Flight Control Testing & Safety Guidelines

When building the control algorithm, teams do not need to start by flying the drone. The drone can be tested safely and effectively in several progressive stages:

1. Hand-held motor response testing (with or without props)

You can run your control loop while holding the drone firmly in your hand.
This allows you to feel how the motors respond to changes in pitch/roll/yaw demands.
It's an easy and safe way to verify that your PID logic reacts predictably before attempting any flight.

- **Without props** → safer, great for verifying sensor readings and motor mapping.
- **With props** → gives realistic thrust feedback; hold tightly and keep fingers clear.

Once your algorithm shows stable, consistent responses, only then move to take off trials.

2. Ground-based "tethered" tests

Place the drone on the floor or desk and run the control loop with props attached.
The drone will try to correct itself, and you'll observe if it oscillates, drifts, or responds sluggishly.
This helps tune initial PID gains and validate sensor fusion.

3. Sensor-only dry runs

Before involving motors at all, log sensor outputs:

- Optical flow motion data from PAW3903 chips (which provide $\Delta X/\Delta Y$).
- Time of Flight readings from VL53L1X (ideal for height-hold tests).

This stage ensures your code handles noise, delays, and edge cases before closing the loop.

4. Slow-throttle hover attempts

After validating logic and responses, perform very small throttle tests — just enough for the drone to become light on its feet.

This reveals instability early without risking a full uncontrolled takeoff.

5. Progressive PID tuning

Increase gains and complexity only after each stage validates the previous one.

Teams should keep notes of overshoot, drift, and oscillations.

6. Incremental feature enablement

If the control system supports modes (hover mode, position hold, direction shift, etc.), enable them one by one.

Never activate multiple untested features simultaneously.

7. Environment matters

• Avoid glossy, reflective, uniform, or patterned floors (optical flow sensors detect stripes, checkerboards, glossy tiles as “challenging conditions”).

• Maintain enough ambient light (at least 30–60 lux depending on sensor mode).

This ensures stable and realistic data during testing.