Table of Contents

Script for 2011 ME227 HW 3 Problem 3

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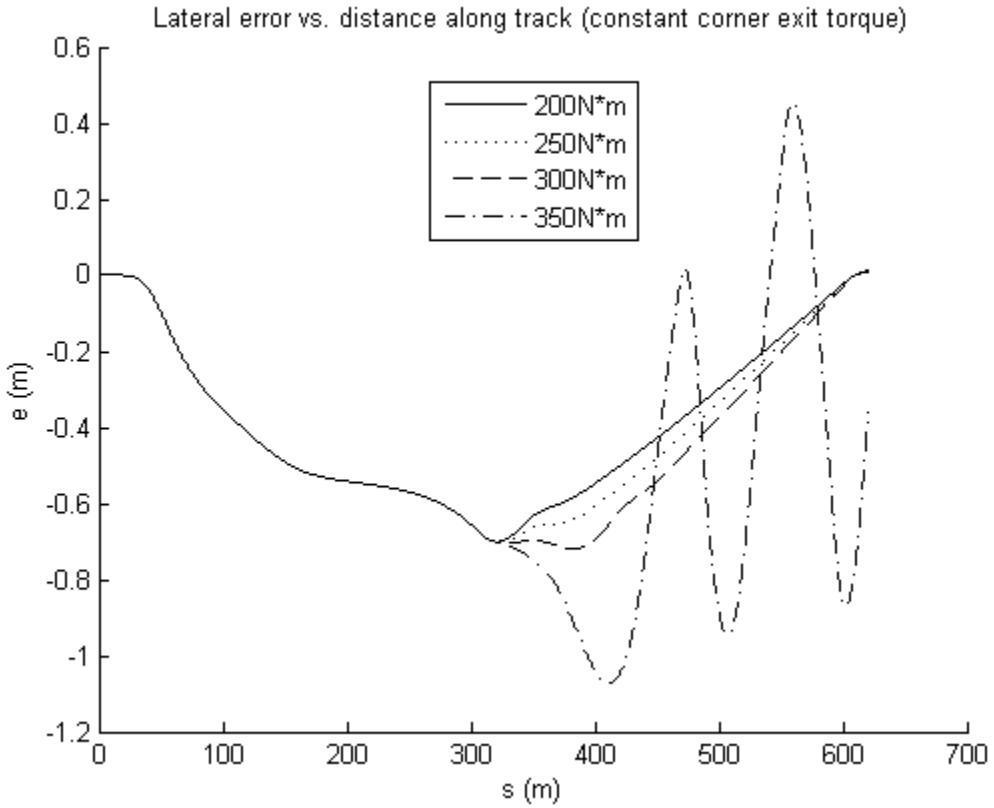
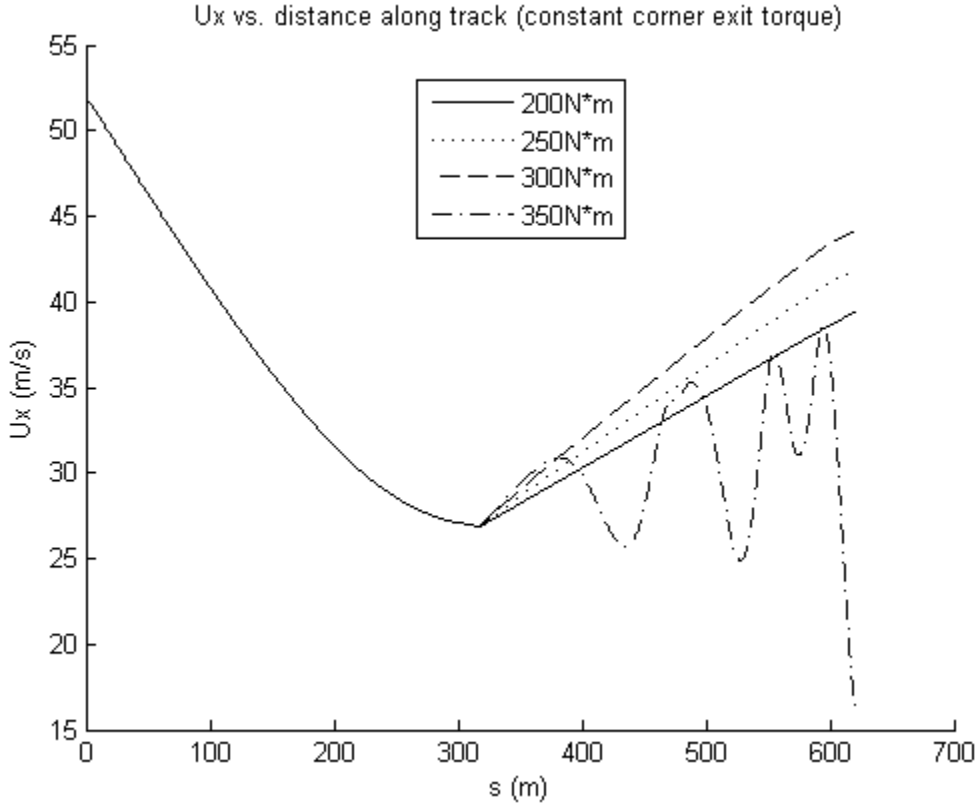
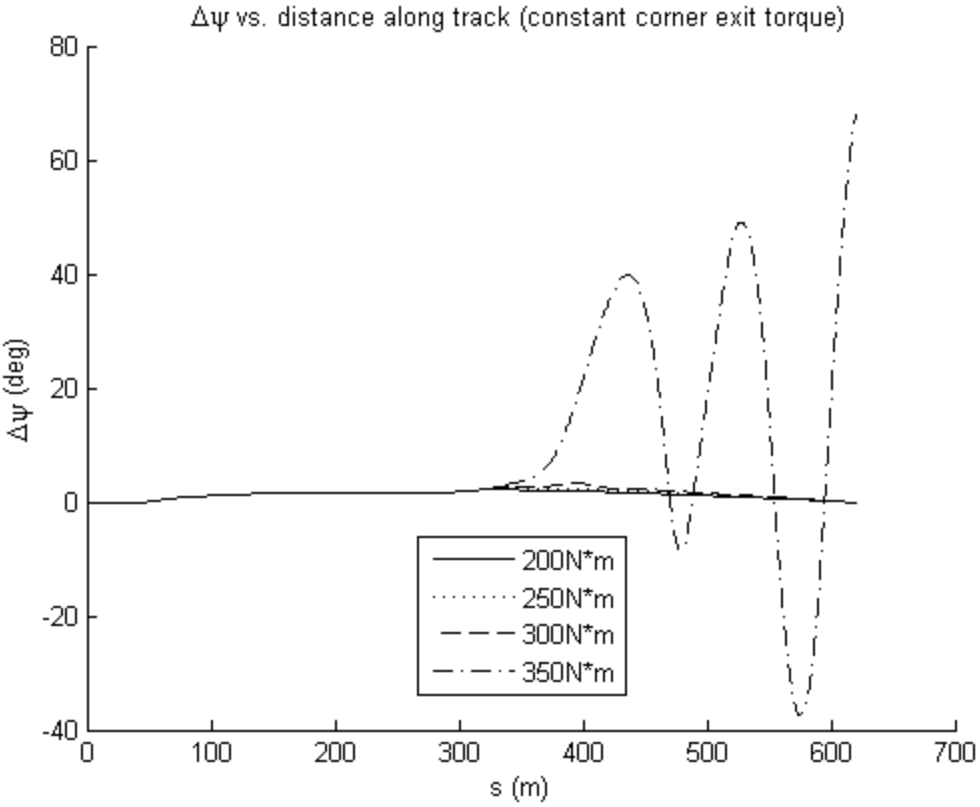
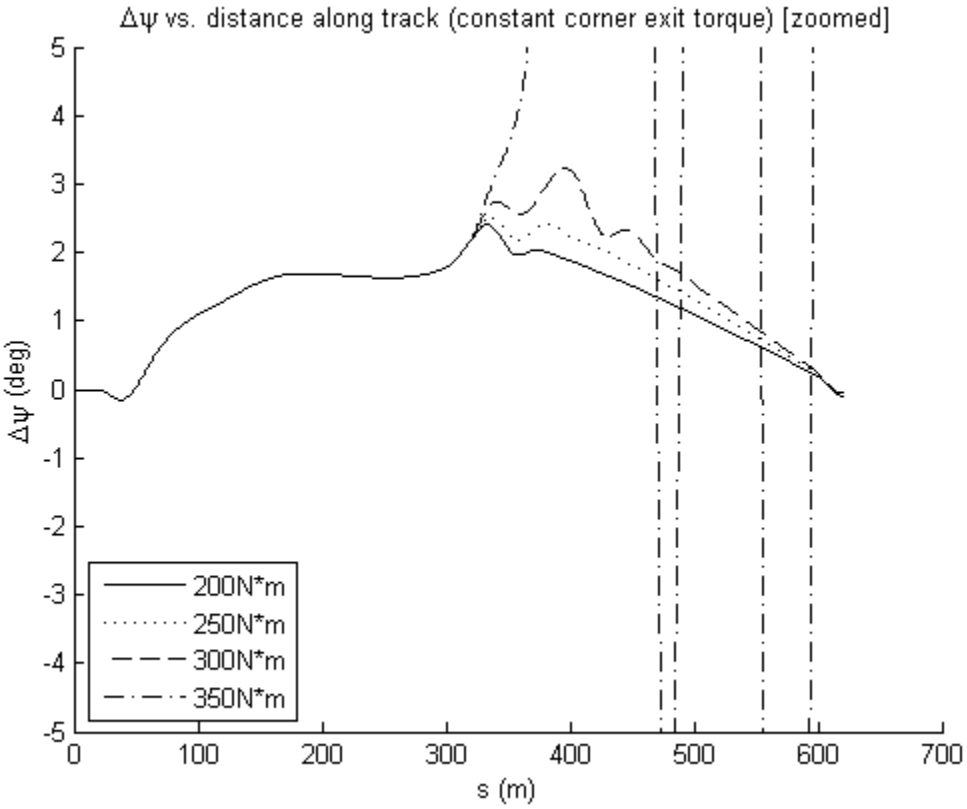
Constant torque

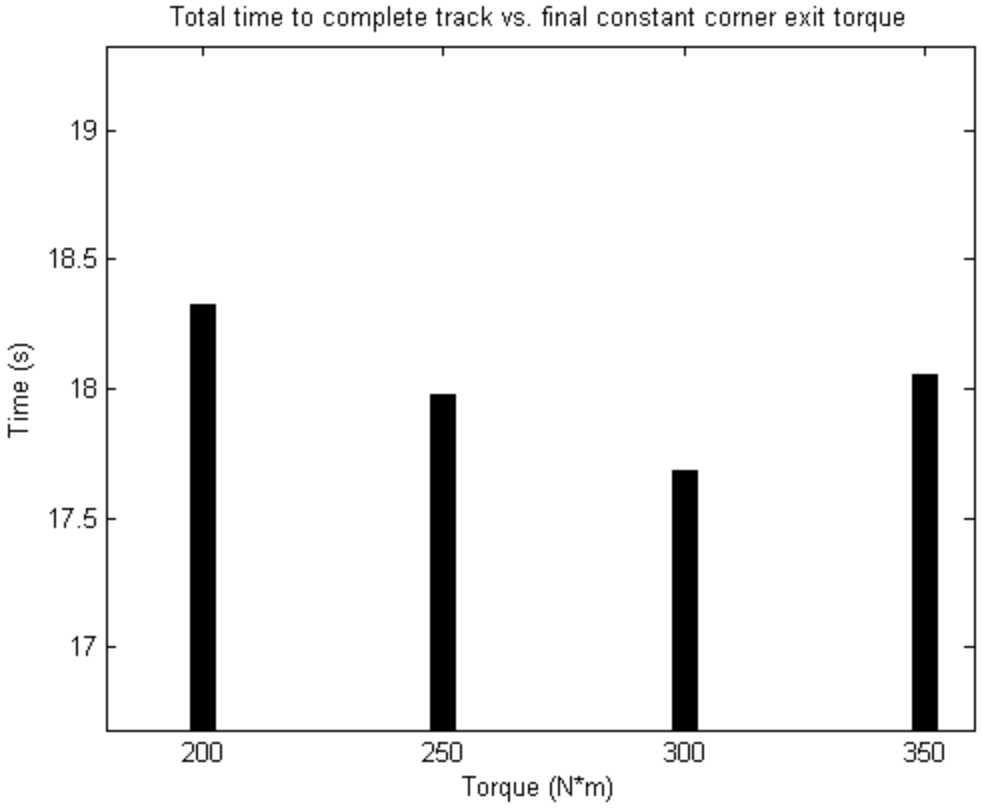
When we apply a constant torque at the corner exit, we take away friction from our lateral force, which keeps us cornering, and apply it to longitudinal force, which propels us forward. This can cause lateral slip. Our total time to complete the track goes down until the constant torque is too high, which point oscillatory response in Ux and deltapsi degrade our time. Our exit speed follows the same pattern, going up until the constant torque is too high.

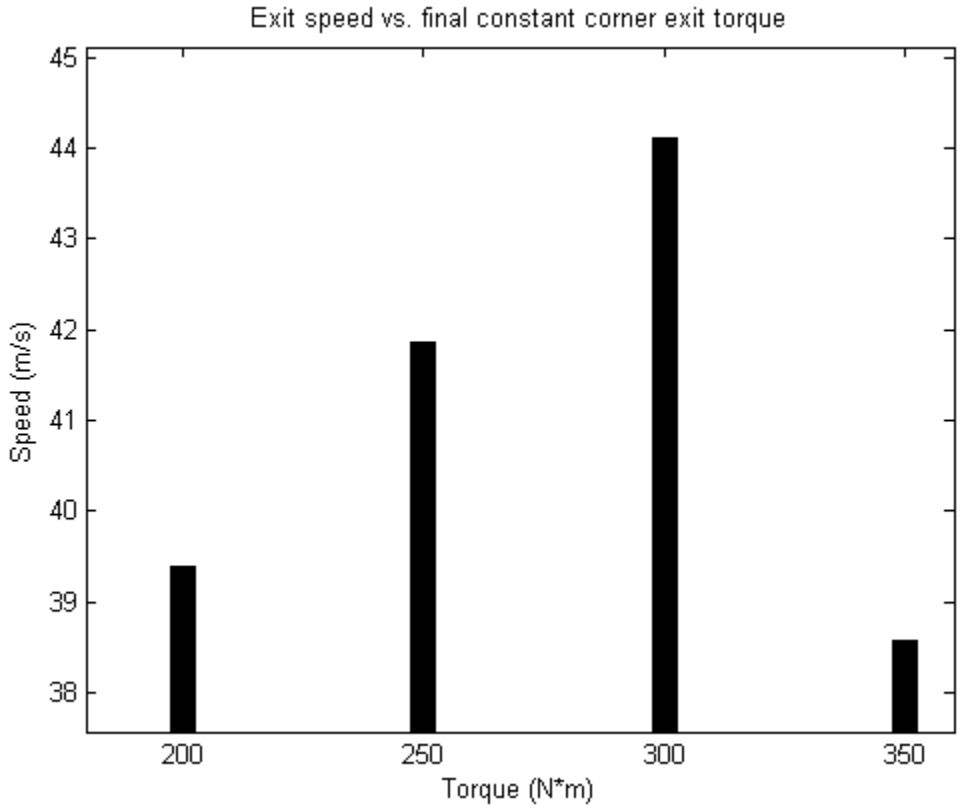


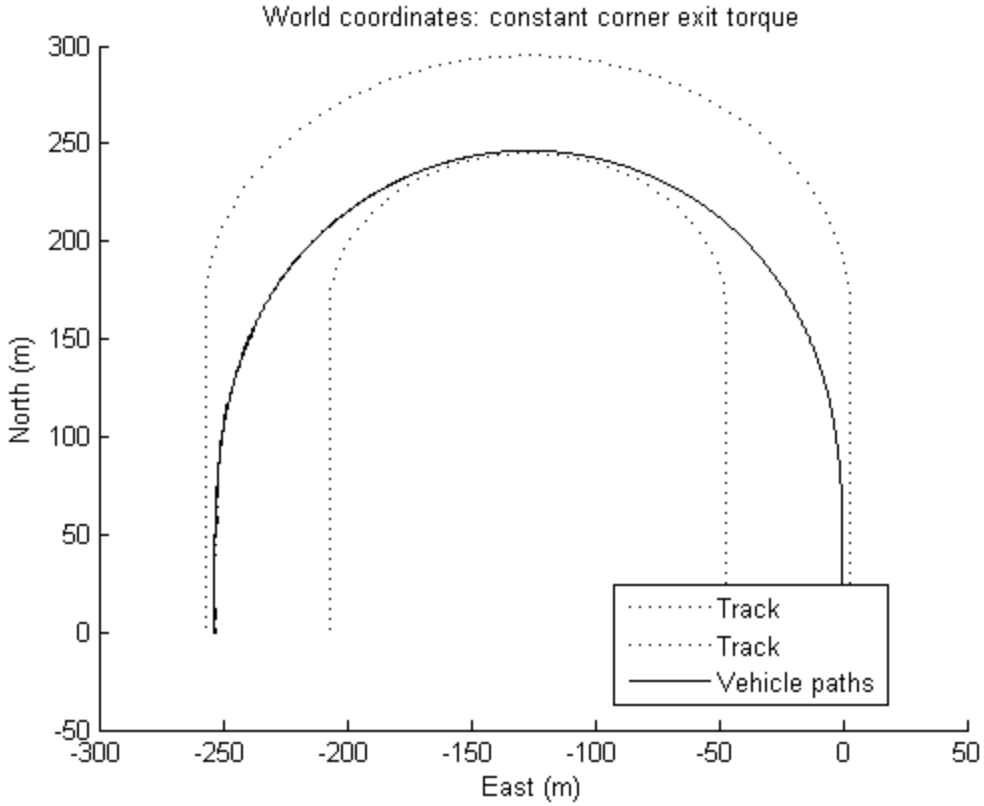

Ux vs. distance along track (constant corner exit torque)
Ux (m/s)
s (m)
200N*m
250N*m
300N*m
350N*m
55
50
45
40
35
30
25
20
15
0
100
200
300
400
500
600
700


Δψ vs. distance along track (constant corner exit torque)
Δψ (deg)
s (m)
200N*m
250N*m
300N*m
350N*m
80
60
40
20
0
-20
-40
0
100
200
300
400
500
600
700


Δψ vs. distance along track (constant corner exit torque) [zoomed]
Δψ (deg)
s (m)
200N*m
250N*m
300N*m
350N*m


Total time to complete track vs. final constant corner exit torque
Time (s)
Torque (N*m)

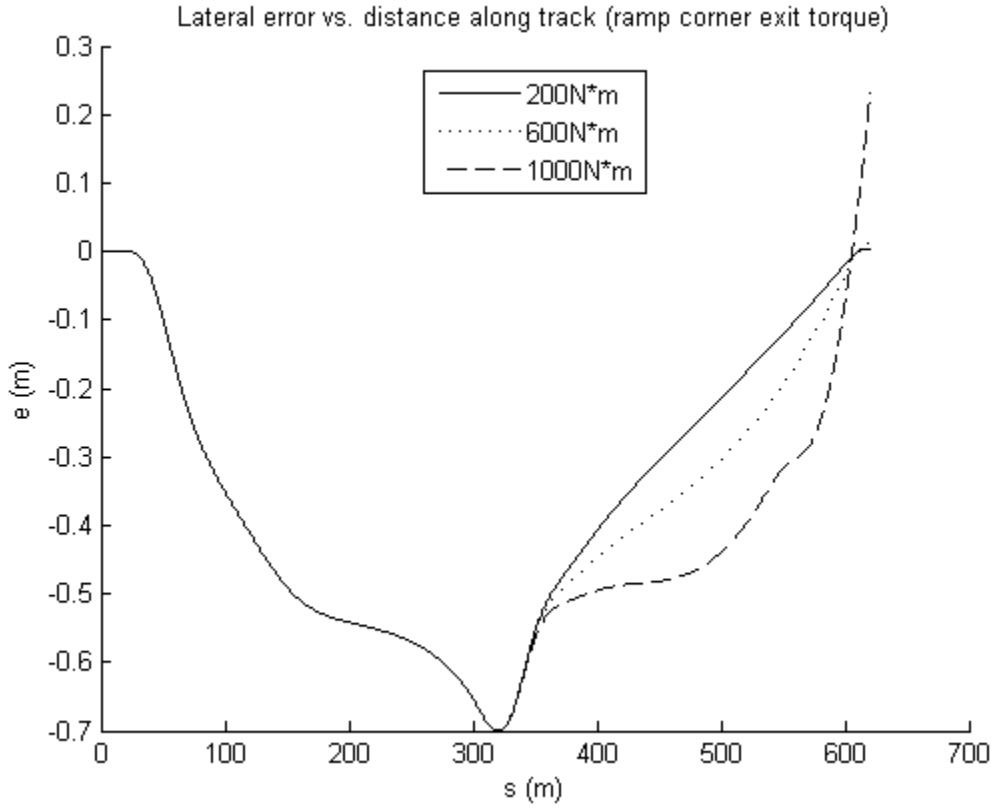

Exit speed vs. final constant corner exit torque
Speed (m/s)
Torque (N*m)
45
44
43
42
41
40
39
38
200
250
300
350

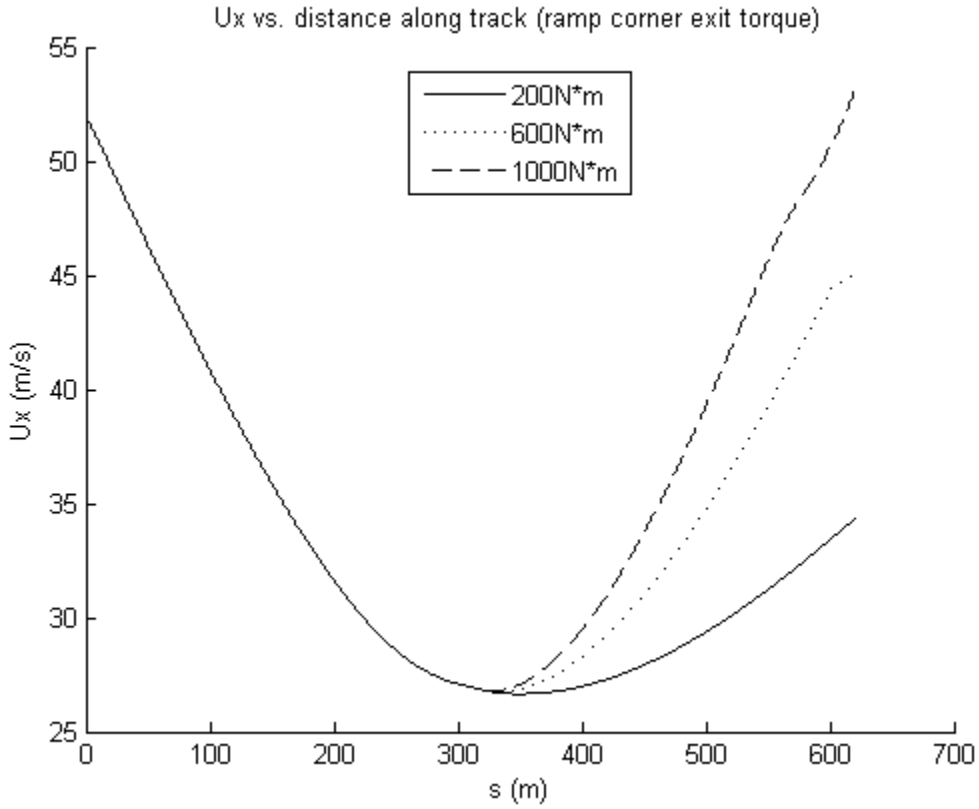

World coordinates: constant corner exit torque
North (m)
East (m)
300
250
200
150
100
50
0
-50
-300
-250
-200
-150
-100
-50
0
50
Track
Track
Vehicle paths

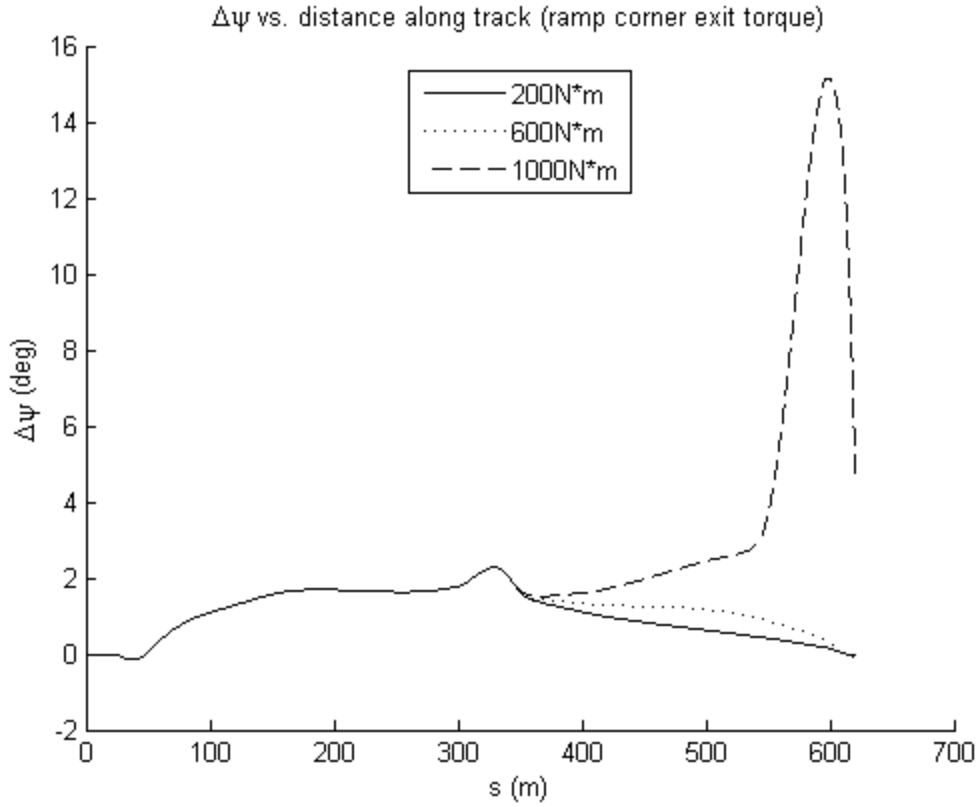
Linear ramp torque

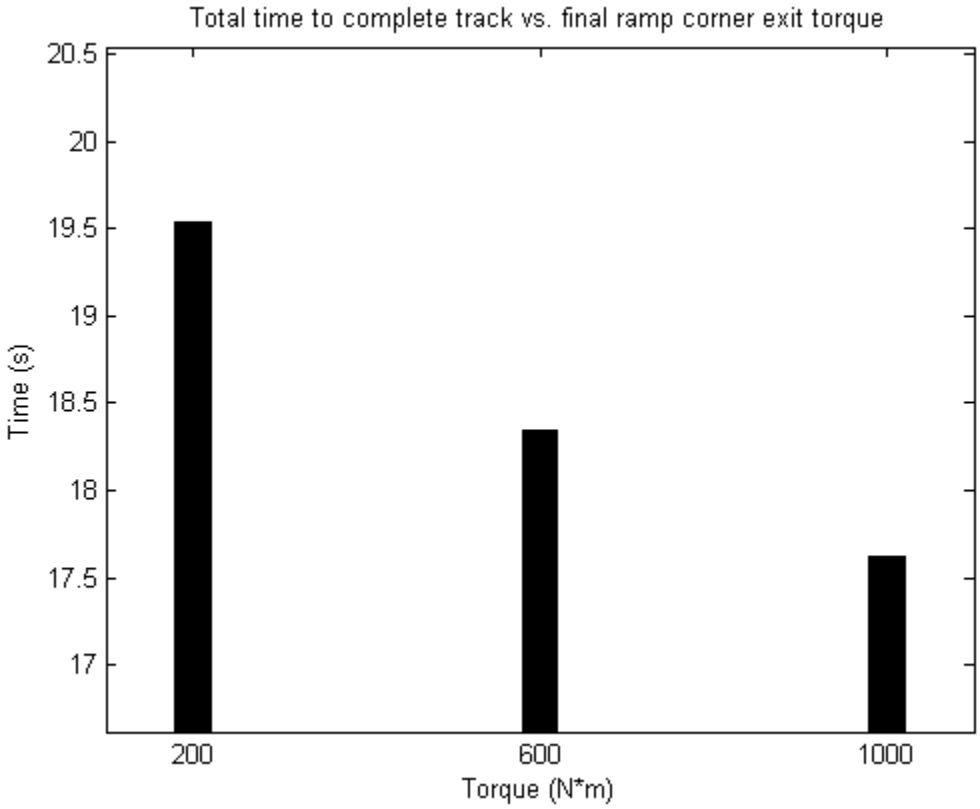
DeltaPsi > 5 degrees when we use the 1000Nm final torque ramp value. Previously, we hit our threshold at 350Nm, so ramping up the torque is clearly a better method since we don't want to lose friction in the lateral direction immediately, but rather gradually as we exit our corner. Our exit speed goes up and our track time goes down as we increase the final ramp torque value.

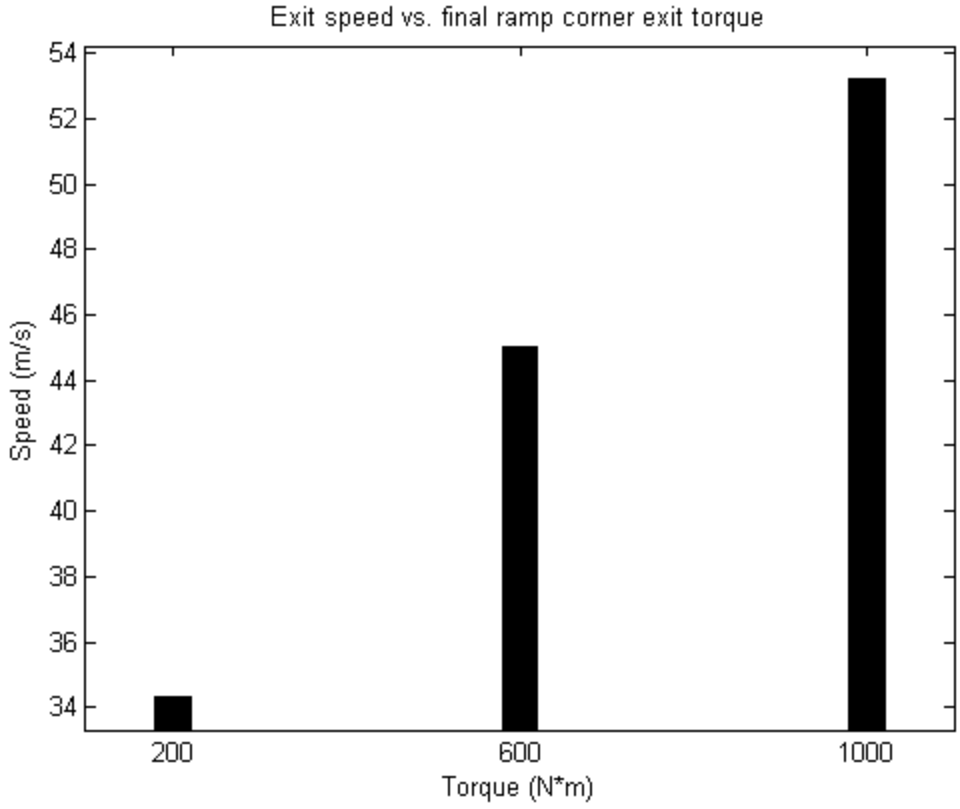
```
driver =

    tmode: 'throttle'
     mode: 'path'
       Ke: 0.1000
     Kpsi: 1
```

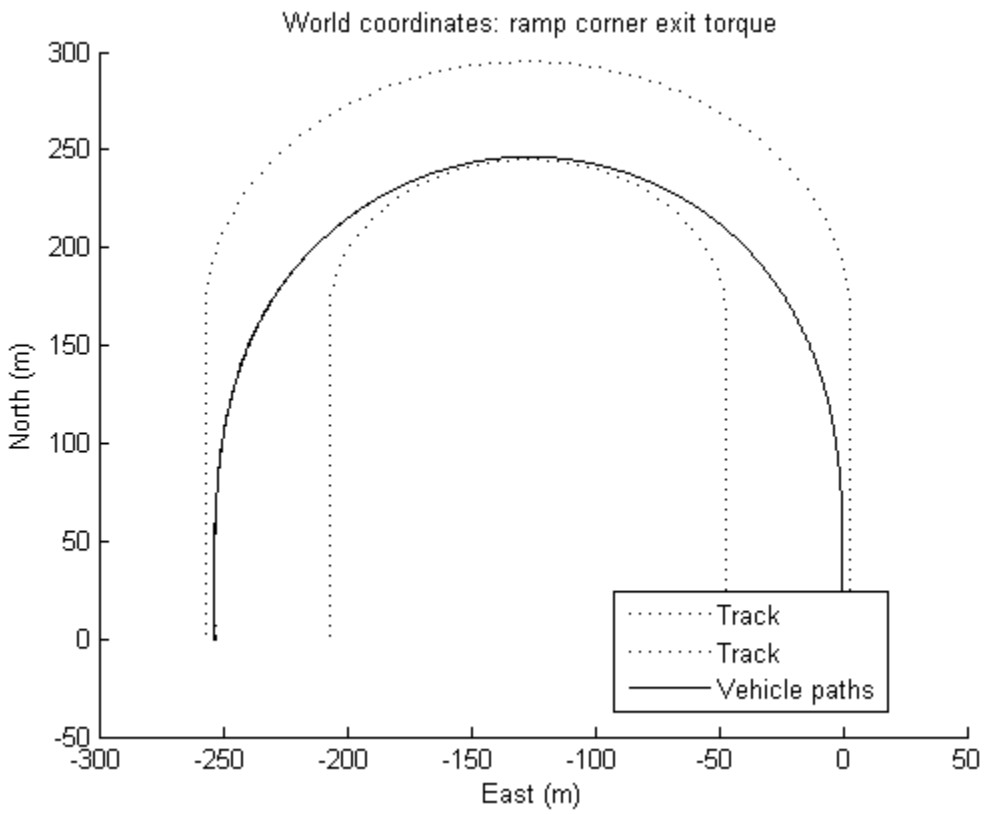



Ux vs. distance along track (ramp corner exit torque)
200N*m
600N*m
1000N*m
Ux (m/s)
s (m)
55
50
45
40
35
30
25
0
100
200
300
400
500
600
700


Δψ vs. distance along track (ramp corner exit torque)
200N*m
600N*m
1000N*m
Δψ (deg)
s (m)
16
14
12
10
8
6
4
2
0
-2
0
100
200
300
400
500
600
700

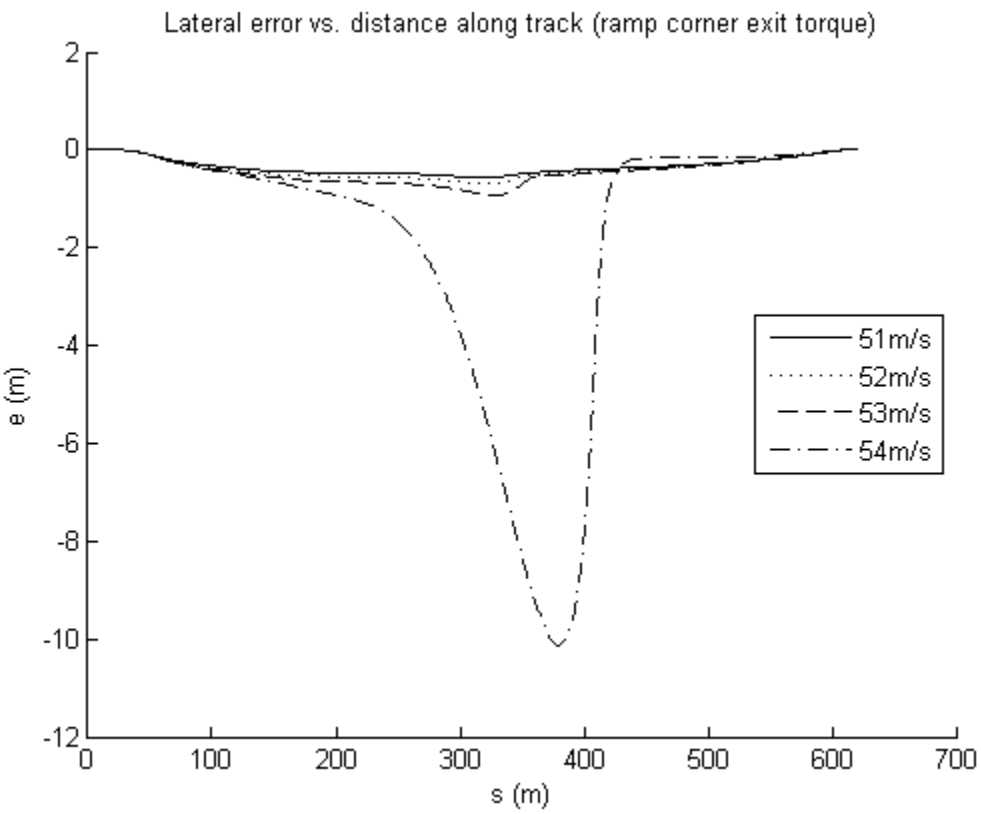

Total time to complete track vs. final ramp corner exit torque
20.5
20
19.5
19
18.5
18
17.5
17
Time (s)
200
600
1000
Torque (N*m)

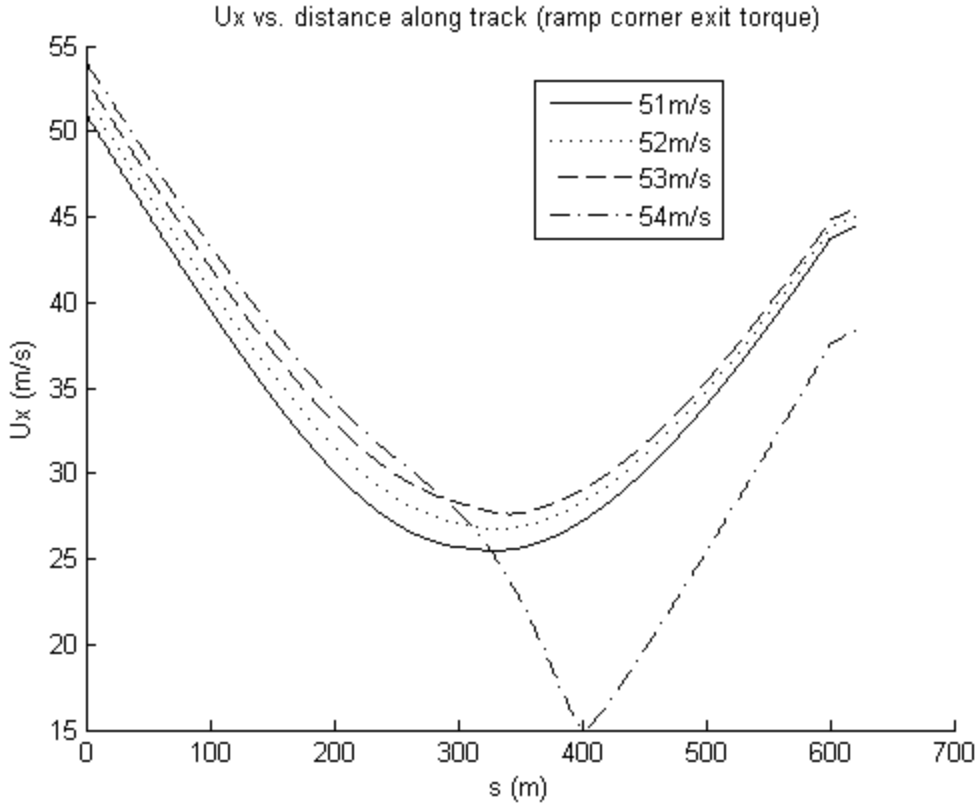

Exit speed vs. final ramp corner exit torque
54
52
50
48
46
44
42
40
38
36
34
Speed (m/s)
200
600
1000
Torque (N*m)

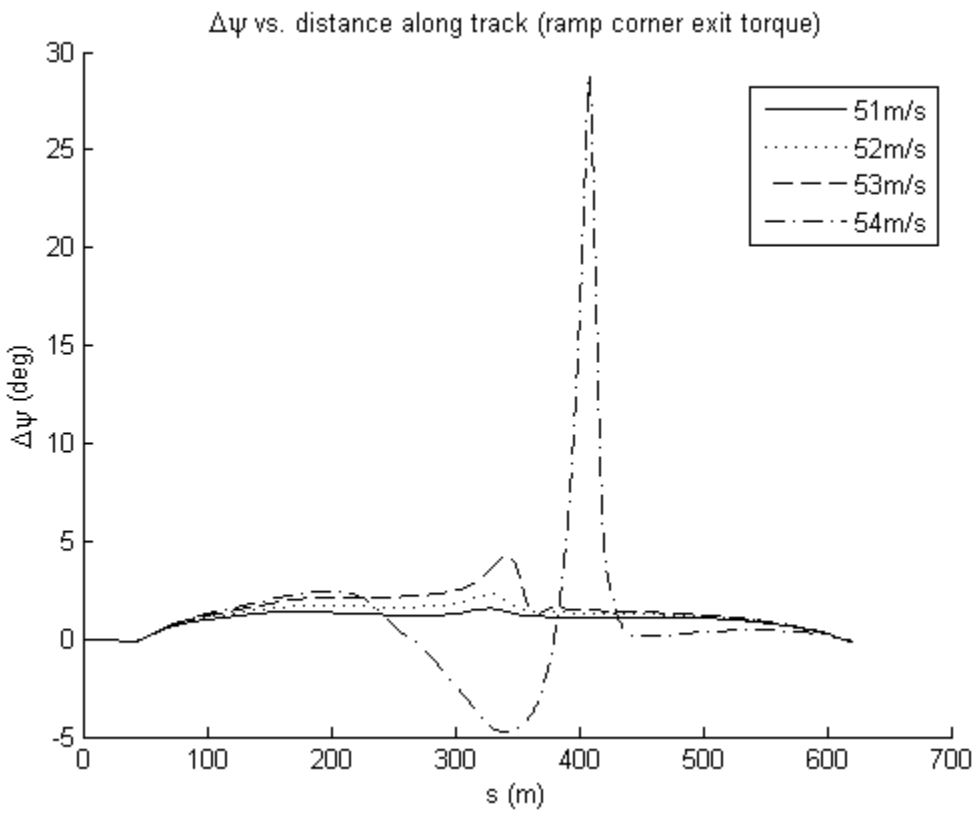


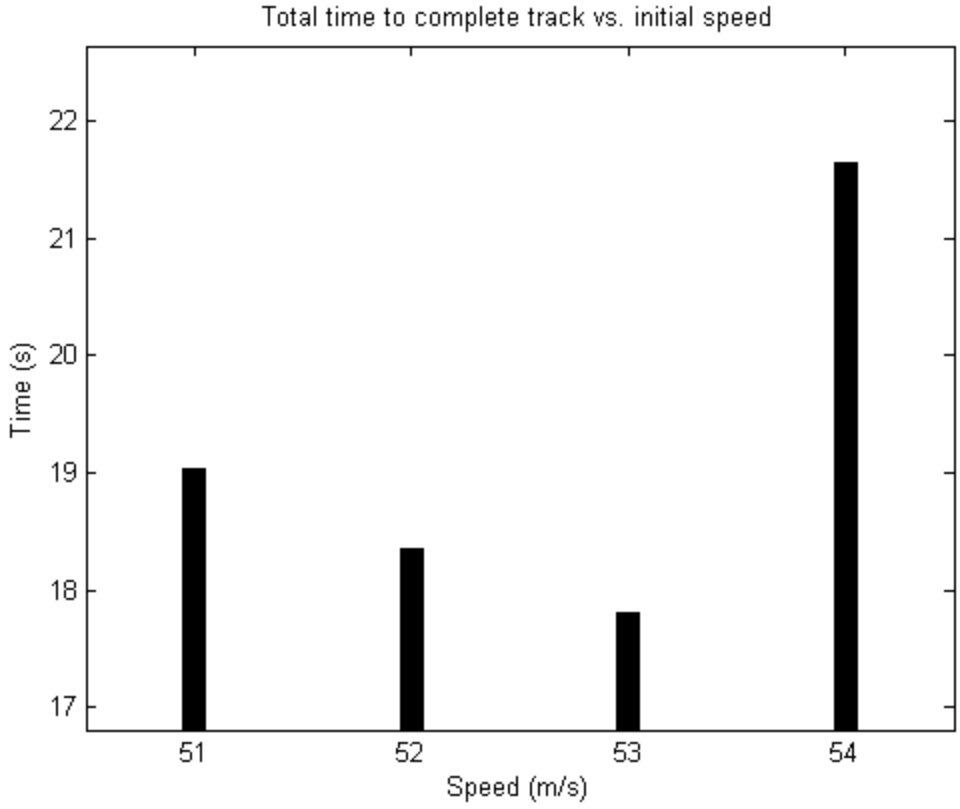
Initial speed changes: linear ramp torque

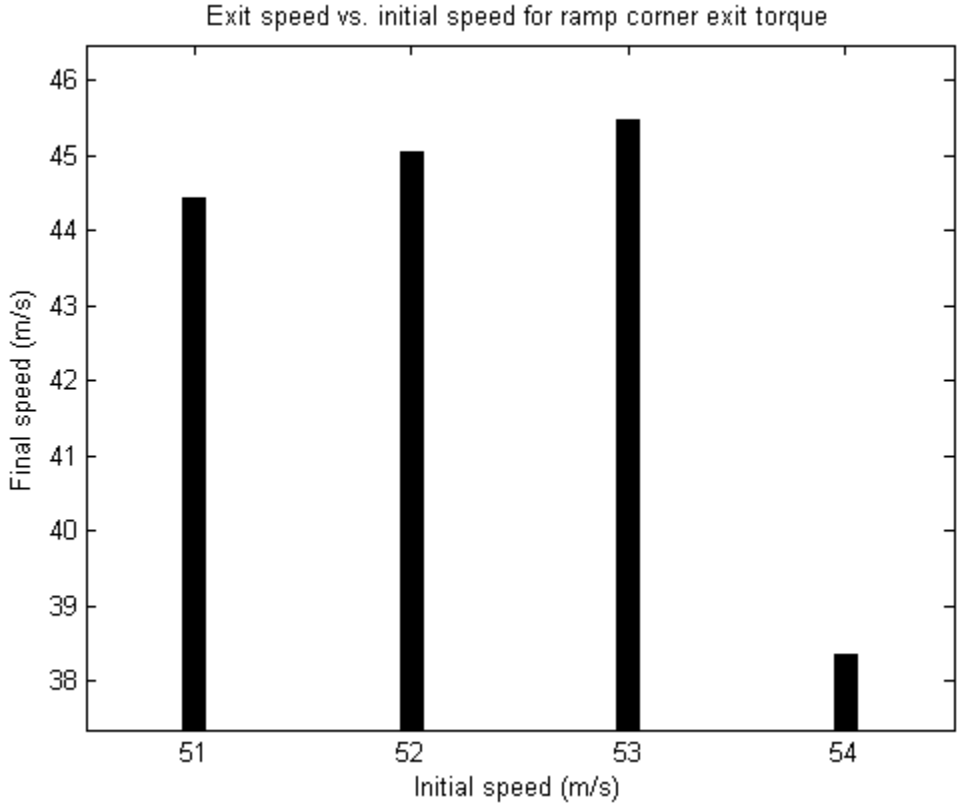
We can increase our initial speed slightly and go through the corner at a faster speed. Increasing the initial speed causes an increase in the lateral error and heading error. Increasing the initial speed also causes faster exit speed and track time, up to a limit.

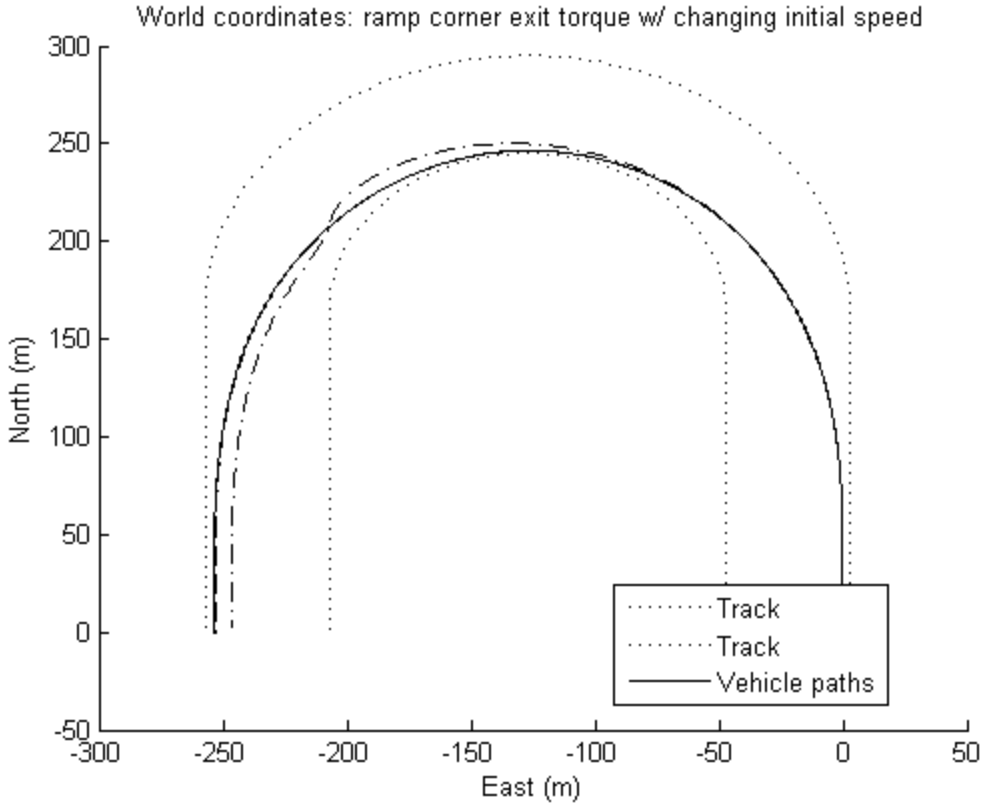

Lateral error vs. distance along track (ramp corner exit torque)
e (m)
s (m)
51m/s
52m/s
53m/s
54m/s
2
0
-2
-4
-6
-8
-10
-12
0
100
200
300
400
500
600
700


Ux vs. distance along track (ramp corner exit torque)
Ux (m/s)
s (m)
51m/s
52m/s
53m/s
54m/s
55
50
45
40
35
30
25
20
15
0
100
200
300
400
500
600
700


Δψ vs. distance along track (ramp corner exit torque)
51m/s
52m/s
53m/s
54m/s
Δψ (deg)
s (m)
30
25
20
15
10
5
0
-5
0
100
200
300
400
500
600
700


Total time to complete track vs. initial speed
Time (s)
Speed (m/s)
22
21
20
19
18
17
51
52
53
54


Exit speed vs. initial speed for ramp corner exit torque
Final speed (m/s)
Initial speed (m/s)
46
45
44
43
42
41
40
39
38
51
52
53
54


World coordinates: ramp corner exit torque w/ changing initial speed
North (m)
East (m)
300
250
200
150
100
50
0
-50
-300
-250
-200
-150
-100
-50
0
50
Track
Track
Vehicle paths

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