

Created PID controller helps to keep vehicle on track with defined path. It is an easy algorithm with quite complicated coefficients that need to be tuned to provide correct PID behaviour.

I set the coefficients manually because twiddle methodology didn't give me satisfying results.

I've started with $K_p = 1$ and K_d and K_i set to 0.

As the car was too unstable I've divided value by 2 till it was able to following the path till first sharp curve. The final value of K_p is 0.125. I wanted to have constant wave steering around main path.

Next I've started with K_i value of 1. Car with such a coefficient goes off road immediately so I've divided value by 10 a few times till it was stable again. Then I've tuned value by dividing value by 2. Final K_i is 0.00025. I have reduce the wave but it still goes off-road, because lack of smoothing near trajectory.

Last coefficient was to set the K_d value. I've started with 1. With this I has finally success in going lap, but car was unstable a little, I've checked the value of 5 – It was too big, so I've reducec K_d to 2.5

Final values was:

$K_p = 0.125$

$K_i = 0.00025$

$K_d = 2.5$

With this setting car goes safety all lap.

Next I've run Program with Twiddle algorithm to increase accuracy of coefficients. After 100 actions I had coefficients:

$K_p = 0.115107$

$K_i = 0.000125644$

$K_d = 1.25644$

```
Kp = 0.115107 Ki = 0.000125636 Kd = 1.25636
CTE: 0.2773 Steering Value: -0.0201289
42["steer",{"steering_angle":-0.0201288636341119,"throttle":0.3}]
total_error = 0.0684346 best_error = 0.0768953
Kp = 0.115107 Ki = 0.000125716 Kd = 1.25716
CTE: 0.2616 Steering Value: -0.0180957
42["steer",{"steering_angle":-0.0180956775582967,"throttle":0.3}]
total_error = 0.0604176 best_error = 0.0684346
Kp = 0.115107 Ki = 0.000125573 Kd = 1.25573
CTE: 0.2458 Steering Value: -0.016196
42["steer",{"steering_angle":-0.016195965735275,"throttle":0.3}]
total_error = 0.052854 best_error = 0.0604176
Kp = 0.115107 Ki = 0.000125644 Kd = 1.25644
CTE: 0.2299 Steering Value: -0.0142621
42["steer",{"steering_angle":-0.014262119775235,"throttle":0.3}]
CTE: 0.2086 Steering Value: -0.00505176
```

This setting also allows to successfully finish lap with nice accuracy. Only once the car on sharp bend has a little problem to not cross the yellow line. But is remains on the road all the time.