PID control project report

1. PID principle and characteristics:

1.1 PID controller is based on the system error, using proportion, integral,differential calculation of the control quantity for control,so that the control system has accuracy, fast response, and stability.

1.2 It has become one of the main technologies of industrial control for its simple structure, and convenient adjustment.

1.3 Proportion (P) control :

Proportional control is one of the simplest forms of control,the output of the controller is proportional to the input error signal.

1.4 Integral (I) control:

For automatic control systems, if input steady state error occurs, and the integral term of the error depends on time,the integral term increases with time, even if the error is small, the integral term will increase with the increase of time, thus pushing the output of the controller to increase. adding the integral term can make the system almost have no steady-state error after entering the steady-state state.

1.5 Differential (D) control:

In differential control, the output of the controller is directly proportional to the differential of the input error signal (that is, the rate of change of the error).the automatic control system may oscillate or even lose stability in the adjustment process, and the add "D item" can predict the trend of error change. In this way, the controller with proportion + differential can make the control effect of restraining error equal to zero or even negative in advance, so as to avoid the serious over-adjustment of the controlled quantity ,therefore the proportional + differential (PD) controller can improve the dynamic characteristics of the system in the adjustment process.

2. Get PID hyper parameter:

2.1 In order to obtain the CTE error, the "PID" parameter should be selected manually first, to enable the car to drive a circle,after the test, when P=0.2,I=0, and D=1, the car can drive a circle.

2.2 Use the TWIDDLE function to get the hyper parameter:

When the car is driving, count step and find that it takes about 2000 steps to drive a circle,set up a loop every 2000 steps and iterate with the current total error compared with the previous error,each time the corresponding increase or decrease PID parameters 0.1 times ratio,after recording the data about 50 times, it was found that the "P" parameter continued to decline and its total error was reduced,as following table(For example,):

Total error	P	I	D
1024.98	0.23716	0.00484505	1.07811
684.784	0.213444	0.00544455	1.18701
566.462	0.1921	0.00544455	1.18701
385.0	0.17289	0.0049001	1.18701
370.0	0.151759	0.0053901	1.17514

Because I finished the project with workspace, the training wasn't long enough,I finally decided to use PID= {0.13447,0.0002722,1.18701 },obviously, this is not the optimal parameter, but based on the above estimation,after the test, the car can run a lap.

3. Think deeply:

The car crossed the line when trying to increase its speed.

In the future, we will continue to try to decelerate when the “cte” error increases,when the speed is too slow, try to acceleration,then optimize with TWIDDLE.