**PID Controller**

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This project is about implementing a PID controller to drive an autonomous car on a track. The input is CTE (cross track error with the reference line) and output is steering control and speed. The target is to drive car autonomously within lane safely.

To choose the final parameter for P, I and D, I used a mixture of Twiddle and manual testing. With twiddle, I got some ballpark idea and then I started playing with each parameter until I had desired result. I implemented Twiddle as discussed in classroom.

With twiddle, I found ballpark value of:

Kp: 1

Ki: 0

Kd: 4.49459

Best Error: 0.011849

Final value with manual tuning:

Kp: 0.2

Ki: 0.0001

Kd: 3.0

Each parameter has their own effect:

P: This factor will try to pursue reference line but will always overshoot either side. Thus, vehicle will keep oscillating. Take a look at video “Only\_P\_Video.mov”.

I: This factor will take care of bias in the wheel due to imperfect wheel alignment. But this may cause big overshoot in starting which should be taken care by D factor. See “wrong-i-value.mov” if his factor is wrong. The moment car starts, it does a big oscillation and gets off the road.

D: This factor takes care of overshoot by the P factor. But this cannot take care of imperfect wheel alignment bias. With P & D, car started nice but after some time bias starter affecting car movement and we can see its starts oscillating. See “p-and-d-control.mov”.

Combining all these factors to calculate steering gives best result.

Future Enhancements includes better convergence method which is track agnostic as twiddle have these limitations:

1. Twiddle methods takes a lot of time to converge.

2. We might need to run twiddle for each track, as it seems it optimizes parameter for given track only.