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ABSTRACT

The UAV have taken many definitions from time to time in literature. However, in common man's perception, UAVs is a class of small aircraft that flies without any human pilot. They may be fully autonomous or remotely operated by a human pilot. An autonomous vehicles are those, operated and controlled by onboard computer, and can be programmed for a specific task or set of tasks. Generally, UAVs are powered or unpowered, tethered or untethered aerial vehicles.

For the present research work, a quadrotor which is classified as a rotorcraft is chosen for the investigation. It is of fixed pitch propeller helicopter having four identical propellers mounted at all four corners and equidistant from the main body. The main body of the system consists of power supply and control hardware. The quadrotor motion control is done by altering the synchronizing speeds of the four propellers.

The dynamics of the quadrotor is highly non-linear and its variables are closely interdependent and coupled in nature. Also it is an under actuated system as it has six degrees of freedom which need to be controlled only by four propeller actuators. Its high maneuver capability requires more precise controller design. The other associated difficulties with quadrotor control are parameter variations and model uncertainties. Moreover, due to fast

dynamics of quadrotor vehicle, all parameters are required to be stabilized within very short period of time within an acceptable level of precision. As the quadrotors are inherently unstable, under-actuated systems, effective attitude stabilizers play vital role in UAV controller design, for maintaining desired orientation and hover throughout the flight duration. The speeds of the four actuators of the quadrotor must be synchronized to obtain attitude tracking control in all three axes. For this reason, an external controller has to designed and applied to the developed quadrotor model.

The whole quadrotor control is divided into two loops;

(i) The inner loop control and

(ii) The outer loop control.

In the inner loop control, the Euler’s angles or the orientation angles are stabilized whereas in the outer loop control, positions are to be controlled. An important part of this research work is dedicated in finding a good controller for quadrotors. The quadrotor has only four controllable inputs which in terms vary the supply voltage to the four rotors to stabilize the vehicle. Therefore, only four out of six system states (roll, pitch, yaw, x, y and z) could be controlled. In this research work the Roll, Pitch and Yaw as an internal loop and Altitude from outer loop are considered as control states.

In the work, carried out in the thesis, the quadrotor dynamics is modeled using Newton-Euler approach. The conventional, modern and intelligent control strategies are applied to design the control systems for the quadrotor model and their performances are compared. The P-D and PID structured conventional controllers, Linear Quadratic Regulator theory based modern controllers, and ANFIS and hybrid PD-ANFIS controllers are designed and implemented to control quadrotor system. The performance of PID, P-D, LQR, ANFIS and PD-ANFIS controller are compared for the modeled quadrotor. The system dynamic performance obtained with these controllers is compared and their investigations carried out are utilized to propose an optimal controller among these applied control schemes.