Assignment 1 First Order Boustrophedon Navigator

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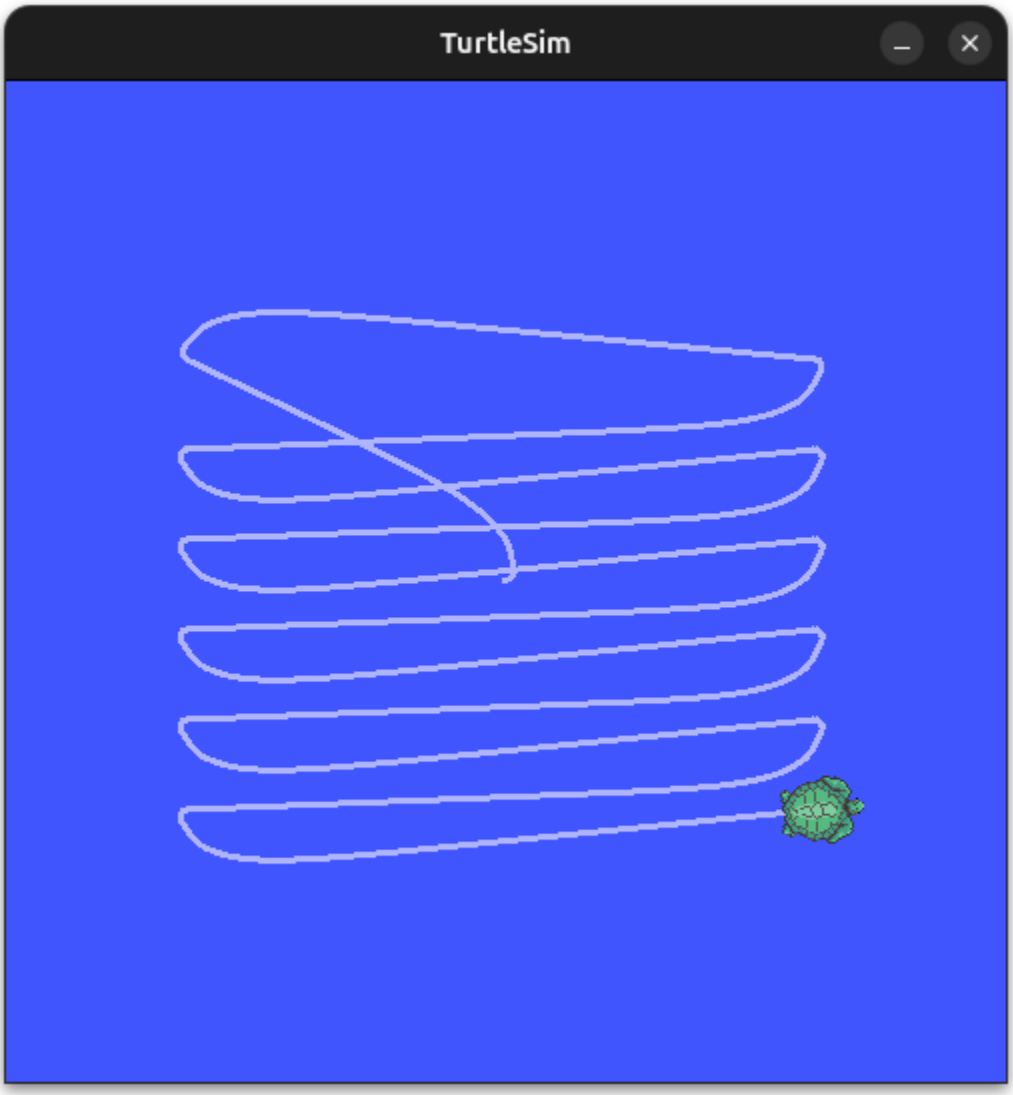
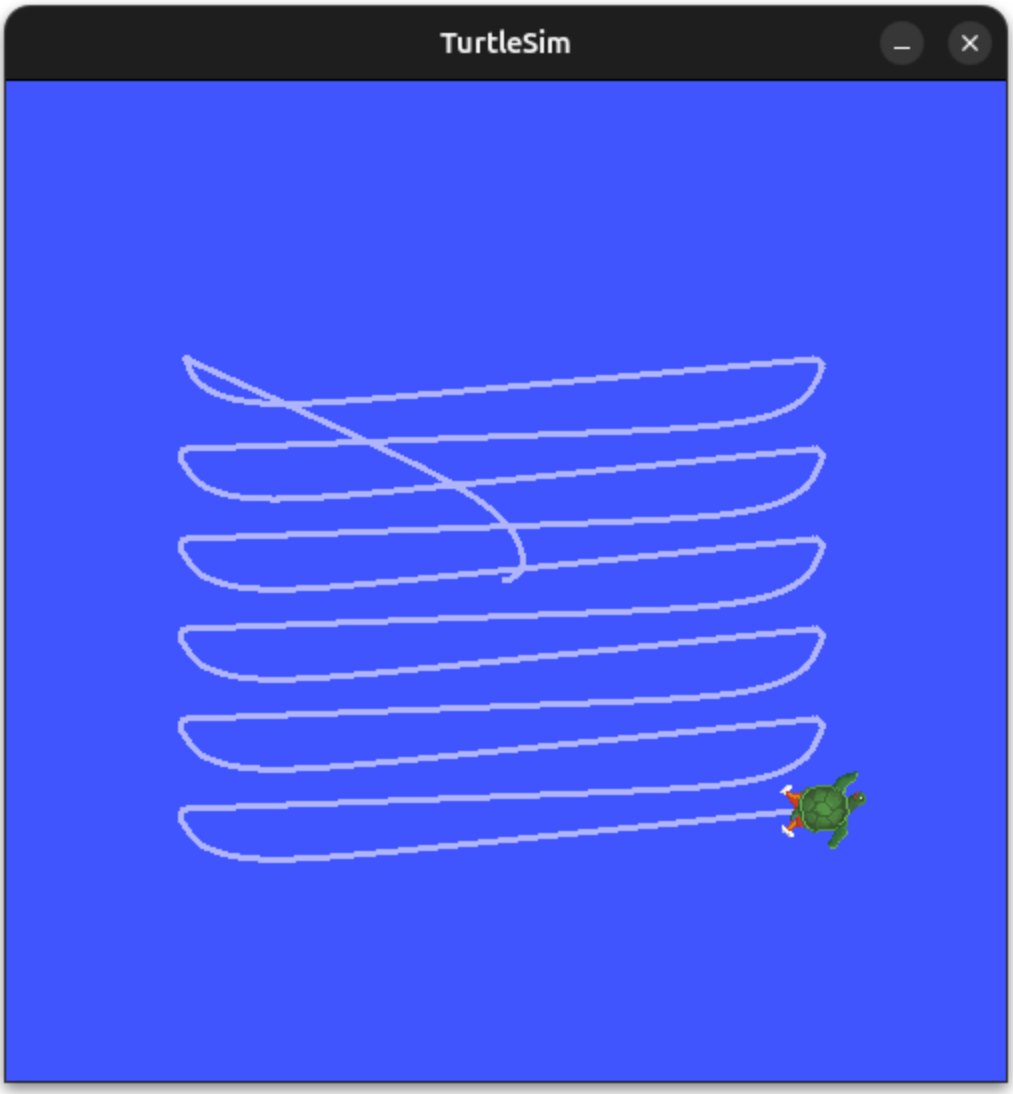
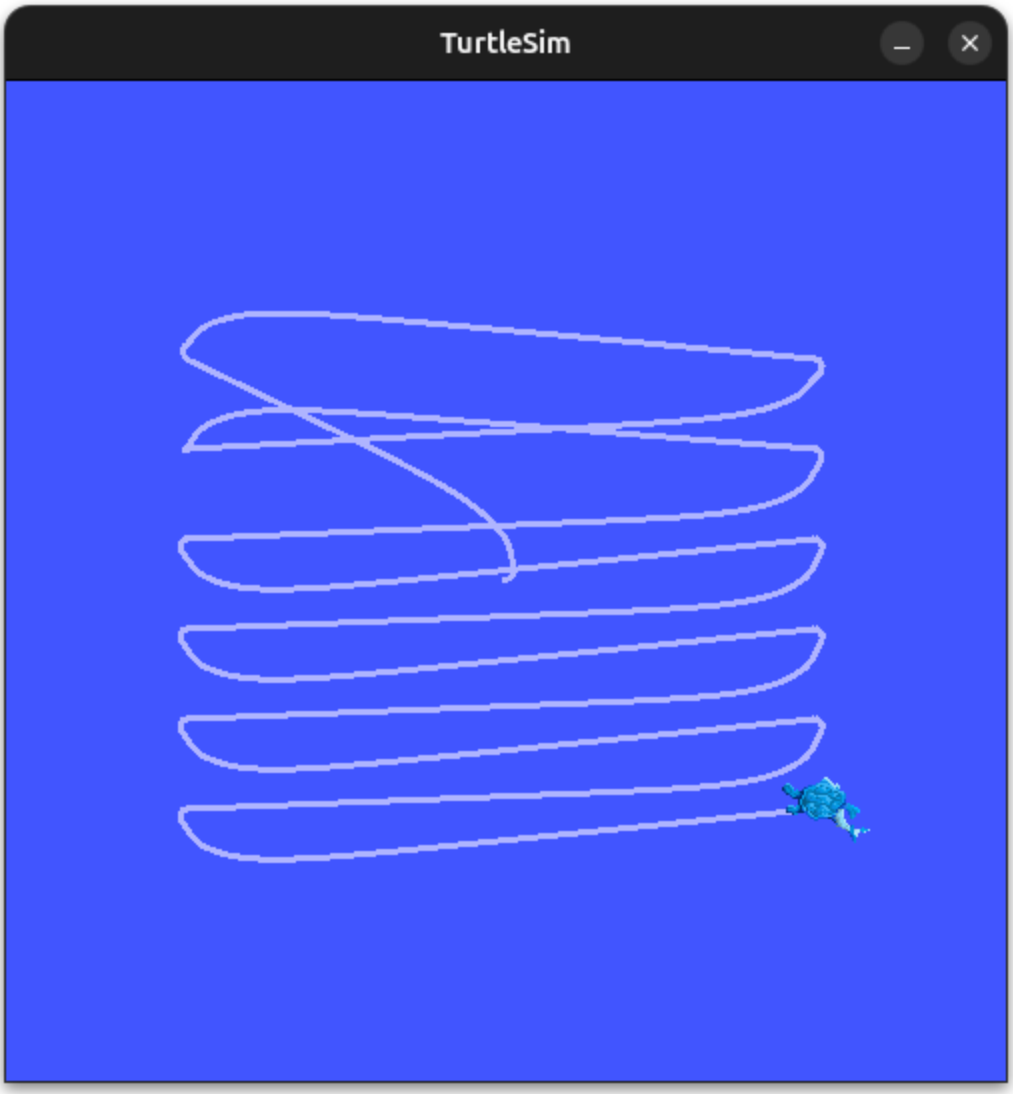
Due Date: Feb 3, 2026



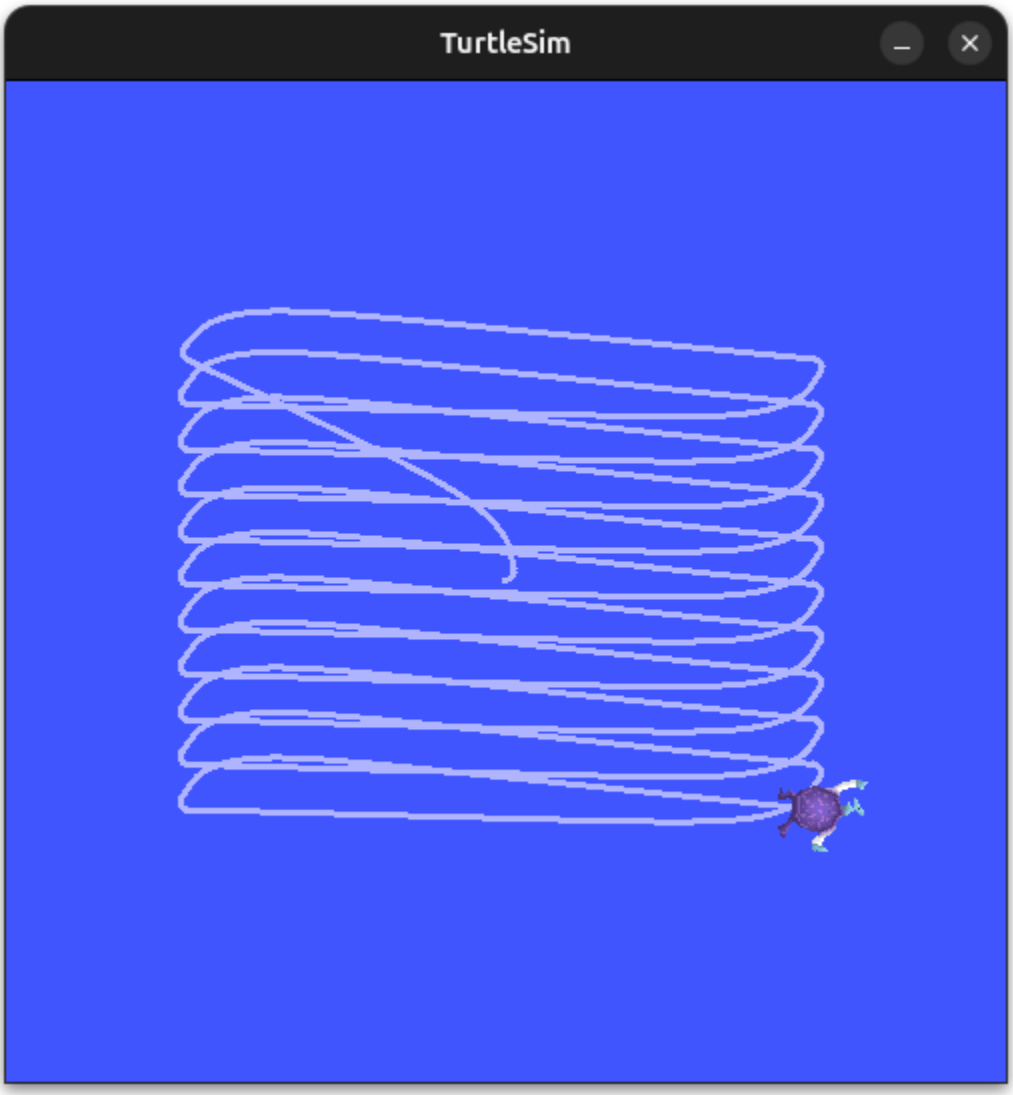
Cross Track Error Average	Kp Linear	Kd Linear	Kp Angular	Kd Angular	spacing
0.311	5.0	0.1	5.0	0.2	1.0


TurtleSim



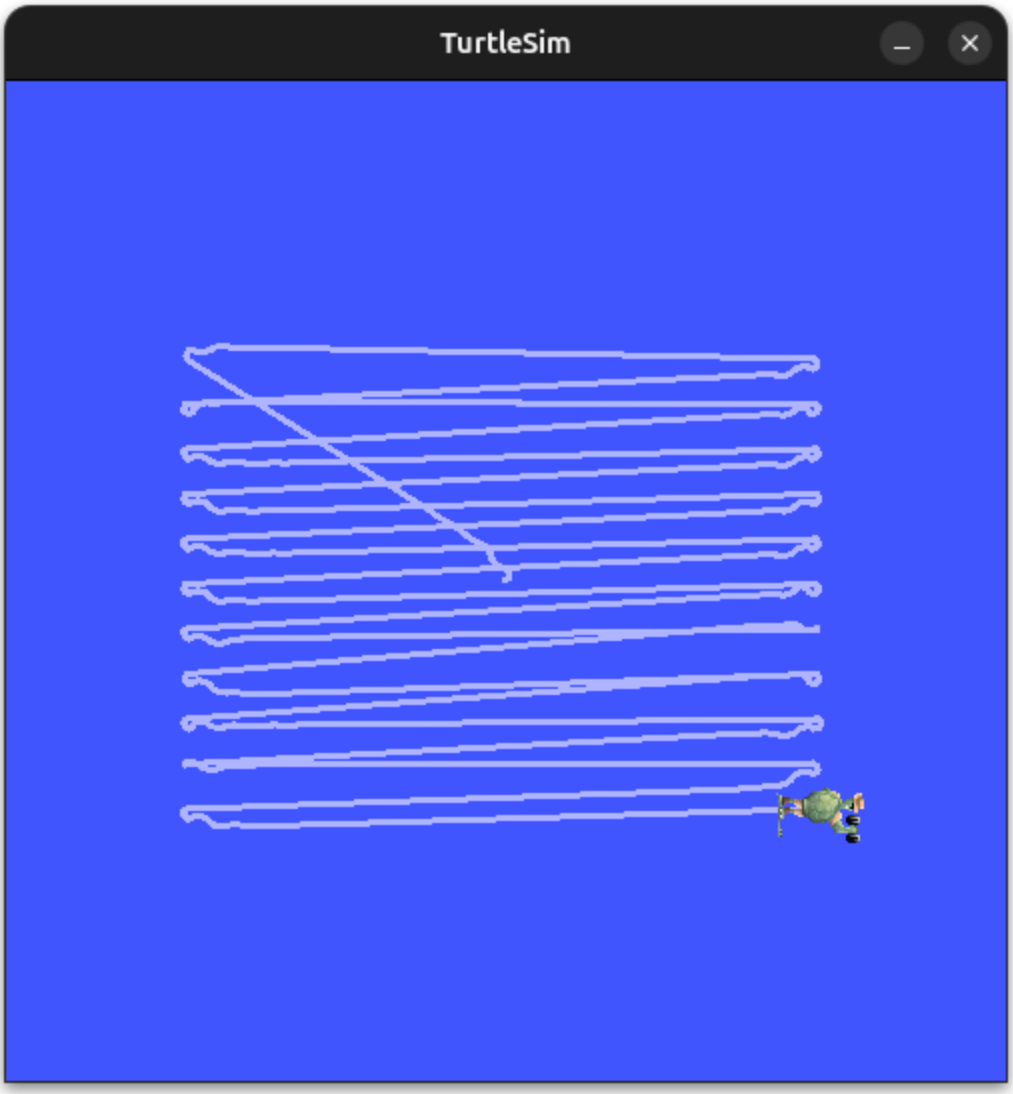
Cross Track Error Average	Kp Linear	Kd Linear	Kp Angular	Kd Angular	spacing
0.311-0.300	10.0	0.1	5.0	0.2	1.0

Not sure why the turtle does different paths between runs with the same parameters set, but I thought I should include it. Now Im going to reduce the spacing to hopefully cover more area. Then I will tune the parameters to reduce the turning radius and overlap less.



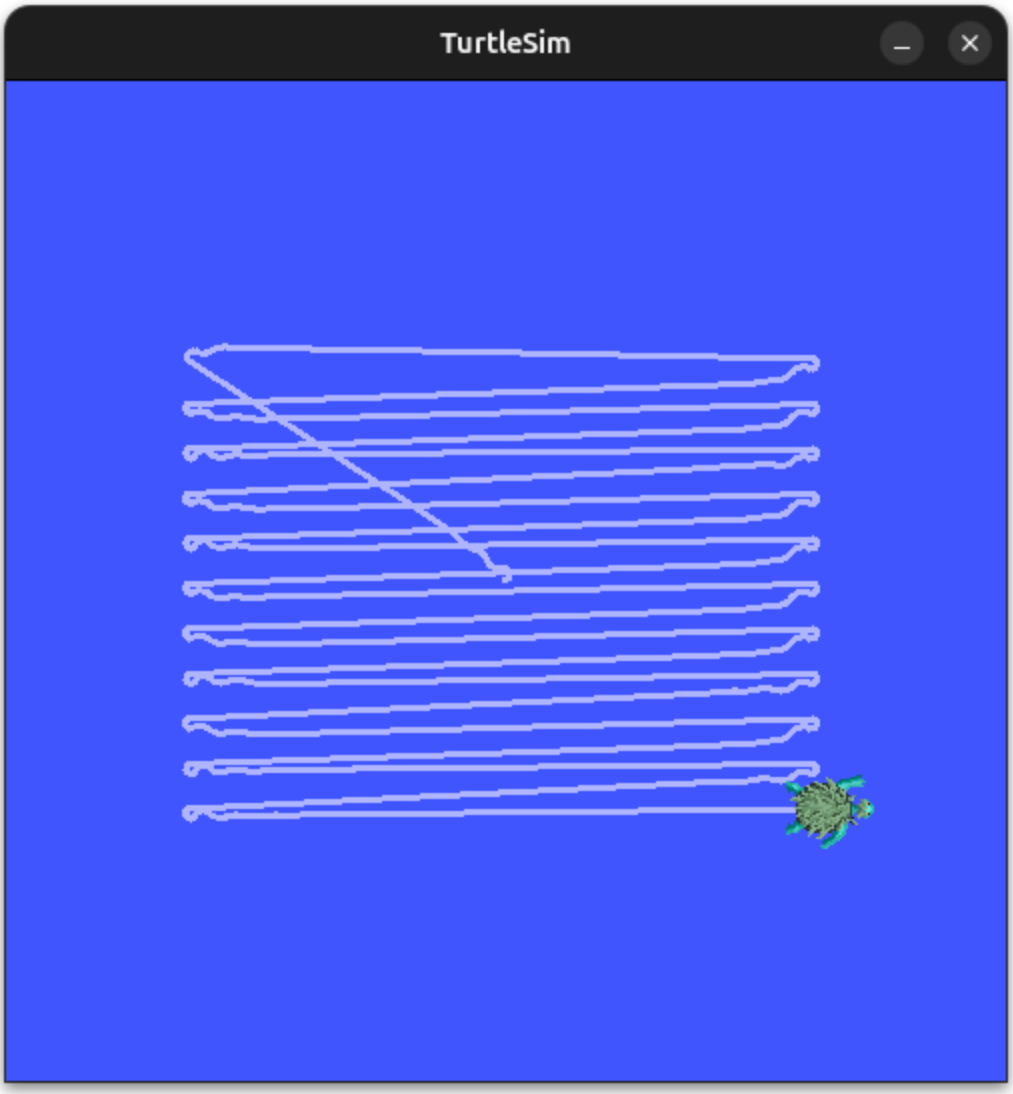
Cross Track Error Average	Kp Linear	Kd Linear	Kp Angular	Kd Angular	spacing
0.309	10.0	0.1	5.0	0.2	0.5

So I need to change the angular Kp gain to account for the large turning radius.



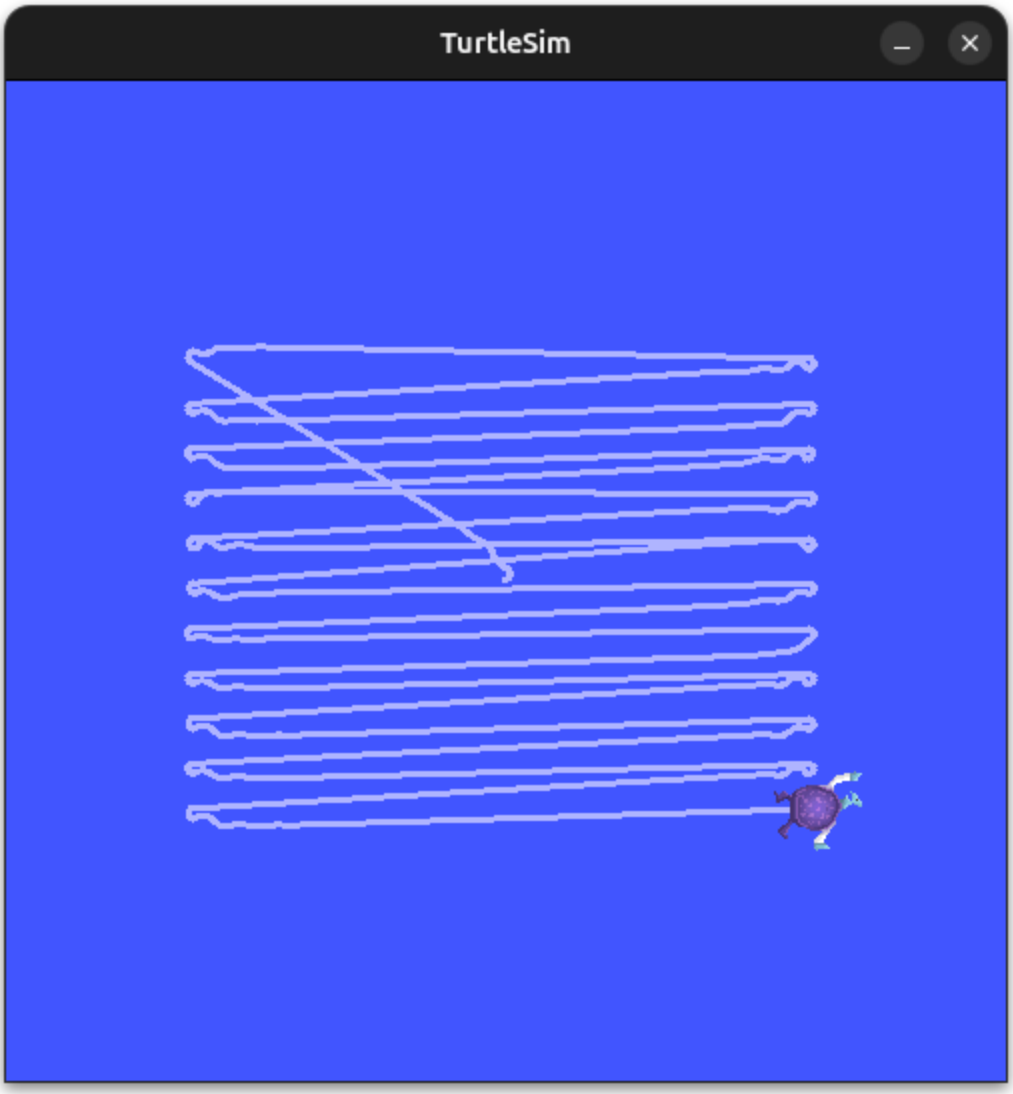
Cross Track Error Average	Kp Linear	Kd Linear	Kp Angular	Kd Angular	spacing
0.064	10.0	0.1	10.0	0.2	0.5

So the cross track error is super low, but it just doesn't seem like a stable system due to squigly lines whenever the turn is completed, So I either have to turn down the velocity going into the turn or up the damping of the angular rotation.



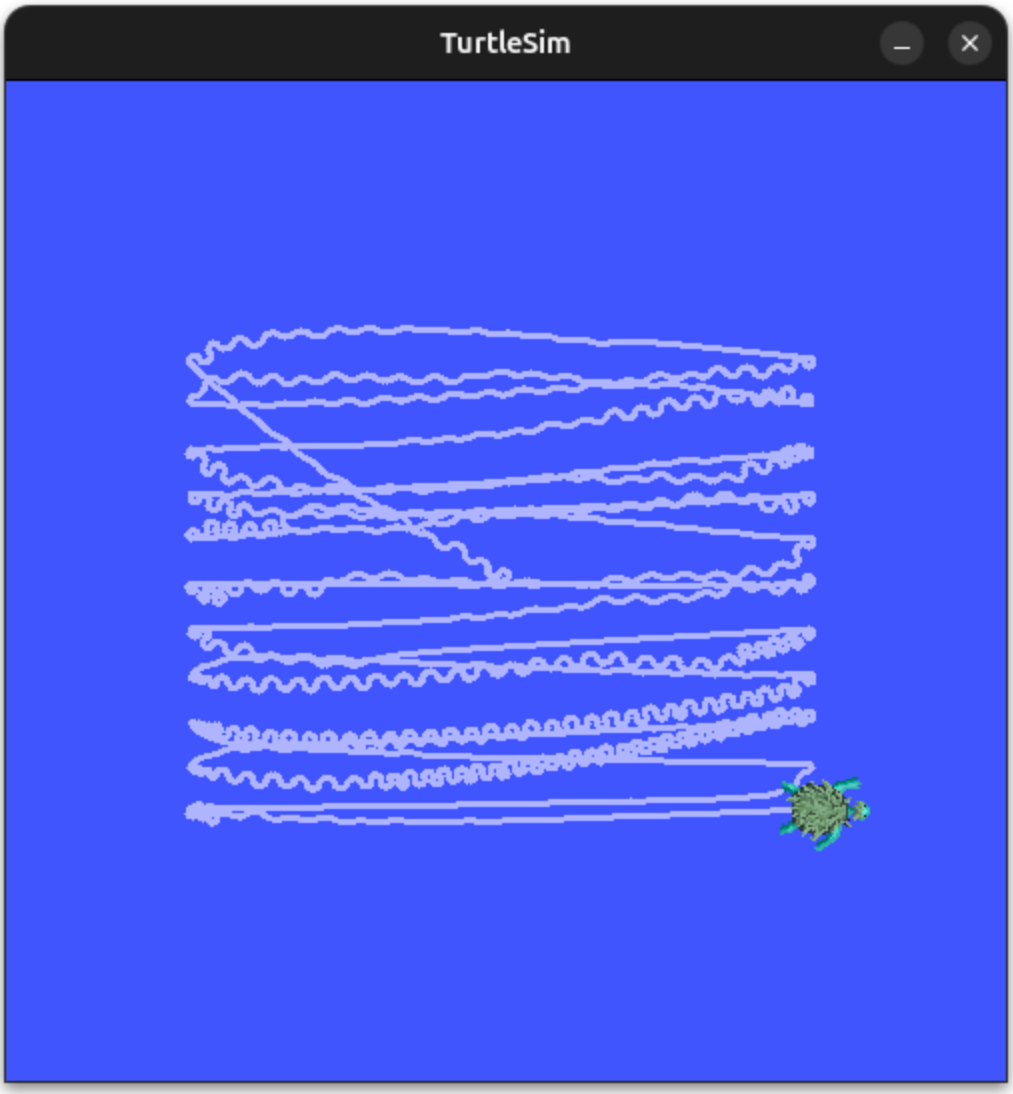
Cross Track Error Average	Kp Linear	Kd Linear	Kp Angular	Kd Angular	spacing
0.08	5.0	0.1	10.0	0.2	0.5

The recovery from the turns are a bit better however, I suspect that the linear acceleration needs to be damped in order to slow down before attempting the turns.



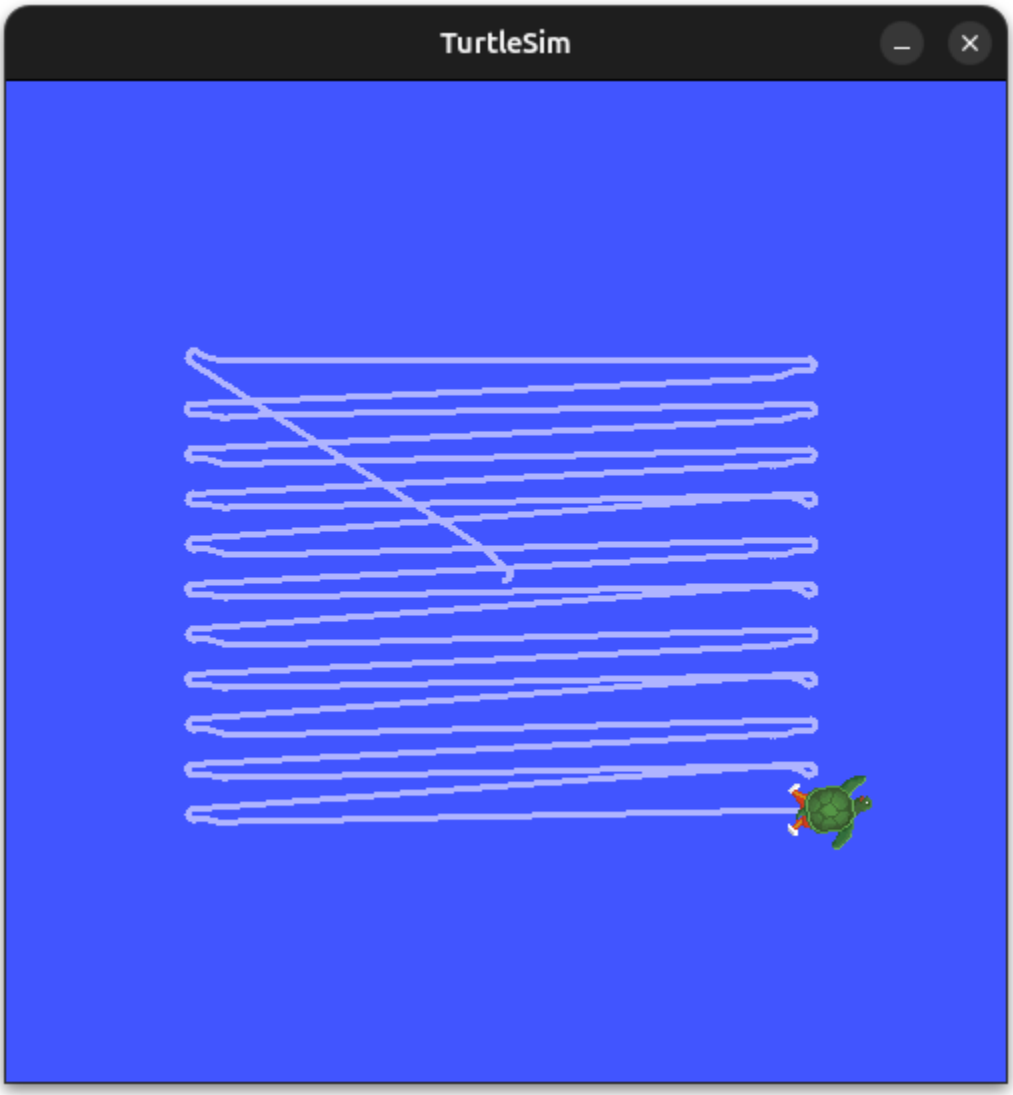
Cross Track Error Average	Kp Linear	Kd Linear	Kp Angular	Kd Angular	spacing
0.065	5.0	0.5	10.0	0.2	0.5

Huge improvement as there are some loops that look feasible to do in real life without tons of jerk. Now I need to change the Kd angular.



Cross Track Error Average	Kp Linear	Kd Linear	Kp Angular	Kd Angular	spacing
0.146	5.0	0.5	10.0	0.5	0.5

Okay, I totally messed up. The oscillations are definitely coming from a Kd angular damping coefficient being too high. So I will instead change it to be lower.



Cross Track Error Average	Kp Linear	Kd Linear	Kp Angular	Kd Angular	spacing
0.057	5.0	0.5	10.0	0.1	0.5

Alright I am very happy with this result. The turtle robot makes turns smoothly and does not loop over itself. It slows down very well before entering corners, and this control scheme would work for a lawnmower or surveyor robot.