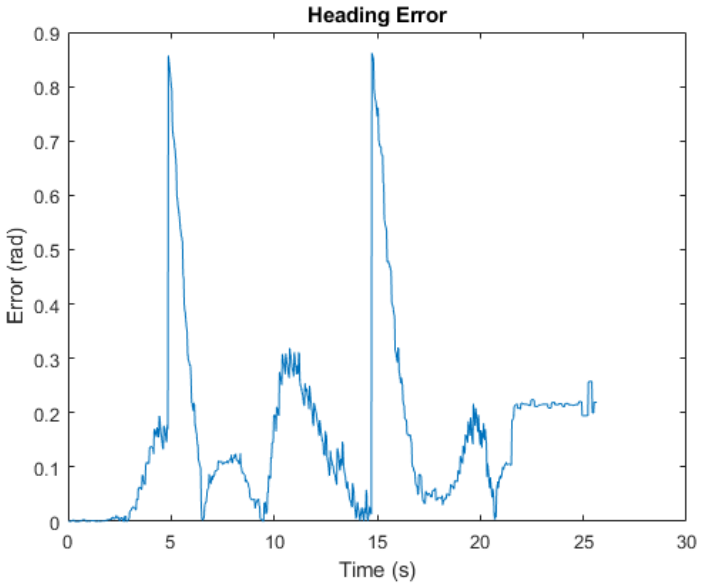


Analysis of two single runs

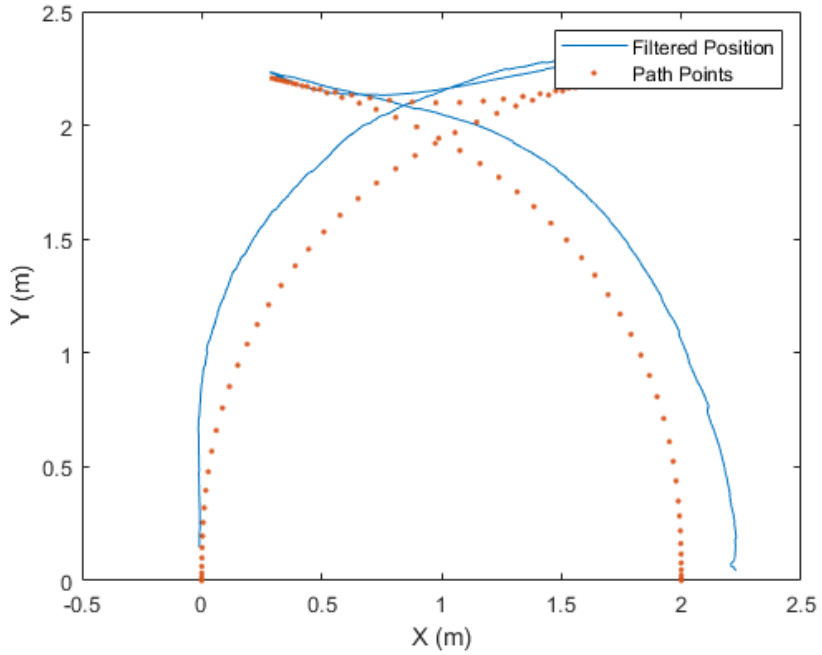
Backman, Reverse motion allowed from [0, 0, pi/2] -> [0, 2, -pi/2]

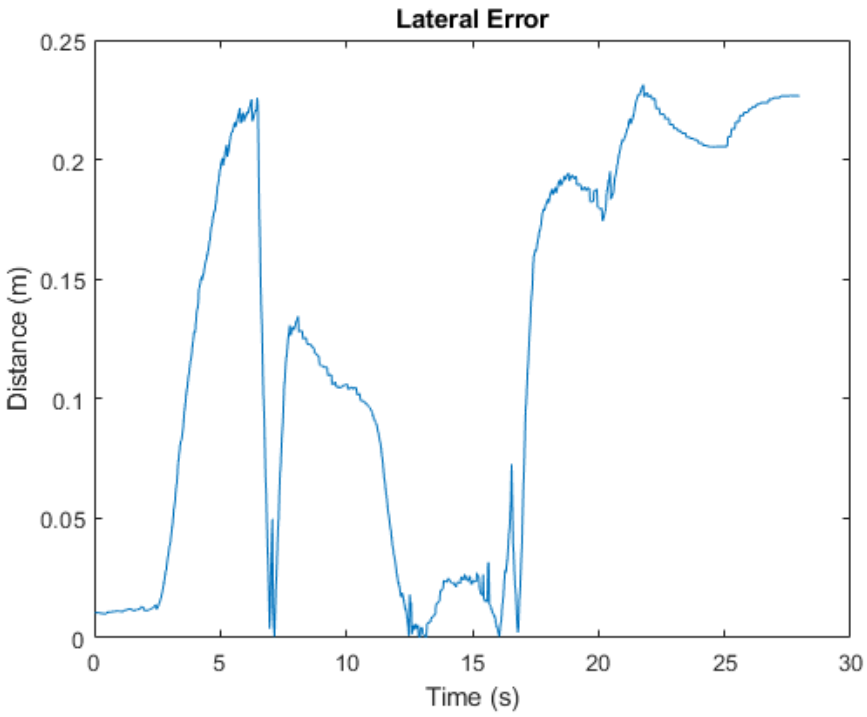


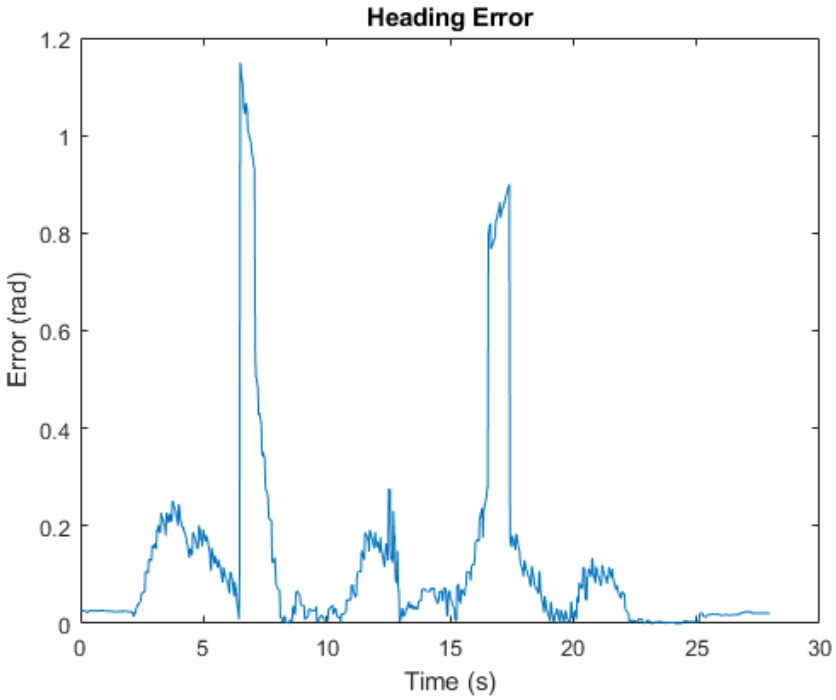

Lateral Error
Distance (m)
Time (s)
0
0.05
0.1
0.15
0.2
0.25
0.3
0
5
10
15
20
25
30


Heading Error
Error (rad)
Time (s)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0
5
10
15
20
25
30

GPOPS, Reverse motion allowed from [0, 0, pi/2] -> [0, 2, -pi/2]






Heading Error
Error (rad)
Time (s)
0
0.2
0.4
0.6
0.8
1
1.2
0
5
10
15
20
25
30