PID Control Project

PID Controller:

The main aim of this project is to develop a PID control for steering and speed control of the vehicle. The controller is designed in C++ and has two stages. One stage is used for steering control and another for speed control.

Tuning:

Once we design the controller it important to find the right parameter values of Kp, Kd, and Ki. These parameters can be tuned using various methods of the controller tuning such as, Zeigler-Nichols tuning, twiddle method that is taught in lecture or manual tuning. I have used manual tuning for this project.

The values of Kp, Ki, and Kd used for steering are 0.13, 0.0001, and 1.0, respectively. While the values of Kp, Ki and Kd used for speed are 0.1, 0.002, and 0.0, respectively.

Effects of PID:

The term PID stands for proportional, integral, and derivative. The proportional control helps in to reach the reference signal as fast as possible. Thus, setting value of gain i.e. Kp reduces rise time but also increases oscillations.

While integral control Ki term also reduces rise time and increase overshoot it also has significant impact of settling time which is gets increases. However, the steady state error is most prominently reduced due to integral control.

Finally, the derivative control Kd is basically used to reduce the overshoot/oscillations in the response which are increased by PI terms of controller. The derivative term has no significant contribution in rise time and absolutely no effect on steady state error.

Note1: While designing a controller is often avoided to use only PD control. If we are using a derivative control it combined with the action of integral control

Note2: Also, using integral term creates integrator windup which can have some adverse effects on the control of system. Thus, while designing a controller we must be careful about this.