Udacity CarND Term2-Project4 PID Writeup

"Describe the effect each of the P, I, D components had in your implementation"

PID is a popular classic control technique. PID stands for Proportional-Integral-Derivative. In this project vehicle control, the Proportional component produces a steering value proportional in magnitude to the cross-track error but in the opposite direction. For example, if the cross-track error is a negative value, the P terms will create a positive value causing the vehicle to turn left. As shown in the "*t2-p4-01-Kp1_Ki0_Kd0.mp4*" clip, where P is set to 1 and I and D are both zero, the vehicle is swinging left and right around the middle of the track, which is the reference trajectory. To reduce the amount of swing, the Derivative component is added. The D term essentially prevents large changes in the cross-track error. And the Integral component is rarely used in practice (Franklin-Powell-Emami 2006). It is used to reduce systematic bias, such as wheel misalignment.

"Describe how the final hyperparameters were chosen"

I tune the PID controller manually with trial and error. I start with Kp = 1 and the other two components as zero. The vehicle swings left and right around the middle of the track and derails quickly. The Kp value is too large. I cut Kp in half to 0.5. The vehicle swings less. I further reduce Kp in half to 0.25. The vehicle now becomes a bit steadier but not as much as I expect. Their results are in clips "*t2-p4-02-Kp0_5_Ki0_Kd0.mp4*" and "*t2-p4-03-Kp0_25_Ki0_Kd0.mp4*". Next I add the Kd = 1 term to reduce the amount of cross-track error. And the vehicle makes a full successful run, as shown in the clip "*t2-p4-04-Kp0_25_Ki0_Kd1.mp4*". So my final hyperparameters settings are Kp = 0.25, Ki = 0, and Kd = 1.