Autotuning Of Controller For Drones

Interns: Mahadev Mishal, Karthik Nayak, Amit Kumar
Mentors: Fayyaz Pocker, Vamshi Krishna, Simranjeet Singh

Manual Tuning Of PID Controller

Proportional-Integral-Derivative (PID) controllers are widely used in industrial systems. They give robust performance for a wide range of operating conditions. In practical implementation, there is a high possibility that due to human intervention the process is not tuned to obtain optimum control. Hence we propose two methods of auto-tuning the PID controller.

$$u(t) = \overbrace{K_p e(t)}^{\text{Proportional}} + \overbrace{K_i \int_0^t e(\tau)d\tau}^{\text{Integral}} + \overbrace{K_d \frac{d}{dt}e(t)}^{\text{Derivative}}$$

Fig: PID Equation

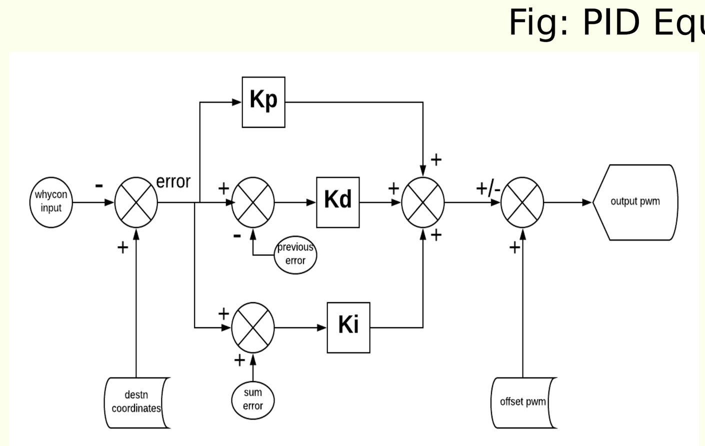

Fig: PID Block Diagram

Fig: Position Holding Of Drone

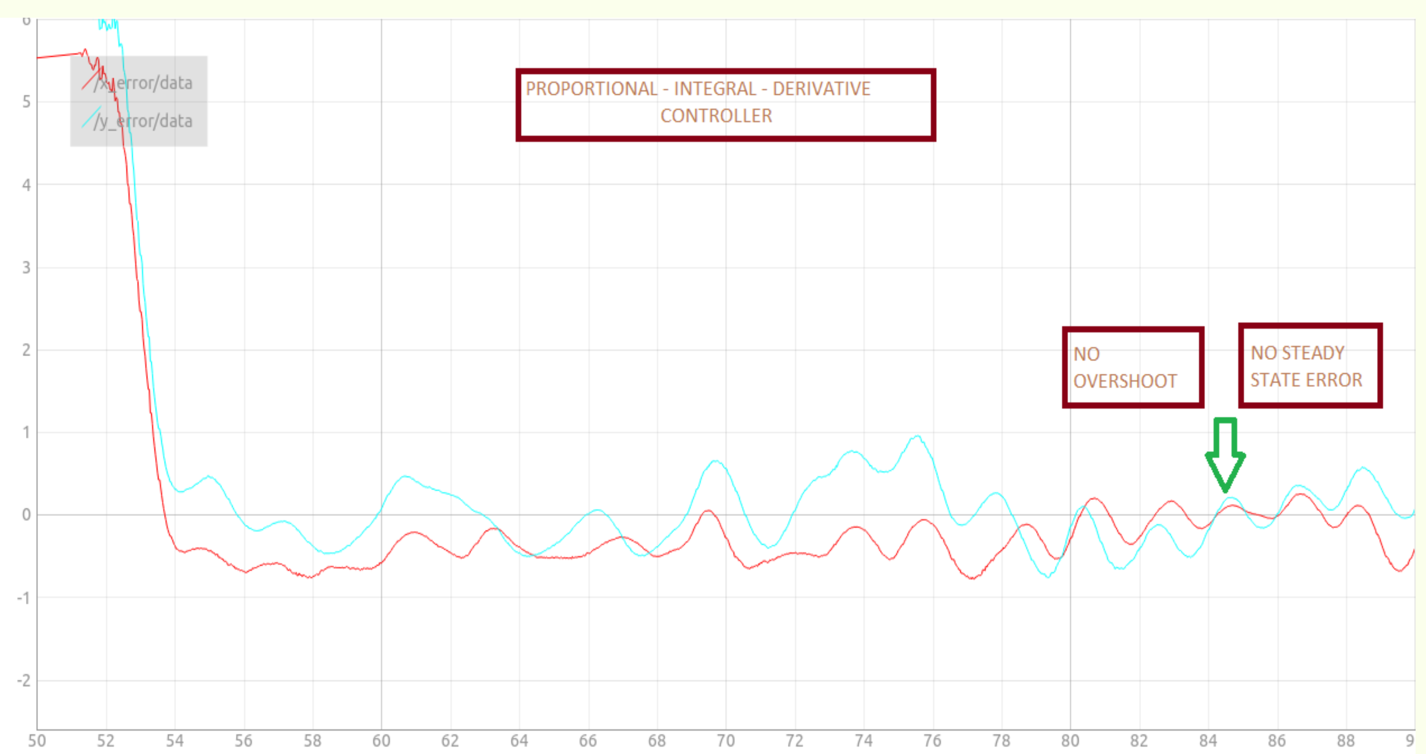

Fig: Response Of Manually Tuned PID Controller

Auto - Tuning Of PID Controller Using Ziegler - Nichols Method

In this method of auto-tuning we try to analyse the nature of what the controller is driving, then reverse-engineer to calculate tuning parameters from the output. We do this by changing the PID output and then observe how the input responds. Kp, Ki and Kd are calculated from the formulae mentioned below.

Controller type	Kp	Ti	Td
P	0.5 * Ku	–	–
PI	0.5 * Ku	Tu/1.25	–
PD	0.8 * Ku	–	Tu/8
Classic PID	0.6 * Ku	Tu/2	Tu/8
Pessen Integral rule	0.7 * Ku	Tu/2.5	3Tu/20
Some overshoot	0.33 * Ku	Tu/2	Tu/3
No overshoot	0.2 * Ku	Tu/2	Tu/3

Fig: Ziegler Nichols Formulae

Ku is the ultimate gain
Tu is the time period of oscillation

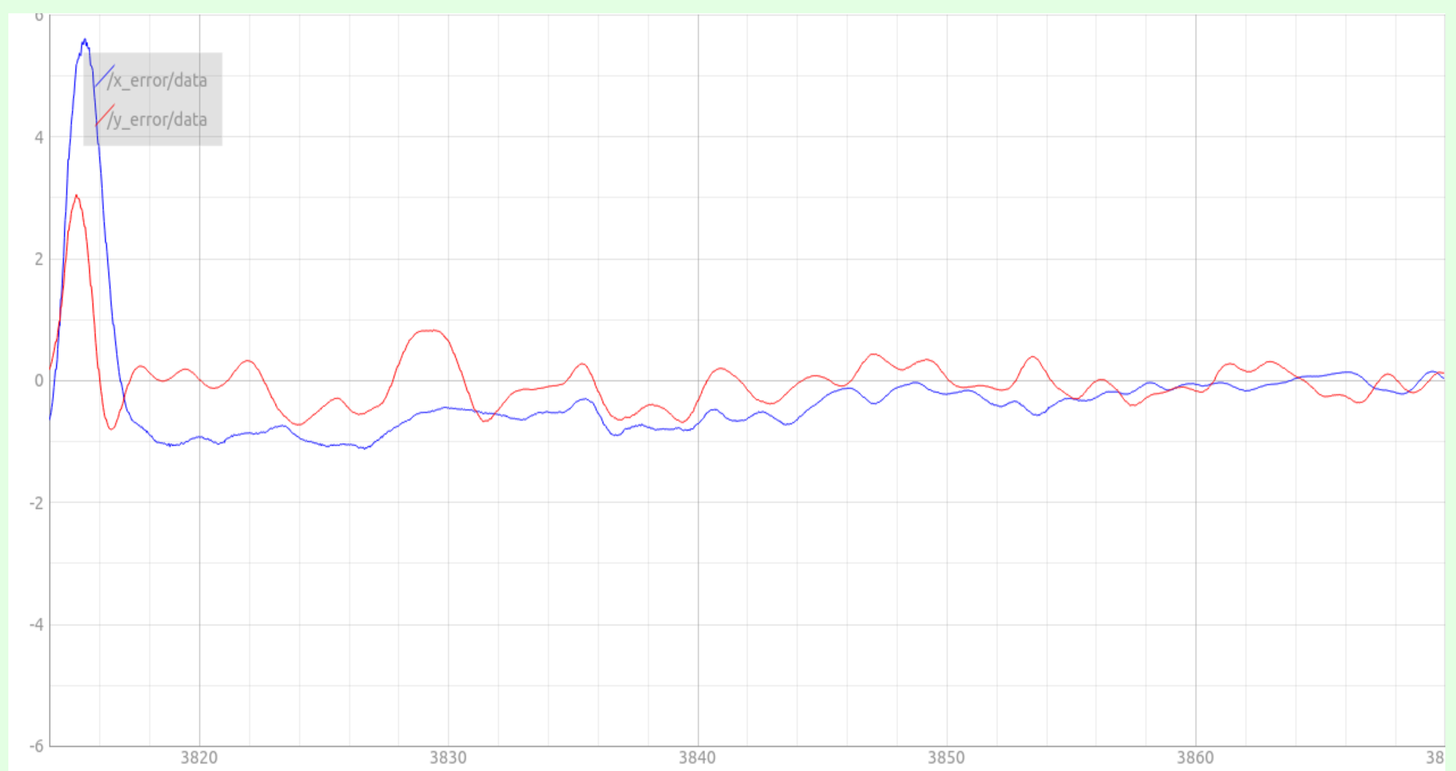

Fig: Response of Auto-Tuned PID Controller

Iteration Based Auto - Tuning Of PID Controller

This method calculates optimum values of PID parameters for the controller by tuning on the flight. The user enters a range for the possible values of the parameters and the code continuously changes them based on the principles of control theory.

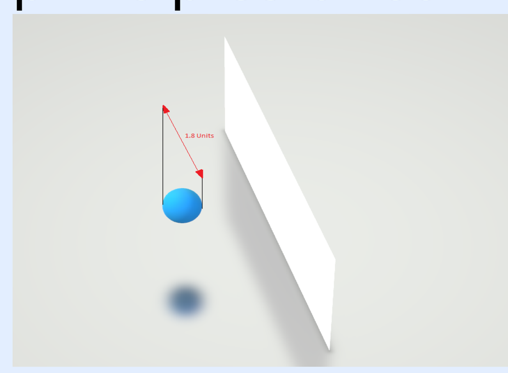

Fig: Kp is increased till the drone enters into an imaginary sphere of diameter 1.8 units

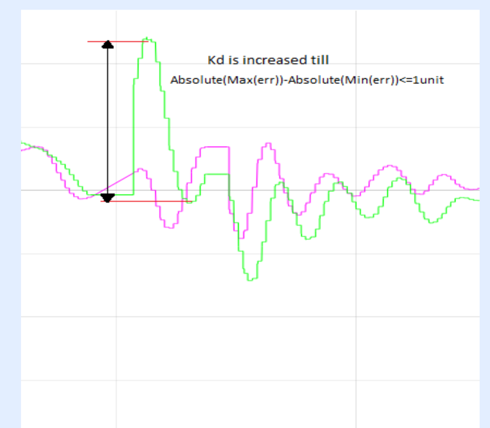

Fig: Kd is increased till twice the amplitude is less than 1 unit

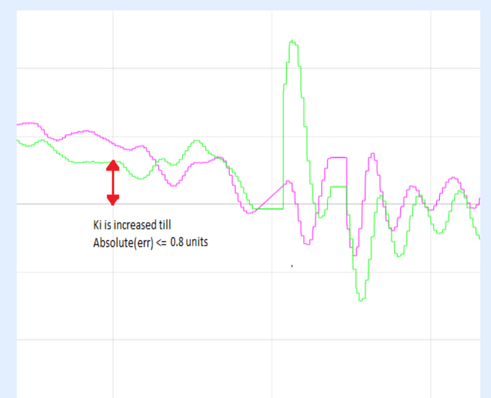

Fig: Ki is increased till the error offset is less than 0.8 units

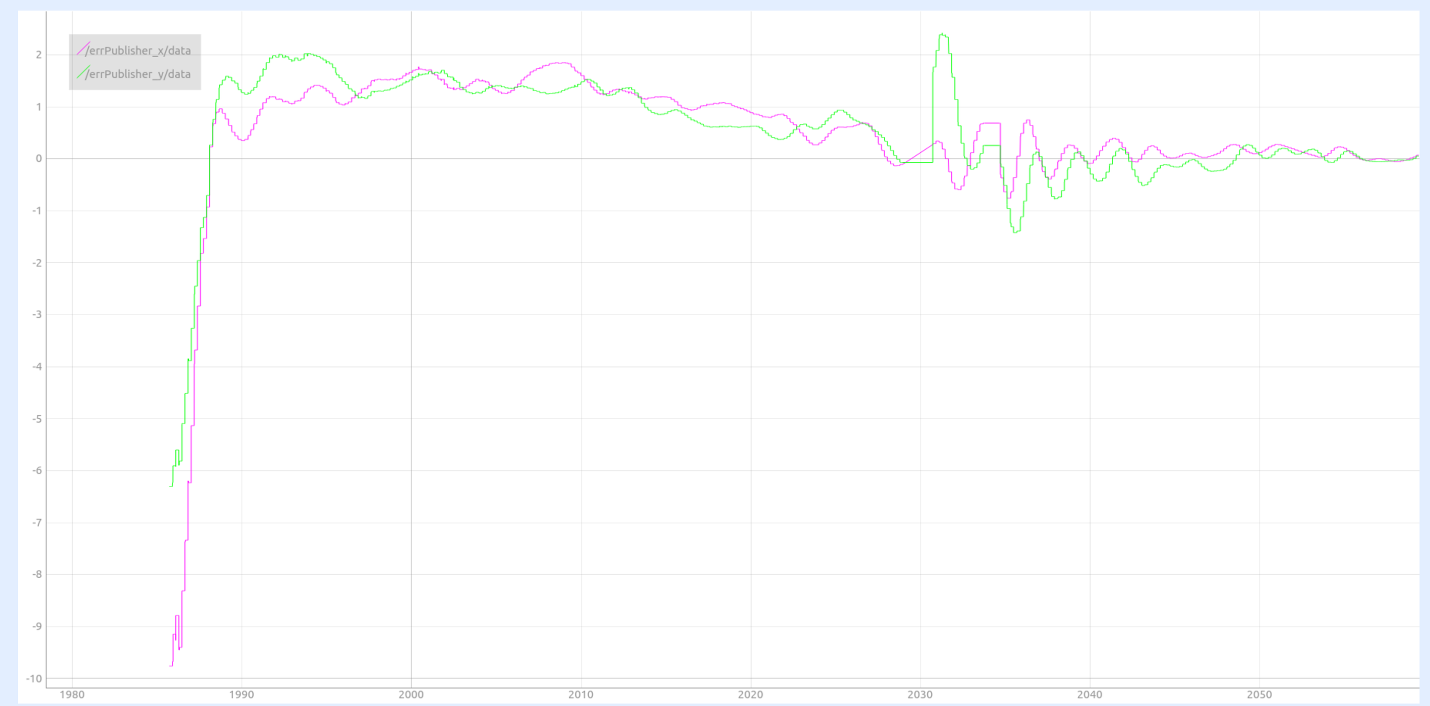

Fig: Response of Auto-Tuned PID Controller

e-Yantra Summer Internship Project 2018