Reflections on Project4: PID controller:
Link to video on youtube: https://www.youtube.com/watch?v=oV5LUx-nUas

Methodology and Results:

I firstly tired to implement the Twiddle approach to automatically find the correct parameters but failed. Due to the short time I have to pass this term I decide to revert back to the good old trial and error method, and follow the intuitions we developed through Sebastian class. I

I would take one parameter at a time and plug in numbers in the magnitudes of 1, 0.1, 0.01 and so, then run the simulator and tweek for better performance. I have documented the performance in the comments inside the code as well.

But before plugging in values, I reduced the car speed to 10 KM/h to control the car easier. Then I focused on the proportional parameter Kp. At low values it wouldn't respond quickly, while higher values gave good results at such slow speed, but would harshly fluctuates at turns, expected behaviors as we seen from Sebastian class. So I fix the value at 0.4 and move to the second parameter to reduce the fluctuations by subtracting the differential distance from CTE.

I started plugging in values of 0.1 and 1 for Kd, but the performance got worse. Hence went the other way round for smaller values until I settled at 0.0001. Makes sense, because we are trying to cut off the harsh fluctuations of Kp component by a more stable parameter that doesn't fluctuates in large values. Therefore a smaller value makes sense to stablize the performance of the car. And it went all the way around the track at 10KM.

Now I wanted to increase the challenge a bit, and increased the speed to 30KM, and another disaster happened. It immediately fluctuated as the car started moving. As a response. I reduced the proportional parameter Kp, and increased a bit the Kd, and the performance improved at values Kp = 0.1, down from 0.4, and Kd = 0.0002 from 0.0001. But still the car would fluctuates and get off the track at the turns, so it was time to introduce the Ki parameter, to account for the accumulated errors and offset developed along the way.

Again started experimenting with different magnitude of values, and noticed improvements at relatively higher values between Ki= 1 to 3. And Higher then that the car would have a timid behavior especially at turns.

Room for improvements:

- Add speed to the equation. Relatively higher speeds when CTE is lowest, and lower speeds when far from CTE, or when at turns for safer driving. PID controller equation can be used for that, and I can define speed limit lower than 100KM ofcourse ☺.
- Make Twiddle work. I will appreciate your tips on that, which is something I will work on as soon as I pass Term2.