

# Progress Presentation-II

e-Yantra Summer Internship-2018  
**Auto-tuning of controller (for Drone)**

Amit Kumar  
Karthik Nayak  
Mahadev Mishal

Mentors: Fayyaz Pocker, Vamshi Krishna, Simranjeet Singh

IIT Bombay

June 22, 2018

# Overview of Project

## Progress Presentation-II

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

## Overview of Project

## Overview of Task

## Task Accomplished

## Challenges Faced

## Future Plans

## Thank You

- **Project Name:** Auto-tuning of controller(for Drone)
- **Objective:** To propose a method of auto-tuning the PID and estimating the values of PID parameters. In this project, we will be trying to auto-tune the pluto drone.
- **Deliverables:**
  - 1 Appreciable auto-tuning of the control parameters and very stable waypoint navigation of pluto drone
  - 2 Documentation of comparing different auto-tuning techniques

# Overview of Task

Progress  
Presentation-II

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

Overview of  
Project

Overview of Task

Task  
Accomplished

Challenges Faced

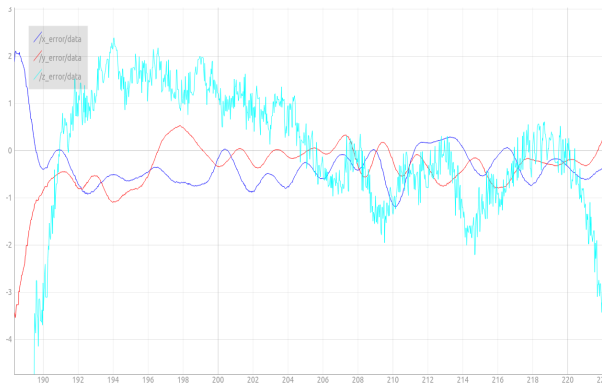
Future Plans

Thank You

Task No.	Task	Deadline (in days)
1	Literature survey of present controllers -PID, Improved PID, LQR	2
2	Implementing PID and tuning PID parameters using Ziegler-Nichols method and testing on AR-Drone model using Gazebo	2
3	Designing a better control architecture for pluto drone for position holding using whycon marker and applying Ziegler-Nichols method to tune the pluto drone manually	5
4	Literature survey of autotuning and selecting a method	2
5	Implementation of auto-tune on the improved control system and testing on AR-Drone model in Gazebo	3
6	Implementing the auto-tune on plto drone using different techniques and comparing them.	14
7	Documentation	2

# Task Accomplished

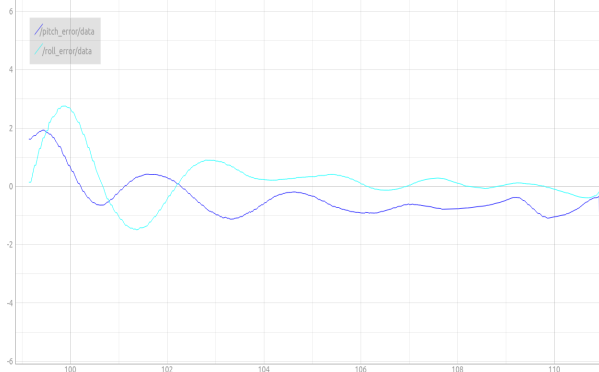
- Implemented a PD Controller for position holding of Pluto X.



- 1 Steady state error!
- 2 Need of PID controller.

# Task Accomplished

- Implemented a PID controller for position holding of Pluto X.



- 1 Steady state error minimised!
- 2 Manual tuning is tedious!.

# Auto-tuning Methods

Progress  
Presentation-II

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

Overview of  
Project

Overview of Task

Task  
Accomplished

Challenges Faced

Future Plans

Thank You

## ■ Method 1: Auto-tuning based on Ziegler-Nichols approach.

Cause forced oscillations to get a ultimate gain **K<sub>u</sub>** and ultimate period **T<sub>u</sub>**, and then determine **K<sub>p</sub>**, **K<sub>i</sub>**, **K<sub>d</sub>** using Ziegler-Nichols method.

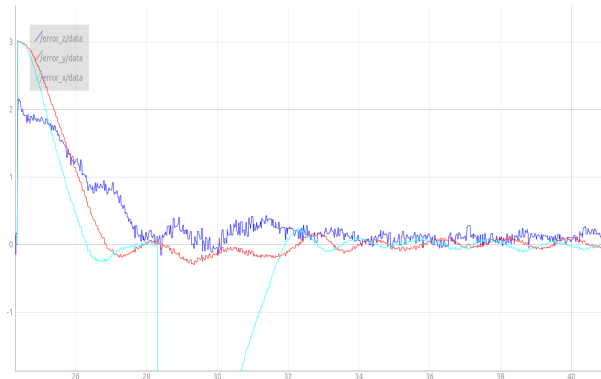
## ■ Method 2: Iteration Based Auto Tuning

In this method, the user enters a range for PID parameters i.e. **K<sub>p</sub>**, **K<sub>i</sub>** and **K<sub>d</sub>**. The algorithm uses a set of iterations to find optimum values.

# Auto-tuning based on Ziegler-Nichols approach

- Simulating position holding of AR Drone in Gazebo by auto-tuning PID parameters.

Cause forced oscillations to get a ultimate gain **Ku** and ultimate period **Tu**, and then determine **Kp**, **Ki**, **Kd** using Ziegler-Nichols method.



Progress  
Presentation-II

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

Overview of  
Project

Overview of Task

Task  
Accomplished

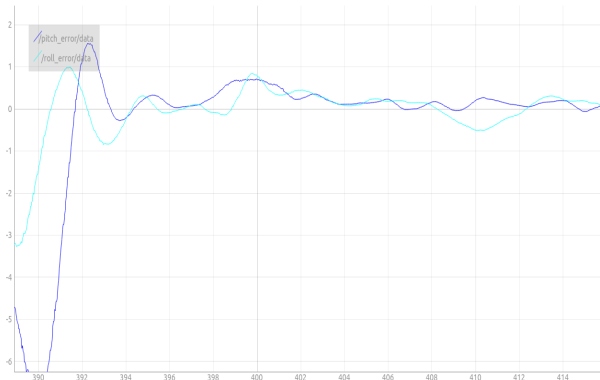
Challenges Faced

Future Plans

Thank You

# Auto-tuning based on Ziegler-Nichols approach

- Implementing position holding and waypoint navigation of Pluto X drone by auto-tuning PID parameters.





# Auto-tuning based on Ziegler-Nichols approach

Progress  
Presentation-II

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

Overview of  
Project

Overview of Task

Task  
Accomplished

Challenges Faced

Future Plans

Thank You

## Advantages:

- 1 The auto-tuned PID parameters are consistent.
- 2 No need to repeat this process every time.

## Disadvantages:

- 1 Need of manually monitoring the drone while tuning.

# Iteration Based Auto Tuning

## Progress Presentation-II

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

## Overview of Project

## Overview of Task

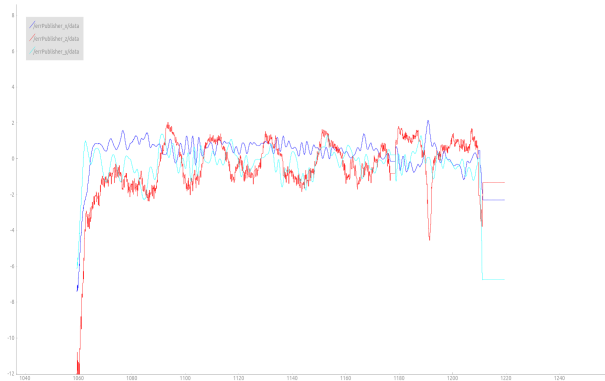
## Task Accomplished

## Challenges Faced

## Future Plans

## Thank You

- Implementing position holding on Pluto X drone using self found PID parameters



# Iteration Based Auto Tuning

Progress  
Presentation-II

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

Overview of  
Project

Overview of Task

Task  
Accomplished

Challenges Faced

Future Plans

Thank You

## Advantages:

- 1 No human monitoring or intervention required **even in a restricted frame.**
- 2 Auto tuning takes place on the go.

## Disadvantages:

- 1 On an average it takes 115 seconds for auto tuning to complete.

# Challenges Faced

Progress  
Presentation-II

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

Overview of  
Project

Overview of Task

Task  
Accomplished

Challenges Faced

Future Plans

Thank You

- Stabilising the drone on Z axis (throttle axis) (Pending)
- Implementing the auto-tuning concept.
- Hardware breakdowns.

# Future Plans

Progress  
Presentation-II

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

Overview of  
Project

Overview of Task

Task  
Accomplished

Challenges Faced

Future Plans

Thank You

- Stabilising the drone on Z axis
- Making the PID architecture more robust.
- Increasing the efficiency and consistency of auto-tuning.
- Documentation.

# Thank You

Progress  
Presentation-II

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

Overview of  
Project

Overview of Task

Task  
Accomplished

Challenges Faced

Future Plans

Thank You

## THANK YOU !!!