Nicolas Buxbaum

EBS 289K

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Assignment 3

Part 2

The robot is initialized at a position that is not on the path, and therefore the initial tracking error is high but falls quickly. The average tracking error is roughly 0.25m. The error will never be zero, despite the fact that the path appears to look accurate. This is due to the effects of look ahead distance, as well as Euler and controller integration. One could improve the error calculation by having a more well defined path (increasing the number of points) since the calculated nearest point to the robot is not necessarily the nearest point on the path if the path was a continuous function.

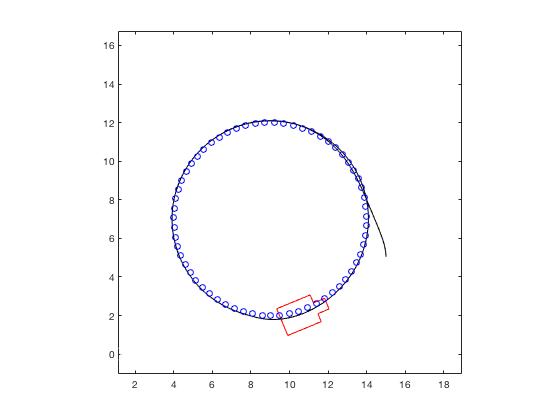


Figure 1 - Circular path

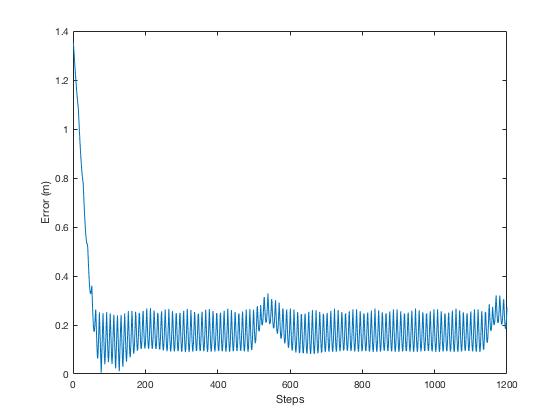


Figure 2 - Error of circular path

Part 3

The maximum error is (LD = 5 m) 2.625 m. The 95th percentile error (LD = 5 m) is 1.503 m. The RMSE of error (LD = 5 m) is 0.733 m. At a fixed speed, one can see the effect of increasing lookahead distance in Figures 3 and 6. Smoothness appears to increase with increasing lookahead distance, while stability decreases with decreasing lookahead distance. One can see the instability (overshoot) right after the second corner in Figure 6. At extremely small lookahead values strong instability in the form of oscillations occur. Corner cutting is greater with greater lookahead distance as expected. When the speed was doubled, no noticeable change occurred to the path or to the tracking error.

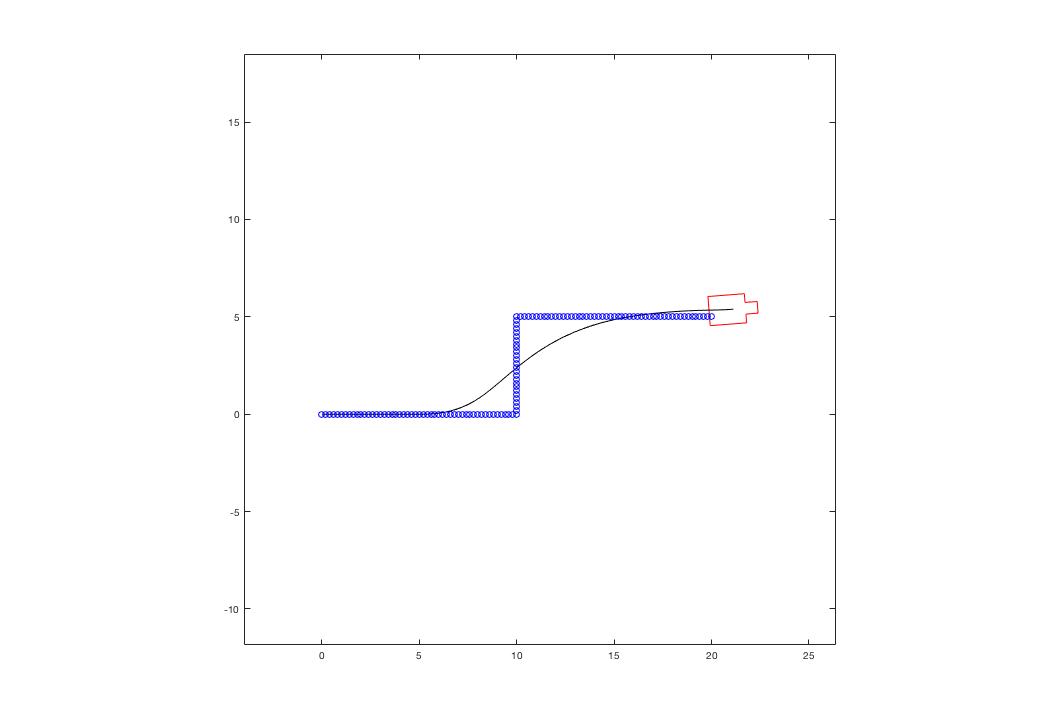


Figure 3 - Lane change path with Ld = 5m

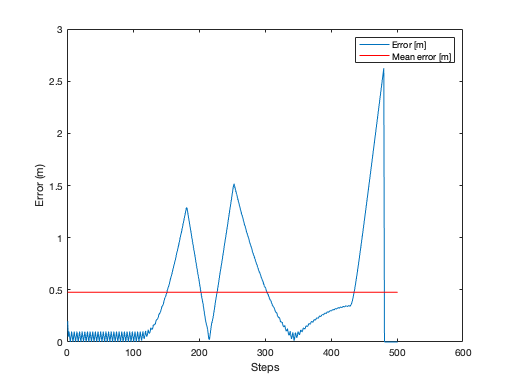
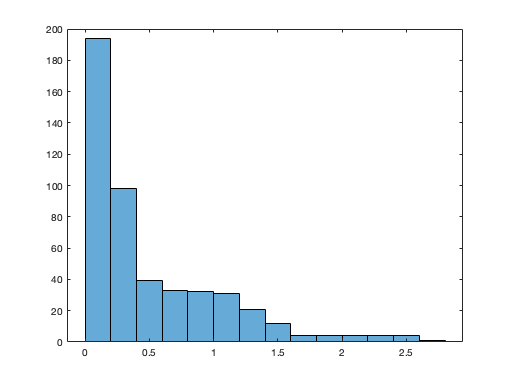
 

Figure 4 - Path error with Ld = 5 m Figure 5 - Error histogram with Ld = 5m

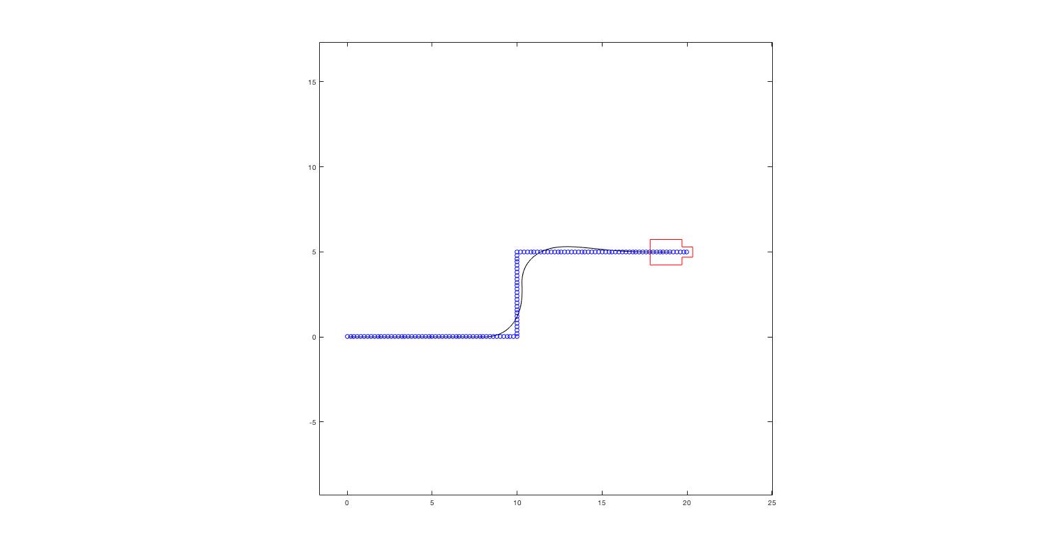
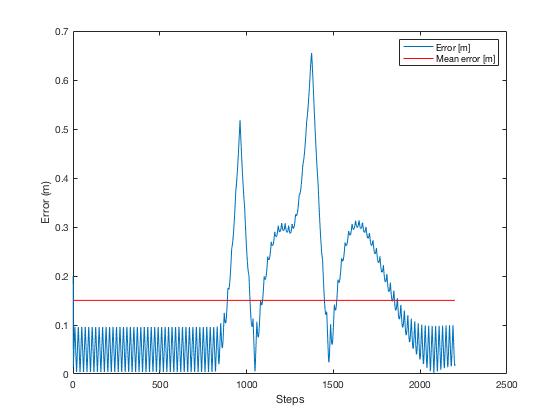
 

Figure 6 - Robot path with Ld = 2 m Figure 7 – Error for path with Ld = 2 m

Part 4

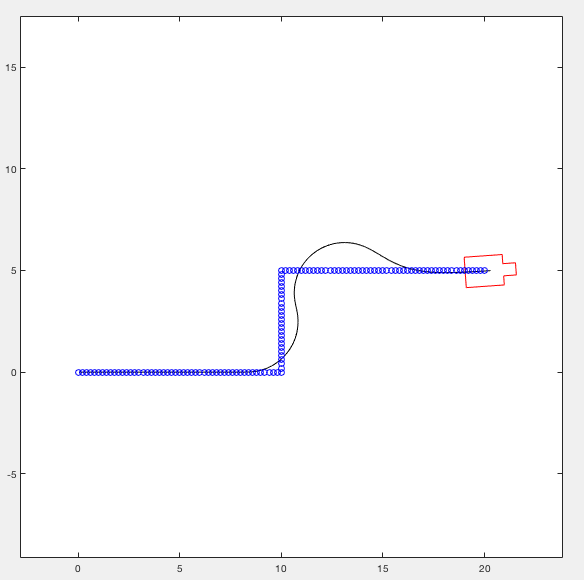
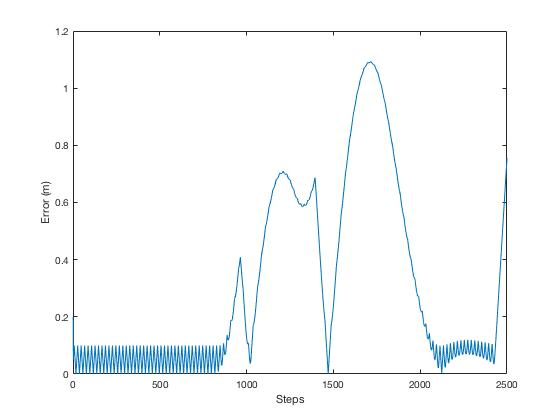
 

Figure 8 - τγ = 0.15 s, τv = 0.5 Figure 9 – Error with τγ = 0.15 s, τv = 0.5

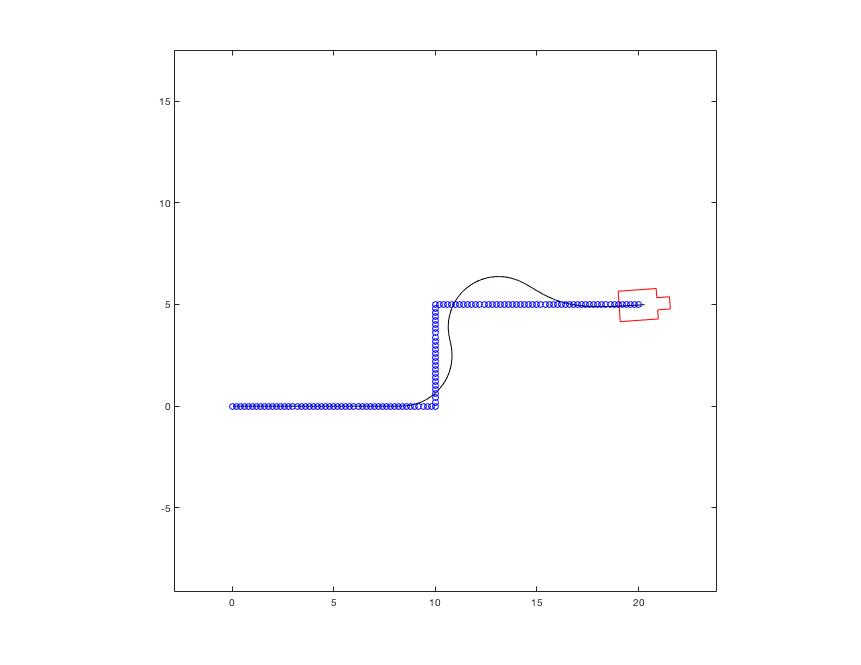
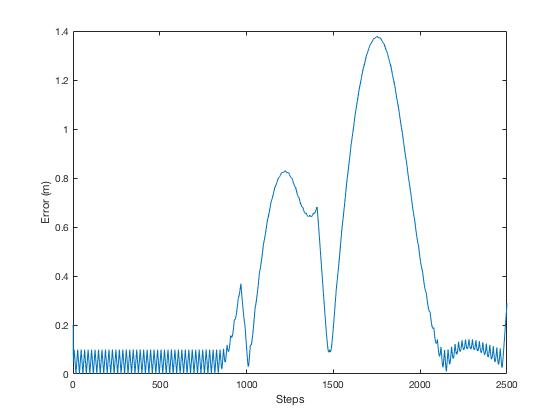
 

Figure 10 - τγ = 0.3 s, τv = 0.5 Figure 11 – Error with τγ = 0.3 s, τv = 0.5

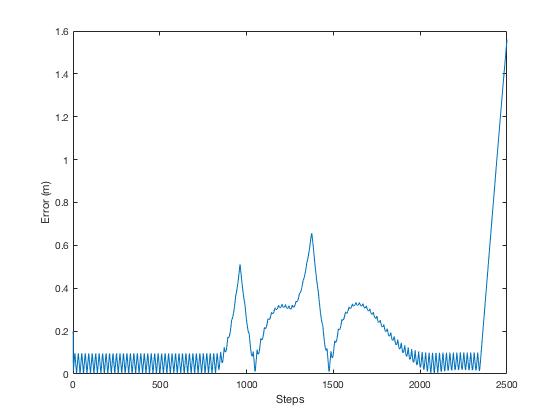
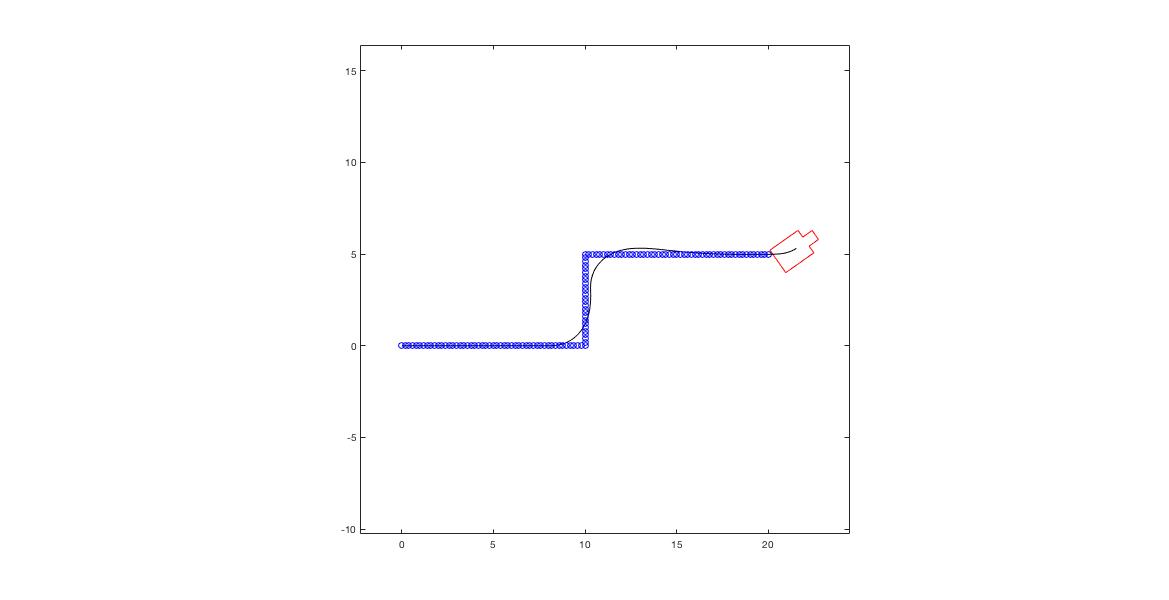


Figure 12 - τγ = 0 s, τv = 0, Ld = 2 m, γmax = 35o Figure 13 – Error for τγ = 0 s, τv = 0, Ld = 2 m, γmax = 35o

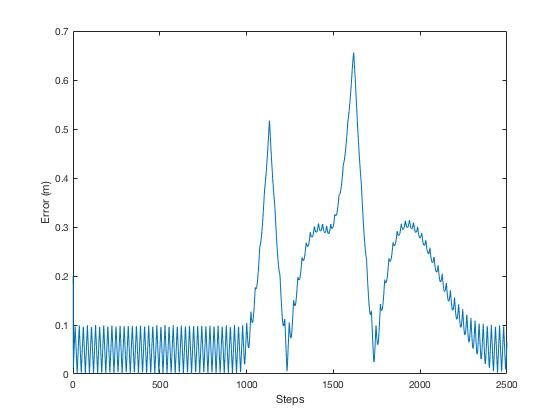
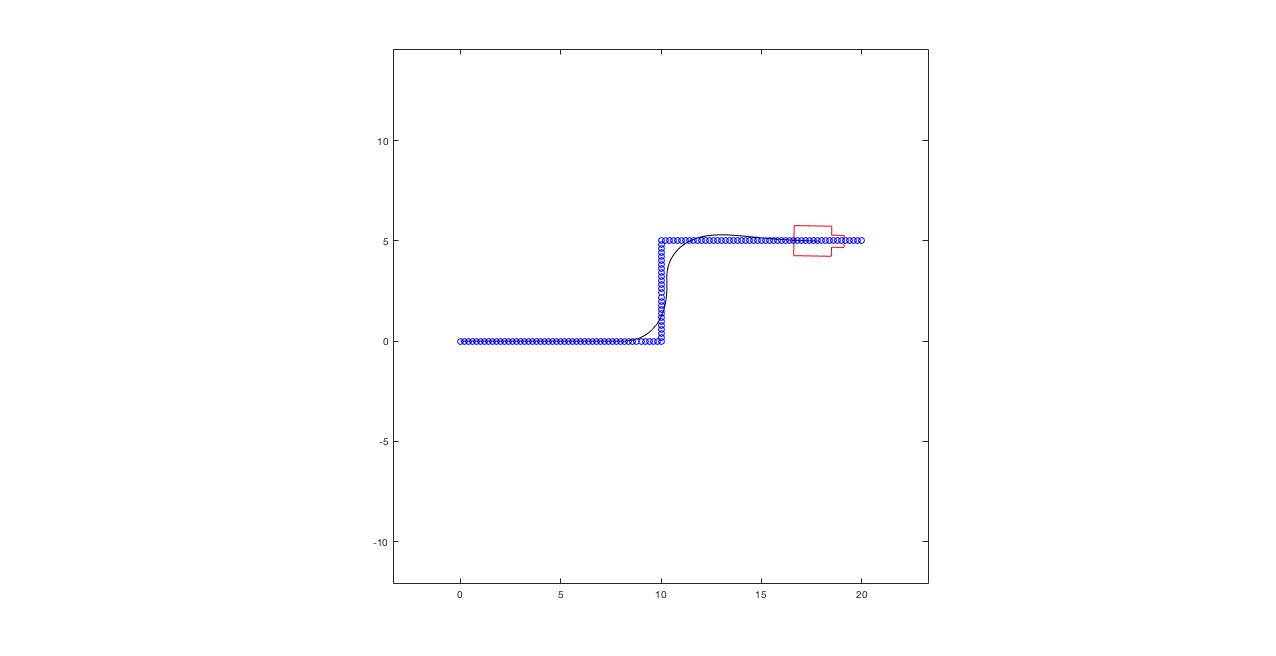


Figure 14 – slip = 15% Figure 15 – error for slip = 15%

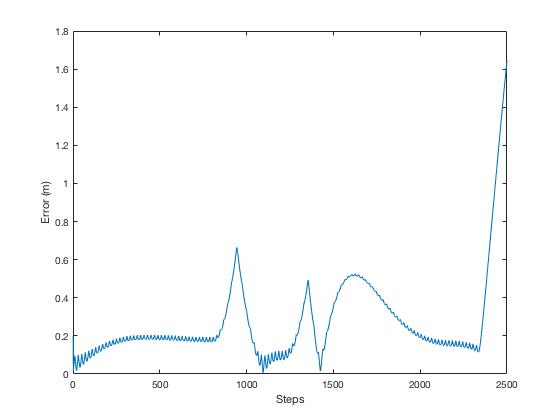
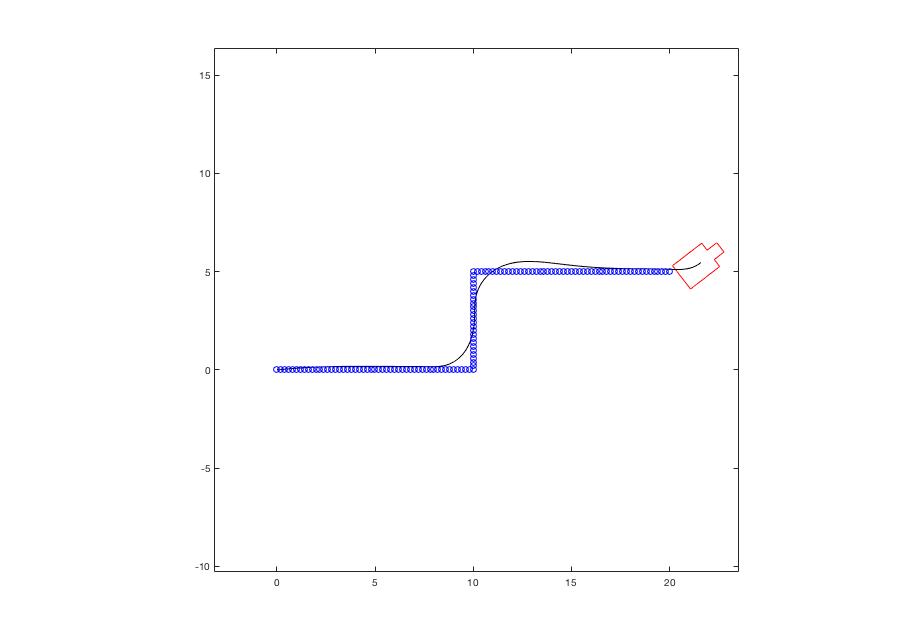


Figure 16 – Skid condition. d1 = d2 = 5 deg Figure 17 – Error for skid condition. d1 = d2 = 5 deg