ME 410 – Week 5
Christopher Luey

(a) Text Description
This week, we completed closed-loop PID tuning for the pitch axis, refining proportional, integral, and derivative gains to achieve fast, stable tracking with minimal overshoot. We then reoriented the test rig to isolate the roll DOF and repeated the full PID tuning process, adjusting for axis-specific dynamics. After successful independent tests, we merged pitch and roll control into a unified PWM pipeline, enabling simultaneous multi-axis regulation. Finally, we implemented pause/resume code when pressing the A and Y buttons and implemented yaw rate control using a P-only controller, completing the core attitude control framework.

Milestone 1 – Pitch PID
Activated the integral path, tuned gains until the pitch loop showed zero-lag tracking while all hard safety limits continued to trip correctly; log captured 4-motor PWM, filtered pitch, and desired pitch. (P=19, I=6, D=3)

Milestone 2 – Roll PID
Reoriented the rig to the roll DOF, zeroed all pitch gains, added an identical PID structure for roll, and demonstrated clean joystick roll-plus-thrust tracking with safeties intact. (P=13, I=5, D=2)

Milestone 3 – Combined Pitch + Roll
Implemented pause (A) / resume (Y) hot-keys, limited thrust to 1200, and hand-held the quad while both axes ran.

Milestone 4 – Yaw P
Disabled pitch/roll, mapped the left joystick to desired yaw rate, applied single-gain P control, and confirmed by hand that commanded and measured yaw rates aligned on the log. (Yaw_gain = 2, Yaw_amplitude = 50)

(b) Task Assessment
Went well
- Pitch & roll PID loops now tuned with negligible steady-state error.
- Code compartmentalized allowing for quick tuning and implementation.
- Pause/kill workflow cut debugging time dramatically.

Issues & Causes
- Vibrations on roll rig due to tuning or long wires.
    - This should not be a concern when we begin to do hands off flight.

Changes for next class
- Make sure PID is tuned and IMU is working properly before doing hands off flight.

(c) Team Member Effort

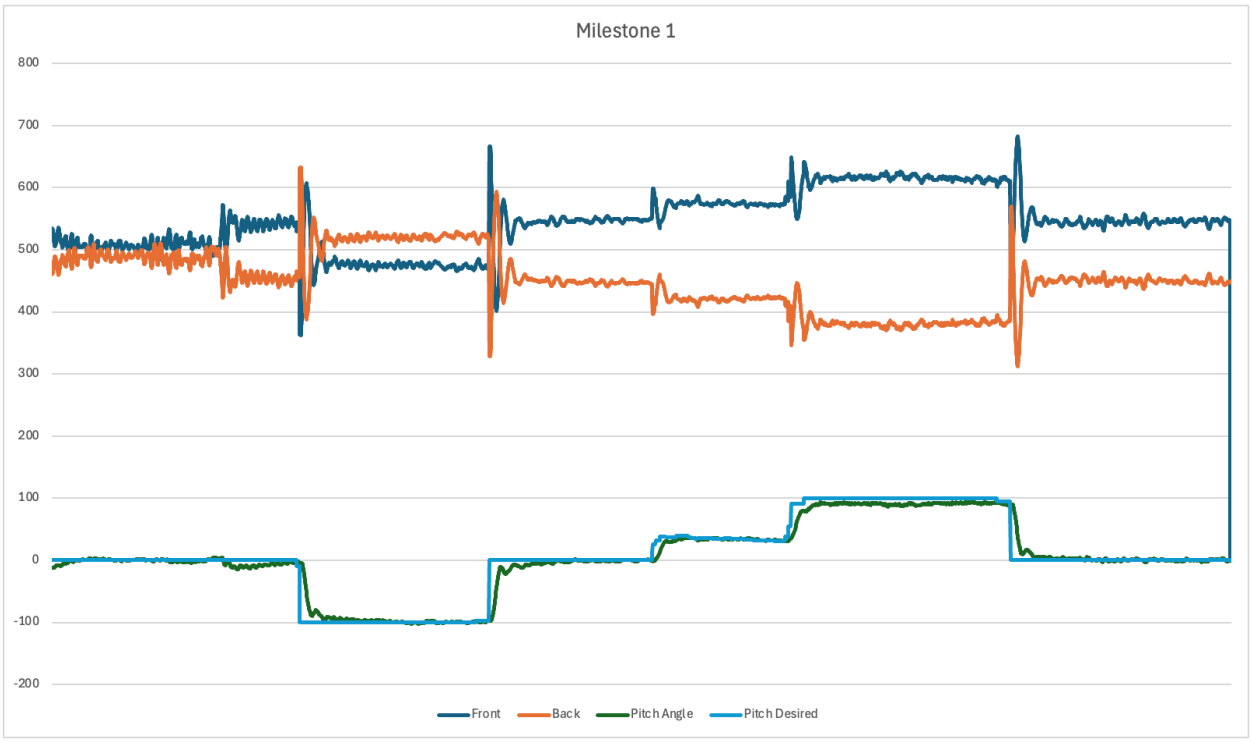
Jason – 20 %

- Rig re-config for roll

Christopher – 80 %

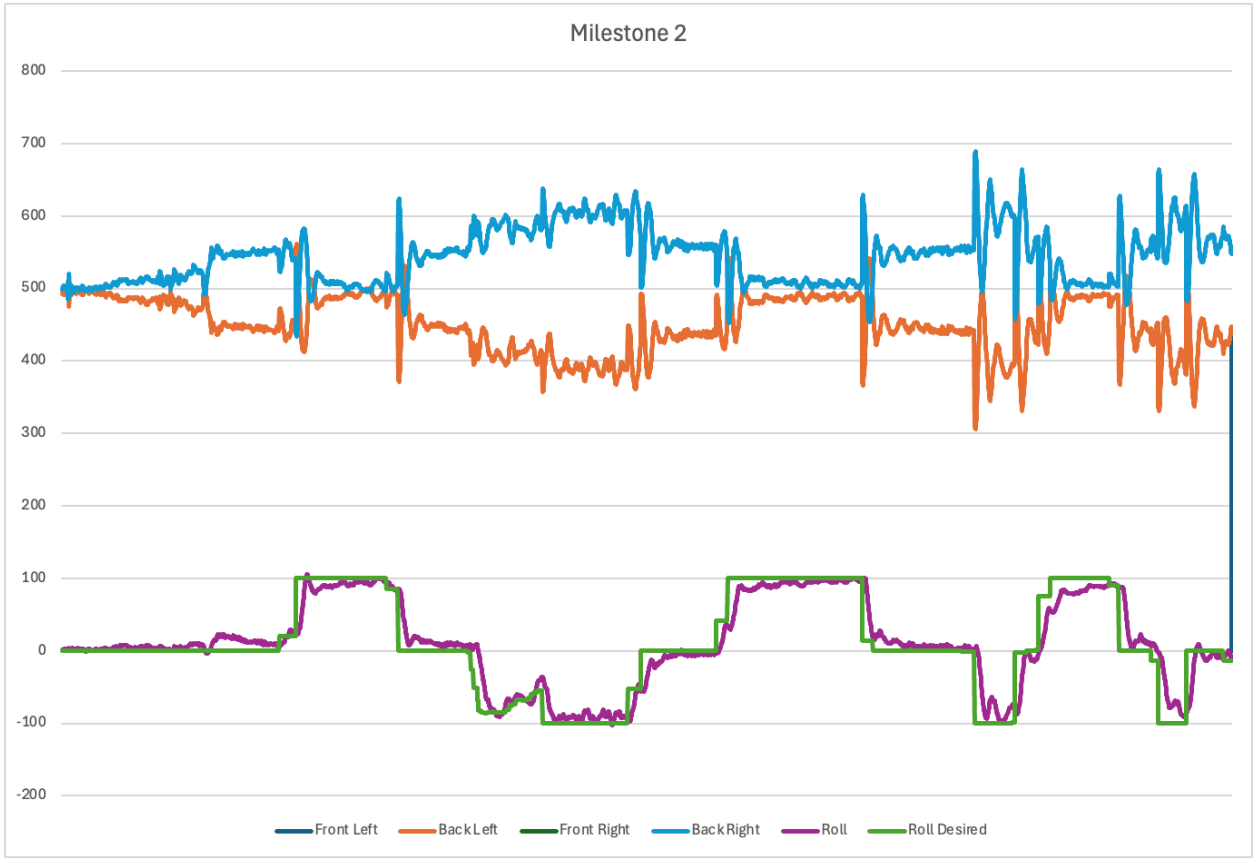
- Write pitch PID code and perform tuning
- Write roll PID code and perform code refactoring
- Write pause/resume code when A and Y are pressed
- Perform PID tuning for roll
- Write yaw control to use gyro setpoint
- Perform yaw gain tuning

Milestone 1



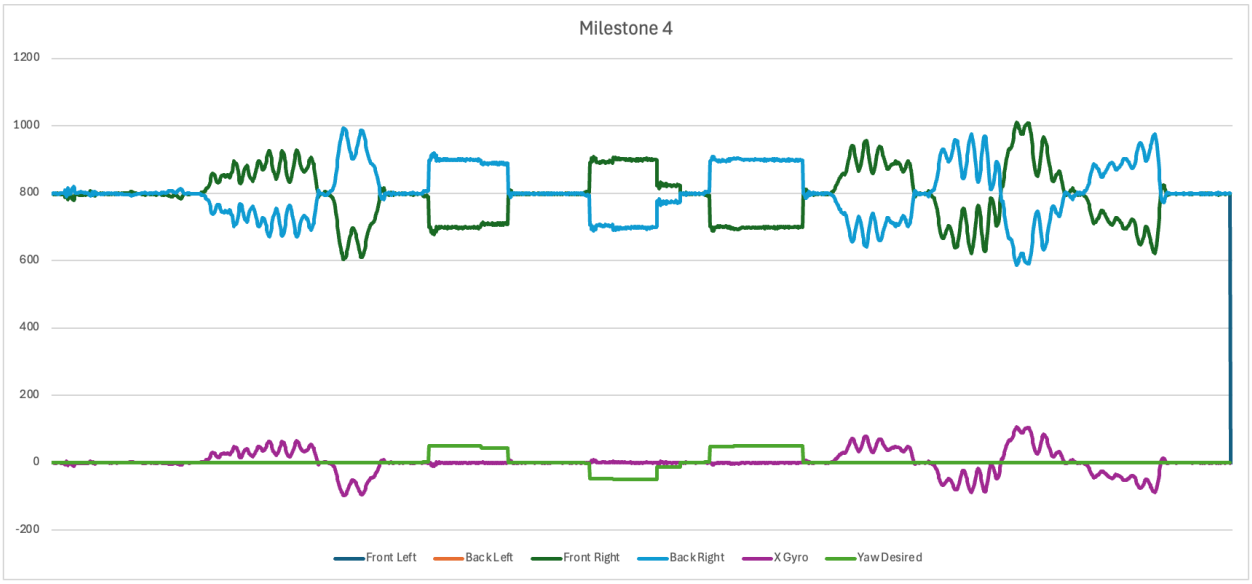
P=19, I=6, D=3 s

Milestone 2



P=13, I=5, D=2 s

Milestone 4



Yaw_gain = 2, Yaw_amplitude = 50