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| Nota di contenuto       | Preface; Acknowledgements; Contents; Acronyms; 1 Fault Tolerant Control; 1.1 Fault and Failure and Their Classification; 1.1.1 Modeling Faults and Failures; 1.2 Fault Detection and Isolation (FDI); 1.3 Fault Tolerant Control Systems; 1.3.1 Passive Fault Tolerant Control Systems; 1.3.2 Active Fault Tolerant Control Systems; 1.3.3 Control Allocation; 1.4 Summary; 1.5 Notes and References; References; 2 Integral Sliding Mode Control; 2.1 Introduction; 2.2 Problem Statement and Equivalent Control; 2.2.1 Sliding Mode Control Laws; 2.3 Reachability Problem; 2.4 A Simple Simulation Example<br>2.4.1 Spring Mass Damper System<br>2.4.2 Simulation Objective and SMC Design; 2.4.3 Simulation Results; 2.5 Practical Sliding Mode Control Law; 2.6 Properties of the Sliding Mode; 2.7 Integral Sliding Mode Control (ISMC); 2.7.1 Introduction; 2.7.2 Problem Statement and ISM Controller Design; 2.7.3 Design Principles; 2.7.4 Integral Switching Surface; 2.7.5 Integral Sliding Mode Control Laws; 2.7.6 The Reachability Condition; 2.7.7 Properties of Integral Sliding Mode; 2.7.8 Simulation Example; 2.8 Sliding Modes as a Candidate for FTC; 2.9 Notes and References; References<br>3 Design and Analysis of an Integral Sliding Mode Fault Tolerant |

Control Scheme  
3.1 System Description and Problem Formulation; 3.2 Integral Sliding Mode Controller Design; 3.2.1 Integral-Type Switching Surface Design; 3.2.2 Closed-Loop Stability Analysis; 3.2.3 Integral Sliding Mode Control Laws; 3.2.4 Design of the Controller Gains; 3.3 Simulations; 3.3.1 Sliding Mode Fault Reconstruction Scheme; 3.3.2 Manoeuvre and Fault Scenarios; 3.4 Summary; 3.5 Notes and References; References; 4 A Fault Tolerant Direct Control Allocation Scheme with Integral Sliding Modes; 4.1 Problem Formulation 4.2 Integral Sliding Mode FTC Scheme with Direct Control Allocation 4.2.1 Design of Feedback Gain  $F$ ; 4.3 Simulations; 4.4 Nonlinear Simulation Results; 4.5 Summary; 4.6 Notes and References; References; 5 An Output Integral Sliding Mode FTC Scheme Using Control Allocation; 5.1 Problem Formulation; 5.2 ISM Controller Design; 5.2.1 Closed-Loop Stability Analysis; 5.2.2 LMI Synthesis; 5.2.3 ISM Control Laws; 5.3 Simulations; 5.3.1 Simulation Results; 5.4 Summary; 5.5 Notes and References; References; 6 An Augmentation Scheme for Fault Tolerant Control Using Integral Sliding Modes 6.1 System Description and Problem Formulation 6.2 Integral Sliding Mode Controller Design; 6.2.1 Stability Analysis of the Closed-Loop Sliding Motion; 6.2.2 Integral Sliding Mode Control Laws; 6.3 Case Study: Yaw Damping of a Large Transport Aircraft; 6.3.1 Baseline Controller; 6.3.2 Fault Tolerant Control; 6.3.3 Nonlinear Simulation Results; 6.4 Summary; 6.5 Notes and References; References; 7 Nonlinear Integral Sliding Mode; 7.1 Nonlinear Aircraft Model; 7.1.1 Strict Feedback Form; 7.2 Control Law Development; 7.2.1 Nominal Backstepping Control Law; 7.2.2 Control Allocation 7.2.3 Integral Sliding Mode Design

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## Sommario/riassunto

The key attribute of a Fault Tolerant Control (FTC) system is its ability to maintain overall system stability and acceptable performance in the face of faults and failures within the feedback system. In this book Integral Sliding Mode (ISM) Control Allocation (CA) schemes for FTC are described, which have the potential to maintain close to nominal fault-free performance (for the entire system response), in the face of actuator faults and even complete failures of certain actuators. Broadly an ISM controller based around a model of the plant with the aim of creating a nonlinear fault tolerant feedback controller whose closed-loop performance is established during the design process. The second approach involves retro-fitting an ISM scheme to an existing feedback controller to introduce fault tolerance. This may be advantageous from an industrial perspective, because fault tolerance can be introduced without changing the existing control loops. A high fidelity benchmark model of a large transport aircraft is used to demonstrate the efficacy of the FTC schemes. In particular a scheme based on an LPV representation has been implemented and tested on a motion flight simulator.

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