Arducopter 3.4.6 Geyer V1.1-rc2

This document describes changes made to AC 3.4.6. AC 3.4.6 was revised to address the concern with the ghost aircraft getting out of sync with the actual aircraft attitude and included a new implementation for unarmed, ground, take off, and flying swash plate behaviors. The improvements will mostly help the Acro mode but will also help stabilize and althold modes with the yaw axis. This version also includes a notch filter in the PID controller to filter out instabilities encountered while tuning the P and D gains. Set-up and testing for the notch filter is provided in a separate document. Recently changes were made to fix issues to include: protecting the aircraft from mode changes and motor shutdown when an RC failsafe occurs that may cause RC input signals to go out of bounds; several modes were disabled in Trad Heli; crash checking was disabled in Trad Heli; and yaw attitude target was reset when aircraft motors are stopped for loiter and althold modes.

Limit of target attitude error with actual aircraft attitude

Trad Heli users identified an issue with 3.4.6 where the error between the target and aircraft attitude was able to get significantly large. This was a big concern in situations where the actual aircraft cannot be adequately controlled due to some aerodynamic phenomenon. This change modified the the attitude controller to allow the user to set a limit to the error between the target and actual aircraft attitude. A new parameter was added to set the error for pitch and roll axes and a separate parameter for yaw axis. ATC_PR_ATT_ERROR is parameter for pitch and roll error limit. ATC_Y_ATT_ERROR is parameter for heading error limit. Parameter units are degrees and can only be positive or zero. Zero disables the attitude error limit. Suggested value is 10 degrees for both.

Improved Swashplate Behavior during Unarmed and Landed States

Swashplate behavior during the unarmed state did not give the user a way to check controls prior to arming. Also user would experience uncommanded leaning of the aircraft during liftoff especially when taking off from uneven terrain. The designed swashplate behavior for each mode is given below.

<u>Acro mode:</u>

With the aircraft unarmed and armed until run up is complete, the software is designed to only command rate with stick inputs. Once you return the stick to center, the swashplate should respond immediately by going to the level position. If you leave the stick centered and put angular rates on the aircraft, you will see the swashplate respond in the opposite direction to the rate. If your P gains are too low then you may not see the swashplate respond to the angular rate inputs.

With the aircraft on the ground and rotors turning the software is designed to leak both attitude error and the integrator. This behavior is turned off after the aircraft is moving faster than 1 m/s. The swahplate behavior can be seen by disconnecting the ESC and arming the helicopter. Making a stick input will cause the swashplate to tilt in the direction of the input and upon centering the stick the swashplate will slowly (~7 seconds with an I gain of 0.1 and a leak rate set to 0.001) return to level. After the aircraft reaches 1 m/s, the attitude error and integrator

leak is turned off and won't turn on again until the aircraft speed is less than 1 m/s. The yaw axis behaves similar to the pitch and roll axes.

Note:
If the user, checks the swashplate behavior for the flying state, the swashplate and tailrotor may exhibit low frequency oscillations with full pitch or roll inputs held for an extended period of time. I don’t have a good explanation for this.

Stabilize and AltHold modes:

With the aircraft unarmed and armed until run up is complete, the software is designed to command pitch and roll attitude with stick input. Once you return the stick to center, the swashplate should respond immediately by going to the level position. If you leave the stick centered and tilt the aircraft, you will see the swashplate respond in the opposite direction to the tilt angle. With the aircraft on the ground and rotors turning the software is designed to leak integrator. This will help with taking off from uneven terrain keeping the aircraft from wanting to lean over as the aircraft is light on the skids. After the aircraft reaches 1 m/s, the attitude error and integrator leak is turned off and won't turn on again until the aircraft speed is less than 1 m/s.
The yaw axis behaves the same as the yaw axis in Acro mode.

Parameter Settings

The parameters that control the attitude error and integrator leak and ATC_ANG_LEAK_RAT and ATC_I_LEAK_RATE. The range of these parameters is 0 to 1 where zero is no leak and 1 is everything is leaked. The values of these parameters should not have to be much above 0.02. The suggested value for the ATC_ANG_LEAK_RAT is 0.001. The value of ATC_I_LEAK_RATE is dependent upon the I gain. For an I gain of 0.1 a ATC_I_LEAK_RATE of 0.001 will leak all the integrator error in about 7 seconds. If your I gain is higher then the leak rate should be higher. The value of ATC_RAT_PIT_ILMI, ATC_RAT_RLL_ILMI, and ATC_RAT_YAW_ILMI have to be set to zero for the Integrator leak to work properly.