

PID tuning theory and configuration guide for MultiWii

P is the dominant part of PID and gets you in the ballpark for good flight characteristics.

Basic PID Tuning - on the ground

- 1 - Set PID to the designers default recommended settings.
- 2 - Hold the Multi-Rotor securely and safely in the air.
- 3 - Increase throttle to the hover point where it starts to feel light.
- 4 - Try to lean the Multi-Rotor down onto each motor axis. You should feel a reaction against your pressure for each axis.
- 5 - Change P until it is difficult to move against the reaction. Without stabilisation you will feel it allow you to move over a period of time. That is OK
- 6 - Now try rocking the Multi-Rotor. Increase P until it starts to oscillate and then reduce a touch.
- 7 - Repeat for Yaw Axis.

Your settings should now be suitable for flight tuning.

Advanced Tuning - understanding impact of P, I and D

P - proportional

P provides a proportional amount of corrective force based upon the angle of error from desired position. The larger the deviation, the larger the corrective force.

A higher P value will create a stronger force to return to desired position.

If the P value is too high, on the return to initial position, it will overshoot and then opposite force is needed to compensate. This creates an oscillating effect until stability is eventually reached or in severe cases, the overshoot becomes amplified and the multi-rotor becomes completely destabilised.

Increasing value for P:

It will become more solid/stable until P is too high where it starts to oscillate and lose control. You will notice a very strong resistive force to any attempts to move the Multi-Rotor

Decreasing value for P:

It will start to drift in control until P is too low when it becomes very unstable. Will be less resistive to any attempts to change orientation

Aerobatic flight: Requires a slightly higher P

Gentle smooth flight: Requires a slightly lower P

I - Integral

"I" gain provides a variable amount of corrective force based upon the angle of error from desired position. The larger the deviation and / or the longer the deviation exists, the larger the corrective force. It is limited to prevent becoming excessively high.

A higher I will increase the heading hold capability

Increasing value for I:

Increase the ability to hold overall position, reduce drift due to unbalanced frames etc

Decreasing value for I:

Will improve reaction to changes, but increase drift and reduce ability to hold position

D- Divide

This moderates the speed at which the Multi-Rotor is returned to its original position. A lower D will mean the Multi-Rotor will snap back to its initial position very quickly

Increasing value for D:

Dampens changes. Slower to react to fast changes

Decreasing value for D:

Less dampening to changes. Reacts faster to changes

Aerobatic flight: Lower D

Gentle smooth flight: Increase D

Advanced Tuning - practical implementation

For Aerobatic flying:

Increase value for P until oscillations start, then back of slightly

Change value for I until wobble is unacceptable, then decrease slightly

Decrease value for D until recovery from dramatic control changes results in unacceptable recovery oscillations, then increase D slightly

Repeat above steps

For stable flying (RC):

Increase value for P until oscillations start, then back of quite a bit

Decrease value for I until it feels too loose /unstable then increase slightly

Increase value for D

General guidelines:

For stable flying with less wobble / jitter (AP / FPV):

Lower P if you have fast wobbles

Lower I if you have slow wobbles

Higher D to smooth changes

ACCRO flying: Lower D to make sharper snappier movements

You will have to accept a compromise of optimal settings for stable hover and your typical mode of flying. Obviously factor it towards your most common style.

Other factors affecting PID

Taking known good PID values from an identical configuration will get you close, but bear in mind no two Multi-Rotors will have the same flying characteristics and the following items will have an impact on actual PID values:

- 1 - Frame weight /size / material / stiffness
- 2 - Motors - power / torque /momentum
- 3 - Position - Motor-->motor distance (I.E. frame size)
- 4 -ESC / TX - power curves
- 5 - Prop - diameter / pitch / material
- 6 - BALANCING
- 7 - Pilot skills