PID Controller Project

Introduction :

One of the most important modules in robotics is control which represent the required action that will be sent to actuators to perform a specific task. In this project I'll apply PID controller one of the most famous and well known controllers in industry.

PID Controller:

The idea of pid is to use feedback to calculate the error and adjust the input to the system in the direction that minimize the error .Achieving that by well tuning controller hyper-parameters Kp,Ki and Kd.

Tuning:

Finding the hyper-parameters is the key to solve the control problem. This can be done by different methods such as manual tuning, Ziegler-Nichols tuning, Twiddle.
I have done both manual tuning and Twiddle. Manual tuning is hard but, the process of tuning help us better understand every single effect of PID parameters. The following table summarizes the effect of increasing parameter on the system.

Parameter	Rise Time	Overshoot	Settling Time	Steadystate error
Kp	Decrease	Increase	Small change	Decrease
Ki	Decrease	Increase	Increase	Decrease
Kd	Small change	Decrease	Decrease	No change

Proportional (P):

Proportion to the error, increasing this parameter will cause overshot and oscillations.

Integral (I):

Accumulate error over time help to reduce steady state error ,good for system bias and model uncertainty.

Derivative (D):

Proportion to the rate of change of error, reduce oscillations,

Project Implementation:

1. Calculate Cross track error (cte).
2. Manual tuning (kp,ki,kd) in the beginning and followed by fine tuning by using Twiddle