

PID Control Project

Reflection

The purpose of this project is to build a PID controller which will control the steering of the car in the simulator. The controller calculates parameters according to CTE (Cross-Track Error) provided by the simulator, which will help keep the car on track.

About P.I.D.

The proportional parameter 'P' means the steer in proportion to the CTE which essentially how far from the middle line of the road. If 'P' coefficient set too high, the car will have quicker oscillations around the middle line. If the 'P' coefficient set too low, the car will have a longer periods of time. And if only 'P' coefficient to used, the controller just multiplies the CTE by 'P' to define the controller output, and the car will oscillate around the middle line.

The proportional parameter 'I' will integrate the CTE over time, until it approaches zero. If 'I' coefficient set too high, the car will have quicker oscillations around the middle line. If the 'I' coefficient set too low, the car will have a longer periods of time.

The 'D' for derivate is the change in CTE from one value to the next. This coefficient essentially counteracts the erratic behavior and oscillations in trajectory that occur if only a 'P' controller is used.

About Hyperparameter Tuning

The method about how I tuning the hyperparameter is following:

1. Choose a 'P' value from 0 and then tuning the 'D' value to get the vehicle to a stable state around the middle line, until I got the first set of parameters that made the car completed a full lap of the track.
2. Increase the 'P' value and tuning the relevant 'D' value.
3. Repeat the step 2.
4. If there are oscillations around the middle line, no matter how I tuning the 'P' and 'D', I increase the 'I' to reach the goal.