



STRAIGHT SHOOT

CAMERA GIMBAL SETUP AND INSTALLATION

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Multirotors are becoming essential tools for videographers;

what better way is there to shoot action from above or in an inaccessible spot? However, some operators find themselves struggling to acquire perfectly stabilized video, only to face another hurdle in post-processing to correct for vibrations incurred during flight. For cinematographers who value professional, smooth footage, the use of a camera gimbal is essential to compensate for the in-flight movements of the multirotor as well as to maintain a level horizon.



Camera stabilization on a multirotor is achieved by using a combination of small sensors that detect movement, a control board, electric motors, and a gimbal frame. Since almost all multirotors produce vibration, it is essential to isolate the camera gimbal from the airframe so the video is not adversely affected during the flight.

The most important step in setting up a multirotor is selecting a gimbal that is specifically designed for your camera. At this point, there are far more cameras on the market than quality gimbals, so you may have to acquire a new camera that fits your gimbal. Also, the weight of both the camera and the gimbal must be calculated and determined to be within the payload capacity of your multirotor.

Fine-tuning Tips

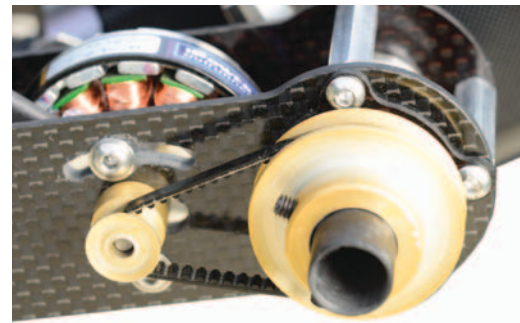
Most controllers will be able to connect to a computer with a cable via USB interface to access the firmware graphical user interface. There are many parameters to choose from while tuning the camera gimbal for smooth operation. Settings to control the RC inputs for gimbal roll, pitch, and yaw if applicable can be selected and set in the firmware. Some firmware has a display of real-time sensor data monitoring, a feature that is very helpful for fine-tuning the gimbal performance.

A great feature on some of interfaces is the display of each axis movement. Once the camera is balanced and the controller is powered and connected to your computer, displace the camera on each axis with your hand and monitor its return to the reference position. The goal is to use the smoothest curve and fastest possible return to the starting position. Keep in mind that the settings for each axis will be different. Also, heavier cameras will have much different parameters than light cameras. Large cameras have much more inertia due to their weight, which can cause oscillation because of the limited power in the motors.

Stop the Shakes

Visible shaking of the gimbal may be caused by electro-magnetic interference. To minimize this interference, fit a ferrite ring around the motors outputs wires near the controller. When updating the firmware for the controller or using it for the first time, press "Use Defaults" to reset all parameters. Also, calibrate the sensor while carefully following the procedure in the operating manual.

If all the above steps have been taken and the gimbal vibrates or buzzes when powered up, the cause is most likely incorrect PID controller settings. In most cases, the D setting and the power setting are too high. To determine the source of the problem, lower each of these parameters until the vibration or buzzing stops. Remember, you don't need to have ultra-fast "return to neutral" when forcing the gimbal to move. A smooth and linear "return to neutral" motion with slower reaction time is preferable to ultra-fast and sharp return to neutral as that could cause more problems during flight.



Belt-drive gimbals may also reduce vibration and they are more precise than direct-drive gimbals.

BALANCE AND VIBRATION

First and foremost, precise balancing of the camera on all axes is critical to the proper performance of the gimbal. The more precisely the camera is balanced, the lower the current draw to the motors, which produce very little torque. If the camera is not balanced precisely, the motors may not have enough power to stabilize it.

Excessive airframe vibration may cause self-excitation of the closed-loop controller and prevent the proper operation of the camera gimbal. It is preferable to reduce the source of the vibration as much as possible by balancing the propellers. Vibration-dampening plates are sometimes used to isolate the gimbal from the multirotor airframe. Since vibration dampening and isolation are such a critical part of the setup and installation, you should consider the best materials available. There are many different materials used to isolate the camera gimbal from the airframe, including silicone and sorbothane.



This camera has been precisely balanced on the tilt-axis. It also has a full 90 degrees range of movement by manual control.

ANATOMY OF A GIMBAL

A camera gimbal is a sophisticated piece of equipment that consists of many important parts. It's important to understand how each piece works within the whole gimbal and how they function together to support your video camera.



PID CONTROLLER. A PID controller is a control loop feedback mechanism widely used in industrial control systems. It calculates an error value as the difference between a measured process variable and a desired setpoint. Its algorithm involves three separate constant parameters: the Proportional, the Integral, and Derivative values. The "P" is the amount of correction, "I" adjusts how fast the correction occurs, and "D" adjusts how much change is allowed to occur based on past changes. The weighted sum of these three actions is used to adjust the process via a control element, such as the position of the camera.

FRAME. Most gimbal frames are manufactured from aluminum, carbon fiber, or other rigid materials. It is essential to have strong support for the camera to obtain optimum results. It is also critical that the moving components in the frame have minimal friction so that less power from the motors is needed to stabilize the camera. Camera gimbals are available in kit form or fully assembled and ready for attachment to a multirotor.

BRUSHLESS MOTORS. The discovery that the rewinding of brushless DC motors to reduce their rotational speed has led to the development of today's direct-drive camera gimbals. As the current in the windings is varied, the magnetic field of the stator is varied and moves the rotor to the correct position for stabilization. There is a wide variety of brushless motors available on the market that can stabilize cameras of different sizes and weights.

SENSOR BOARD. Many controllers have an external sensor board containing an Inertial Measurement Unit that detects motion and acceleration. It is comprised of small electro-mechanical accelerometers and gyroscopes. The sensor board must be securely attached to the camera gimbal and its orientation must be configured in the controller's firmware.



“POWER” PARAMETERS

The “power” value is the power feed to the motor all time, whether it is stationary or rotating. It must be adjusted so that the motor temperature stays under 60° Celsius (140° F) and that the gimbal does not vibrate. You will also notice that when the value is too high, the motor will have reduced torque and will just generate heat. A power value that is too low will not provide enough torque for the motor to move the camera and stabilize the gimbal. You must find the right value depending on your motor. General values are between 80 and 100.

SETTING THE “P”

The “P” parameter is the torque setting that will rotate the motor to go to a defined position or to come back to a reference position. The higher the “P” gain, the more torque the motor has with which to move. If the P setting is too high, the gimbal will begin to oscillate. If you see this, raise the “D” value by 1 or 2 until the gimbal is stabilized.

SETTING THE “I”

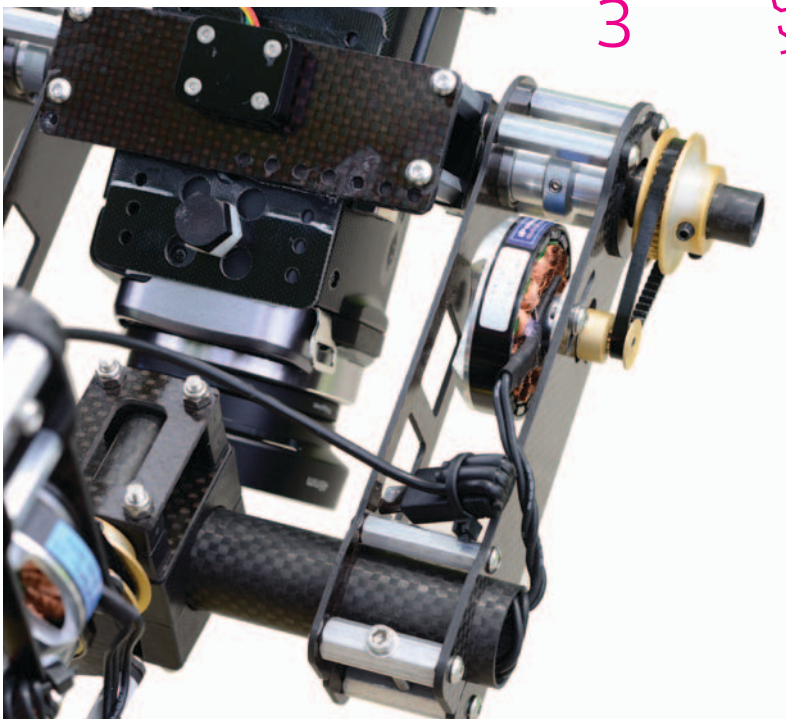
The “I” parameter is the speed of rotation of the motor. The higher it is, the faster the motor will rotate. But a fast reaction means a fast stop is needed. As there is lot of inertia during the rotation of the camera, this parameter should be increased slowly and not set any faster than needed. The movement to come back to neutral after an external disturbance will let the roll come back to neutral much slower than the pitch on many gimbals. You should normally set up the pitch not to be too fast, but to come back to the neutral position very smoothly and then stop after just one slight “bounce” on the real-time display.

SETTING THE “D”

The “D” parameter controls the “bounce” when motor arrives at the reference point and goes a bit farther than needed. (This is why D should be as close as zero as possible.) But you will experience not so normal values on some motors and different windings. Small, light cameras will have a very low D setting but heavier cameras will need a higher value. Setting the D parameter too high will cause a buzzing or vibration when the gimbal is touched or sometimes randomly in flight.

High-quality Results

Using a camera gimbal is essential to getting the smooth, professional video that we all want, so it's worthwhile to invest in a high-quality setup, and spend time programming it and getting it to work properly. These tips should get you started, but always read the instruction manuals that come with your equipment. Investing your time and dollars up front will be worth the result: vibration-free, high-quality footage. ✈️



SHOULD THIS PHOTO BE USED SOMEWHERE?