Control of the Twin-Rotor System

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Declaration

I declare that I am the sole author of this thesis and that all the work presented in it, unless otherwise referenced, is my own. I also declare that this work has not been submitted, in whole or in part, to any other university or college for any degree or any other qualification.

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Than Tien Thinh

June, 2010

Abstract:

The problem of Multi-Input-Multi-Output (MIMO) control has always been an interesting sub-field within the field of control. Among the systems that require MIMO control, the helicopter stands out as one of the prominent examples. This type of aircraft requires two rotors, rotating in perpendicular planes, therefore can not rely on Single-Input-Single-Output controllers to maneuver in the space. Also, un-manned helicopters have not yet been seen in armies worldwide, this fact gives the task of developing MIMO control systems for helicopters a large room to grow.

In order to model the helicopter in laboratorial space, a Twin-Rotor Apparatus has been developed by Feedback company. This apparatus is being studied in Universitat Politècnica de Catalunya, Spain, to provide a good model for teaching and research in the field of MIMO control, with the aim to develop more efficient control methods for the real helicopter.

The complete mechanical model for this apparatus has been developed using the software MAPLE. Based on this mechanical model, several control schemes are created to control the apparatus using MATLAB-Simulink. These control schemes are designed to make the Twin-Rotor system go to predetermined points and follow periodical input signals.

The task of designing the control schemes requires the author to work on state-space configuration, linearization and experimental works. Mathematical approximation is also applied to get the approximated polynomials for variables relationship.

The controllers designed work successfully and make ways for the design of similar controllers using for other MIMO systems.

Nomenclature

Symbol	Description	Units
q_1	Generalized coordinate for pitch angle	radian
q_2	Generalized coordinate for yaw angle	radian
q_3	Generalized coordinate for main rotor angle	radian
q_4	Generalized coordinate for tail rotor angle	radian
θ_v	Pitch angle, the same as q_1	radian
θ_h	Yaw angle, the same as q_2	radian
α_main	Main rotor angle, the same as q_3	radian
α_tail	Tail rotor angle, the same as q_4	radian

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