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The Use of Improved Digital Signal Processing in Quadcopter Stability with Varying Wind Conditions

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The use of quadcopters in photography requires precise levels of stabilization despite unfavorable wind conditions. The DSP used must be able to stabilize both the drone and gimbal in order to do so

In professional and novice quadcopter use, clear images are a requirement. Blurry images and videos are the consequences of poor stabilization caused by base drone movement and wind. Figure 1 shows what this looks like on a quadcopter, with varying wind directions and the general direction of the drone. As this happens the gimbal must be stabilized by being parallel to the ground regardless of the angle the the rest of the drone is to the ground. This same is needed when the drone is hovering and there is a cross wind, the quadcopter must apply a force in the opposite direction of the wind. This is combined with the gimbal stabilization in order to take photos that are clear. Digital-Signal-Processors allow for this to be so effective, but better stability can be achieved. With rapid changes in movement and wind, the gimbal can occasionally be at an angle in the moment the change in acceleration occurs.

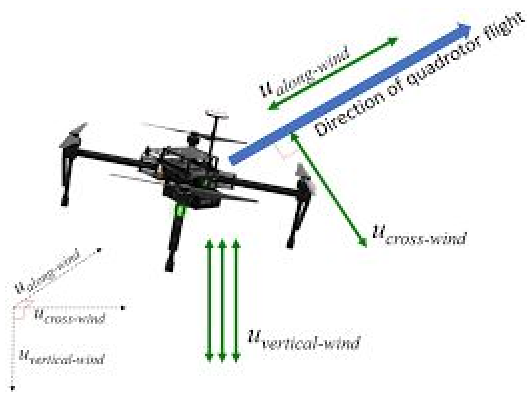

Figure 1: Forces on a drone

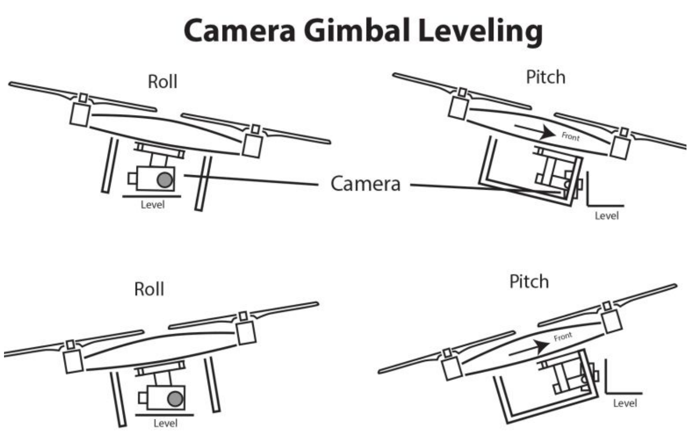

Figure 2: Example of Gimble Leveling

As any other device that takes inputs from various sources and gives an output accordingly, a control system and algorithm is needed. One type is an Adaptive Control Algorithm (Zulu) which as stated adapts to changes in the quadcopters environment in order to keep itself and the gimbal in the correct positions respectively. Below Figure 3 shows how the Adaptive Control Algorithm works using a block diagram. The different blocks take information from the various sensors on the quadcopter in order to insure stability. A few other algorithms that drone manufacturers may use are

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Proportional Integral Derivative, Sliding Mode Control, Backstepping Control, Robust Control Algorithms, Optimal Control Algorithms, Intelligent Control, and Hybrid Control Algorithms (Zulu).

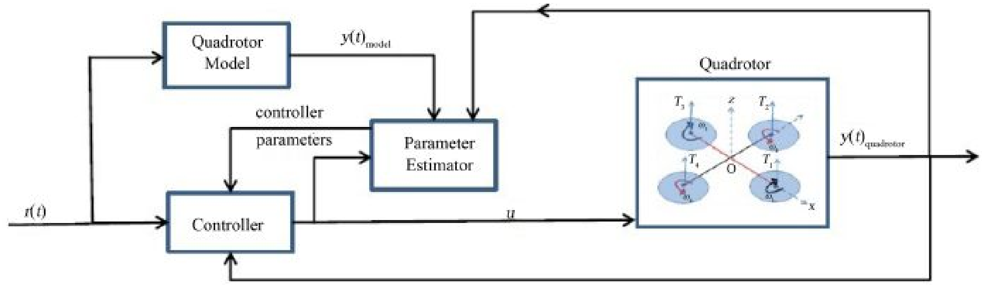

Figure 3: Block Diagram of an Adaptive Controller used in Quadcopters (Zulu)

Quadcopter stability takes a lot of teamwork between the various components involved. The gimbal has two to three motors to control the cameras. In order to get the needed adjustments for the gimbal, the four main motors must change the position of the drone to counteract the effects of the world on the drone. These are both then tied to a quick and simultaneous DSP to make sure the stability of the drone is world class. Without one of these parts, the results would be subpar and thrown away by enthusiasts and average consumers alike. Stability is the core of quadcopter operation without it the drone would be difficult to fly and also take quality photographic content.

Zulu, A., & John, S. (2014). A Review of Control Algorithms for Autonomous Quadrotors. *Open Journal of Applied Sciences, 04*(14), 547-556. doi:10.4236/ojapps.2014.414053