Mechanical Engineering Master's Defense

Modeling and Control of a Quadrotor Aircraft

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abstract

Given the increasing use of quadrotor vehicle applications, this thesis seeks to identify critical tradeoffs with respect to modeling, control and vehicle design.
With this goal, we focus on a very generic/standard quadrotor configuration.
A two control nonlinear 3DOF (degree of freedom) model for the vehicle's longitudinal dynamics is used as the basis for all developments.
The model is used to investigate how the static and dynamic properties of the vehicle change as function of the flight condition as well as mass and geometry.
This analysis is used to make control-centric recommendations with respect to vehicle design.
While the two-input two-output system is decoupled at hover, it becomes coupled with forward speed.
This leads to the following questions:
(1) Til what flight condition will the decentralized hover controller perform acceptably?
(2) At what flight condition does a multivariable controller become essential?
That is, when is a centralized multivariable controller needed to decouple the system dynamics in the presence of uncertainty.
These critical control design questions are answered within the thesis.
Comprehensive tradeoffs are provided using a classical lead lag control architecture.

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