FPGA Implementation of a Digital Controller for a Small VTOL UAV

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Vertical Takeoff and Landing (VTOL) flight vehicles are inherently unstable and require control systems in either the form of a digital controller and/or human operator to maintain safe flight. The emergence in recent years of a booming market for small unmanned aerial vehicles (UAV) beyond academia and military has promoted a large amount of new commercial and hobbyist activity. As the market continues to grow, there is a necessity for small, robust flight controllers so these aircraft can fly safely with often inexperienced operators. For these flight controllers, an FPGA is an attractive platform to use due to its small form factor and its ability to exploit parallelism to implement a Multi-Input-Multi-Output (MIMO) controller. To that effect, I intend to explore this space and design a FPGA digital controller for a sub 1.5 kilogram quadrotor UAV. The digital controller will be designed using a Mojo V3 FPGA/ARDUINO board that will control the four motors on the aircraft. The aircraft will most likely be tethered to a ground station for simplicity reasons in the lab environment. The initial goal will be to achieve stable flight in altitude hold mode through offline design methods using MATLAB. Later iterations will possibly explore adaptive controllers through fuzzy logic control and neural online learning networks.