Integration of Control Algorithms for Quadrotor UAV's Using an Indoor Sensor Environment

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This thesis develops an architecture that facilitates the design and indoor testing of control algorithms implemented onboard quadrotor UAV's using an ultra-wideband (UWB) indoor positioning solution from Ubisense. Initially, details are provided on basic quadrotor dynamics, the setup of the indoor sensor environment, and the communication scheme. A thorough analysis is conducted on the accuracy and estimation lag of Ubisense UWB sensors for providing indoor position information to the quadrotor. Once this framework is established, the focus is placed on design and experimental validation of the altitude hold control algorithm. The observer used is a discrete Kalman filter that minimizes the covariance of position and acceleration measurement inputs to produce a smooth estimation of states (position, velocity and acceleration). These estimated states are then fed into a modified PD plus Integral controller to produce quadrotor thrust commands for given altitude step commands. Results indicate that the technology used is capable of maintaining a UAV's altitude within an error margin of +/-13.3 cm, but the relatively slow update rate of the Ubisense system limits the possibility of more complex and aggressive maneuvers.

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