



Erasmus Mundus



Education and Culture



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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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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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Contents

Chapter 1: Introduction	1
1.1. Motivation	2
1.2. The Twin Rotor MIMO System	4
1.3. Project Objective	6
Chapter 2: Mechanical Model Setup	8
2.1. The MAPLE and Matlab Model	9
2.1.1. List of Parameters in the Mechanical Model	9
2.1.2. The Open Loop Simulation Model	10
2.2. The Controller for the Simulation Model	14
Chapter 3: Preparation for the Real-Time Controllers	22
3.1. Designing the Controller for the Electrical Sub-system	24
3.1.1. System Identification for the Electrical Sub-system	24
3.1.1.1. <i>Tail Rotor</i>	27
3.1.1.2. <i>Main Rotor</i>	28
3.1.1.3. <i>Validation</i>	29
3.1.2. Non-linearity in the Electrical Sub-system	30
3.1.3. Electrical Sub-system Controller Design	32
3.1.3.1. <i>PI Controller</i>	32
3.1.3.2. <i>Second Order Controller</i>	35
3.1.3.3. <i>Controller Choice</i>	37
3.1.4. Anti-windup Scheme	37
3.2. State Estimator	38
3.3. Non-linearity Link Between the Two Sub-systems	39
3.4. Electrical Sub-system Scheme and Non-linear Link	40
Chapter 4: Real-Time Controllers	41
4.1. First Controller with Linearization around Point	42
4.2. Second Controller with Linearization around Point	45
4.3. Third Controller with Global Linearization	48
4.4. Sinusoid Tracking with Global Linearization	51
Chapter 5: Summary and Conclusions	59
References	62
Appendix	63

List of tables and figures

Figures

1.1. Model of aerodynamic force	3
1.2. The more popular model of the helicopter with a lift blade and a tail blade – Russian helicopter Mi24	3
1.3. The Twin Rotor MIMO System (TRMS)	4
1.4. Model of the TRMS	5
1.5. Angular sensors	6
1.6. Control chain for the TRMS	7
2.1. Oscillation of the open-loop TRMS model around one equilibrium point	13
2.2. Oscillation of the open-loop TRMS model in the close neighbourhood of the equilibrium point	14
2.3. The scheme for both the non-linear mechanical plant and the linearized plant	19
2.4. The linearized model converges to $q_{10} = 1$ without integral action	19
2.5. The complete model converges to $q_{10} = 1$	20
2.6. The complete model converges to $q_{20} = 1$	20
2.7. The complete model converges to $q_{30} = 2$	21
2.8. The complete model converges to $q_{40} = 3$	21
3.1. Model for the DC Motor	24
3.2. Step response of tail speed	27
3.3. Step response of main speed	28
3.4. Step response of the modelled transfer function for the main motor	29
3.5. Step response of the modelled transfer function for the tail motor	30
3.6. Gain-Voltage diagram for tail rotor	31
3.7. Gain-Voltage diagram for main rotor	31
3.8. Validation experiment for the PI controller	34
3.9. Validation experiment for the second-order controller	37
3.10. Anti-windup scheme with a controller	38
3.11. Experiment to get the function Speed = f(Torque)	40
3.12. Electrical sub-system scheme with the non-linear link between the two sub-	

systems as $\text{Speed} = f(\text{Torque})$	40
4.1. Scheme of the PI controller in Section 4.1	43
4.2. Performance of the PI controller in Section 4.1, a. Pitch, b. Yaw angles	44
4.3. Scheme of the controller in Section 4.2	46
4.4. Performance of the controller in Section 4.2, a. Pitch, b. Yaw angles	47
4.5. Scheme of the controller in Section 4.3	49
4.6. Performance of the controller in Section 4.3, a. Pitch, b. Yaw angles	50
4.7. Scheme of the controller in Section 4.4	53
4.8. Performance of the controller in Section 4.4 with the same reference frequency	54
4.9. Fourier transform of the error signals (reference frequency is 0.03Hz)	55
4.10. Performance of the controller in Section 4.4 with two different reference frequencies	56
4.11. Fourier transform of the error signals (reference frequency is 0.03Hz for pitch and 0.06Hz for yaw)	57

Tables

2.1. List of mechanical parameters	10
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