

Reflection

The P, component causes the car to steer proportional to the car's distance from the lane center (which is the CTE) - if the car is far to the right it steers hard to the left, if it's slightly to the left it steers slightly to the right.

The D, component counteracts the P component's tendency to overshoot the center line. D parameter will cause the car to approach the center line smoothly without overshooting.

The I, component counteracts a bias in the CTE which prevents the P-D controller from reaching the center line.

Hyper Parameter Selection

Initially hyper parameters are fixed as 0.1 for Kp , 0.004 as Ki and 1.3 as Kd. The vehicle is able to complete the track but oscillates vigorously while turning.

Then a twiddle based approach is implemented. The parameters are first initialized as 0.01 for Kp , 0.001 as Ki and .6 as Kd. Probing increments are chosen to be 0.1 times the initialization. Termination criteria for twiddle($dp_p + dp_i + dp_d < 0.01$) is chosen to be .01. This helps twiddle in learning better parameters as it runs longer to experience the first left turn from the starting point.

Final learned parameters are Kp: 0.089543 , Kd: 4.05613 , Ki: 0.00640946. The vehicle does better this time when compared to the fixed parameters but oscillation during turning still remains.

More tuning of the parameters are required to smoothen the oscillation.