PID Tuning Guide (written by NotFastEnuf)

note: this guide may be a bit Whoop/Racer/FPV related, which should not discount this very good guide! I (SirDomsen) tune very similar.

After spending countless hours analyzing logs for research sake - I came to some very simple tuning conclusions that always seem to hold true. Here is my abridged and adapted guide for tuning micros. I know you didn't ask for it but it might inspire others to share something that I can learn or help someone in need.

1. Set I at a reasonable place based on known experience to start
2. Keep raising P gain until the effect of all eternal influences like wind & propwash tighten up into very high frequency oscillations. No big bumps allowed. No need for the repetitive snappy roll or pitch inputs - just go fly on a windy day and cruise around like a sunday drive & do a couple slow decents. If you can't find bumpy air - go up higher. Its there even on a calm day.
3. Raise D gain until all high frequency P oscillation is damped.
4. Go back and raise I till you see misbehavior, or the craft feels stiff - like its carrying too much momentum into turns - then lower it till that goes away and feels good to you

Pushing it further or troubleshooting: -
1. If you cant turn the bumpy ride from external influences like wind or propwash into clean crisp high frequency oscillations - then you have too much latency and P is out of sync with the motion that the gyro is measuring. Reduce filtering. You will be able to raise P higher (this happened to me with the E011)
2. If you reduce filtering too far - you will not be able to raise D gain high enough and it will be dominated by noise. This looks like a very bumpy ride for no reason
3. Find the sweet spot in filtering where you have as much P as you need to always keep the craft tight no matter what conditions you fly in and just enough clean D to keep high frequency oscillation damped.

Final Step:
Adjust setpoint weighting, rates, and expo to create the "feel" that you like now that it is tuned. Setpoint weighting at or very close to zero feels like a racer and increasing it slows the crafts reaction to stick inputs creating a smoother freestyle feel. The adjustment is sensitive to raise it in small increments.That feature is not widely understood.

End result - micros don't feel like micros anymore!!! I know you didn't ask for all that, but if you understand my process, maybe it will help you understand why I think an FPV camera is a better tool than a blackbox log for tuning a micro. On a larger craft - the forces that it can generate are bigger than external forces like wind so the process is different and blackbox plays a slightly different roll in the process. In short, I would not use it to tune a micro, but I might use it to help analyze a problem that I can't intuitively solve if I encounter one.

If you are flying a micro that has a bumpy ride outside - consider this procedure … it really works. I apply the same methodology to betaflight and on a typical 8.5mm craft - and this will produce P gains over 100 and D gains even higher for pitch and roll - but a locked in craft that flies like a 250 size. Those kind of coefficients may sound crazy but it really works. P gain as a starting point typically has to be increased more the lower a craft's thrust to weight ratio is. Ideally your craft should be dominated by P's influence while P is slowly corrected by I for accumulated errors, and calmed by D so it looks smooth.

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