ROSE-HULMAN INSTITUTE OF TECHNOLOGY

Investigation in the Control of a Four-Rotor Aerial Robot

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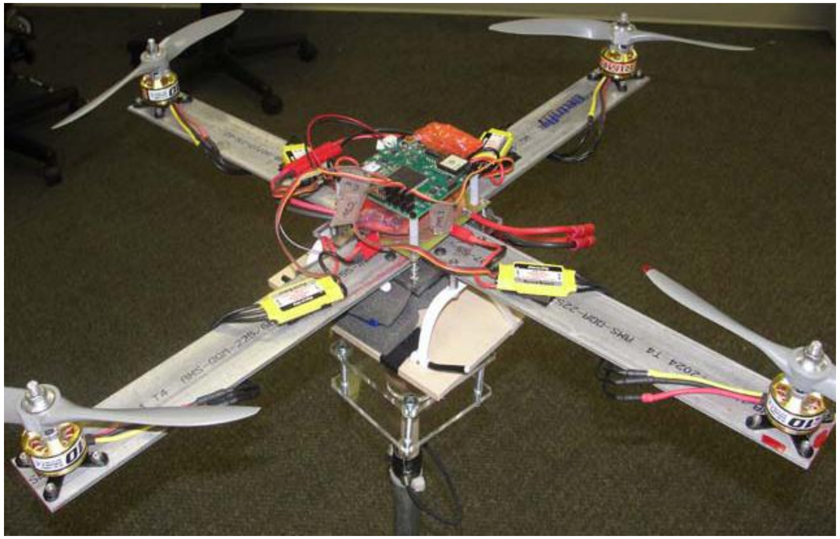
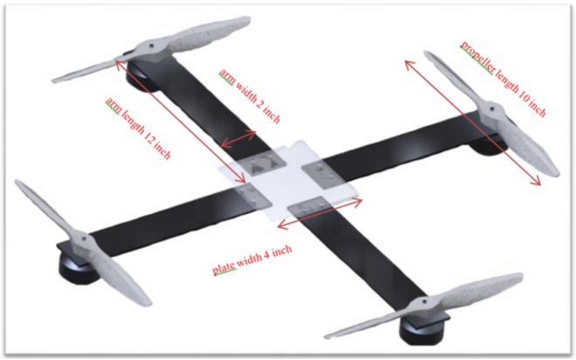
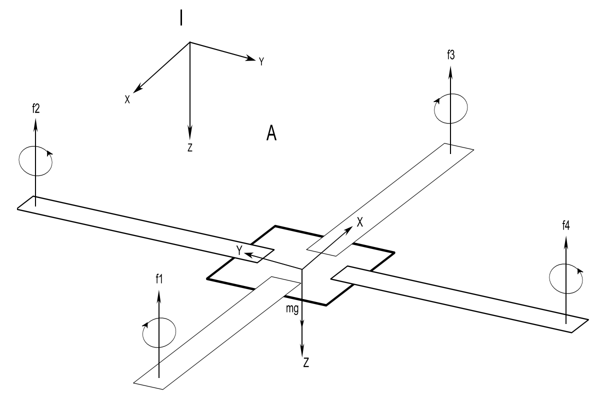


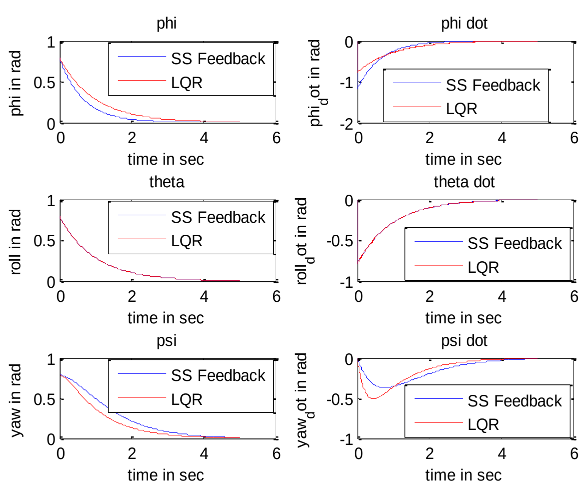
This presentation will focus on the design, modeling and control of a 4-rotor aerial robot (i.e. quadcopter)



Hardware Design

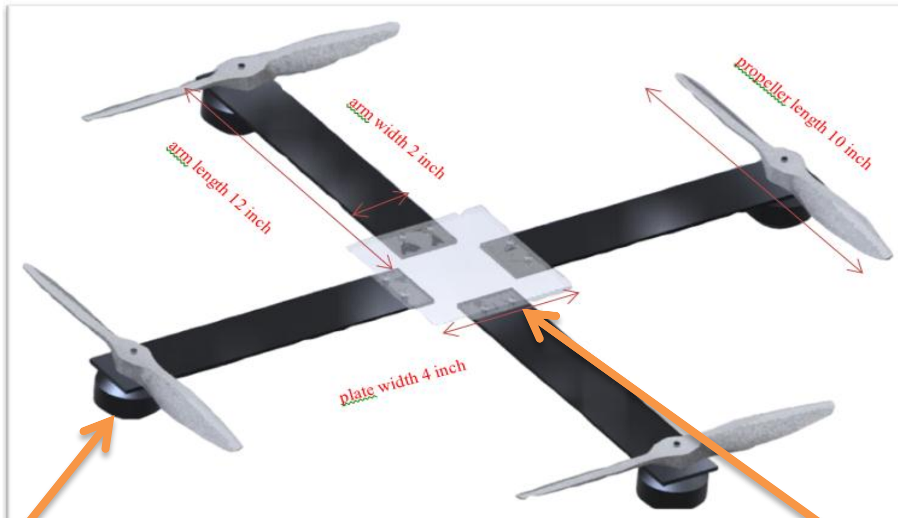


Parameter Identification and Modeling

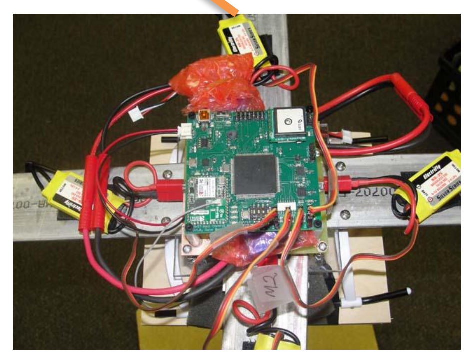


Simulation and Control

The quadcopter was designed to hover stably and measure air quality.

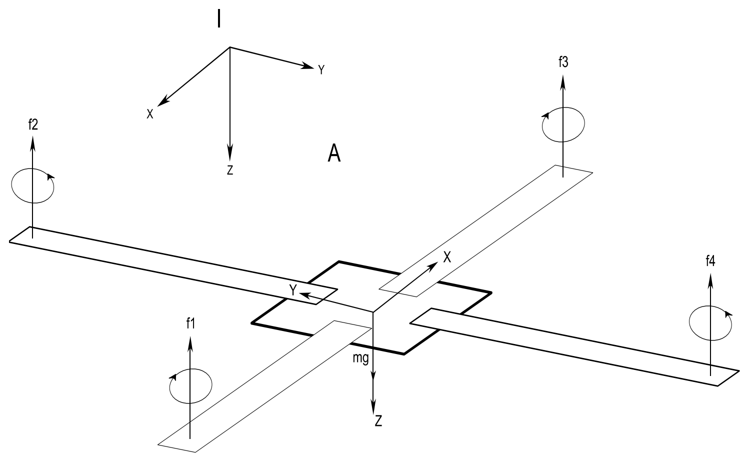


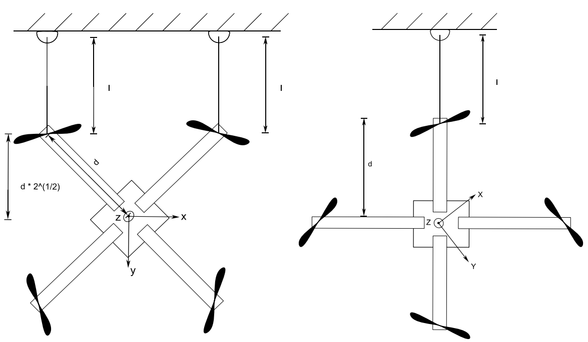
Hardware Design



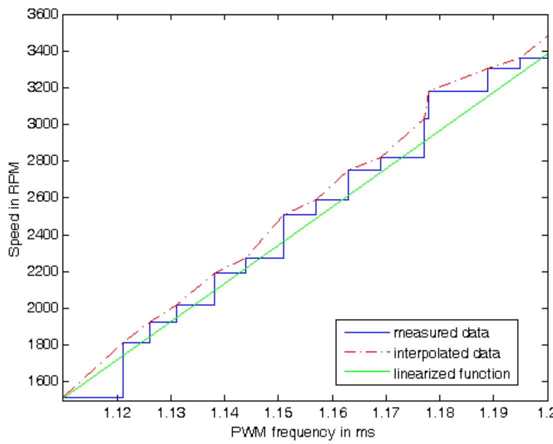
Electrical Design

In order to develop a controller, the kinematic model was derived and key parameters identified





Moment of Inertia



Motor Speed (rpm)

In this work, the controller for the inner control loop to stabilize the UAV was designed.

$$u = -K * x = -\begin{bmatrix} k_{11} & \cdots & k_{1n} \\ \vdots & \ddots & \vdots \\ k_{41} & \cdots & k_{41} \end{bmatrix} * \begin{bmatrix} x_1 \\ \vdots \\ x_n \end{bmatrix}$$

PD feedback control

$$J = \tfrac{1}{2} * \int_{t_0}^{\infty} [x^T * Q * x + u^T * R * u] dt$$

Optimal LQ Control

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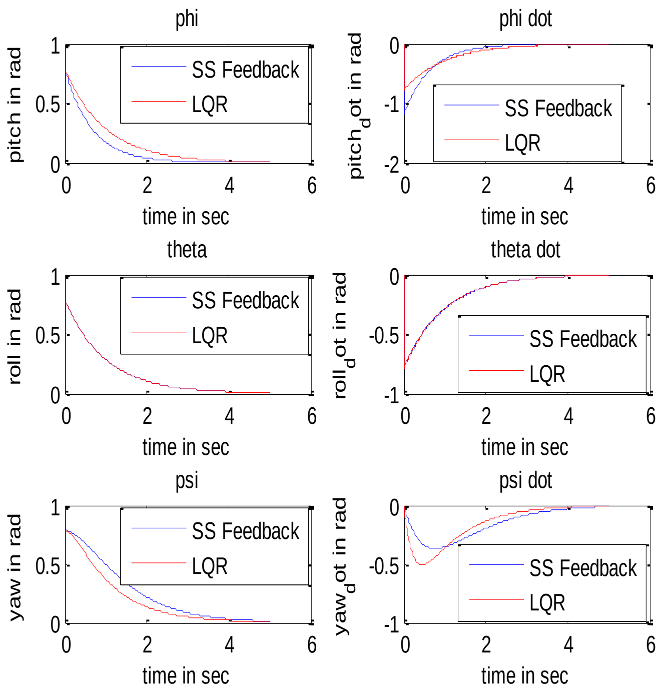
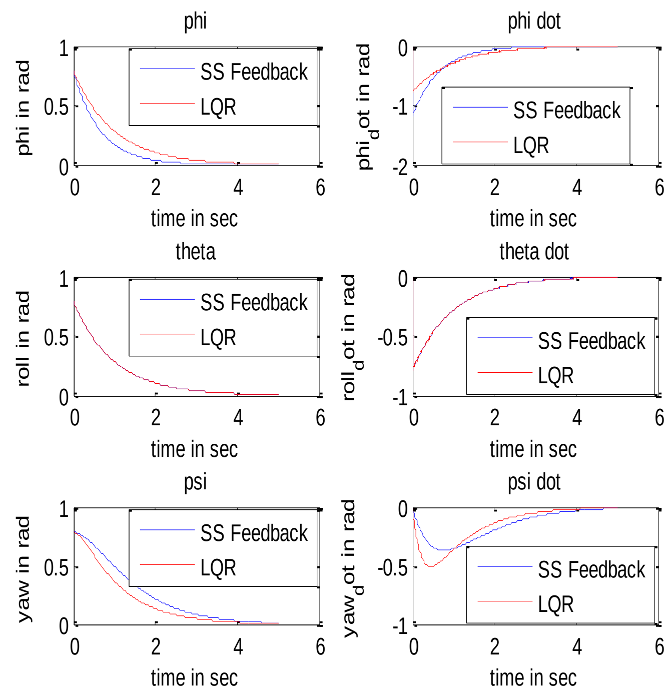
The designed controllers were simulated using MATLAB/Simulink and LQR performed the best

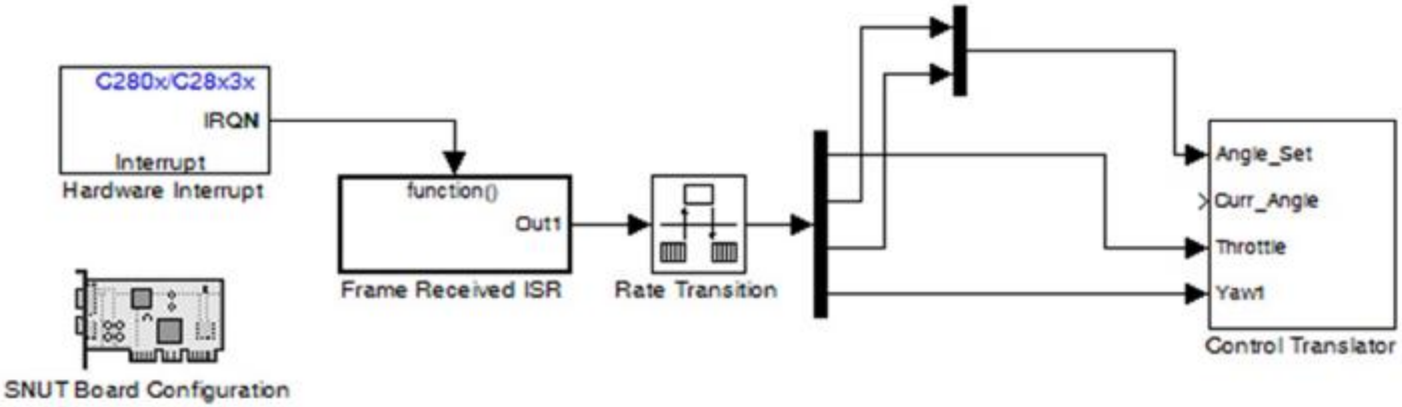


Linear model



Nonlinear model

The controllers were embedded on the hardware by using MATLAB libraries and also Embedded C code



In summary, to implement control architectures on an un-modeled quadcopter requires better sensor data and a robust controller such as hardware in the loop.