

PID CONTROL

The aim of this project is to build PID controller that controls steering angles as well as tune PID coefficients to drive around the center line of the track. In other words, to minimize cross track error that is the distance of the vehicle from the center line.

THREE ELEMENTS OF PID

P: Proportional: this term applies a correction to the steering wheel angle proportional to the error. If vehicle too far from the goal it steers hard, if it is close the goal it steers slightly.

D: Derivative: The work of the term D is to control oscillations and how smooth the vehicle will steer to the reference trajectory.

I: Integral: It's the sum of error to deal with system bias in the CTE which counter a bias in the cross track error that prevent the PD controller from reaching its goal.

PARAMETERS TUNING

The coefficients of the PID controller selection for this project is using trial and error method. It is simple manual method as describe below

1. Set all gains to zero
2. Increase the **P** gain until the response to a disturbance is steady oscillation.
3. Increase **D** gain until the oscillations go away
4. Repeat 2 and 3 until increasing the D gain does not stop the oscillations
5. Set P and **D** to the last stable values
6. Increase the **I** gain until it brings you to the set point with the number of oscillation desired.

So after parameter tuning following above manual method the optimal parameter found are **0.1** , **0.005**, **3.8** for proportional gain (**K_p**), derivative gain (**K_d**) and integral gain (**K_i**) respectively.