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Introduction to Fly-by-Wire Flight Control Systems *Flight Control Systems* Advanced Techniques for Clearance of Flight Control Laws *Aircraft Control and Simulation Airplane Flight Dynamics and Automatic Flight Controls* **Production Support Flight Control Computers: Research Capability for F/A-18 Aircraft at Dryden Flight Research Center** *Practical Methods for Aircraft and Rotorcraft Flight Control Design* Advances In Aircraft Flight Control *Advances In Aircraft Flight Control* Flight Control Systems **Bureau of Aeronautics Flight Control System Manuals: The artificial feel system** *Flight Control System Manuals: Automatic flight control systems for piloted aircraft* **Development and Flight Test of an Emergency Flight Control System Using Only Engine Thrust on an MD-11 Transport Airplane** Aerospace Flight Control Systems **Optimization Based Clearance of Flight Control Laws Automatic Flight Control Systems - Latest Developments Flight Control System Manuals: The human pilot Bureau of Aeronautics Flight Control System Manuals: Automatic flight control systems for piloted aircraft** *The Interpretation of Flying Qualities Requirements for Flight Control System Design* **Airplane Flying Handbook (FAA-H-8083-3A)** CONDUIT: A New Multidisciplinary Integration Environment for Flight Control Development **Fault-tolerant Flight Control and Guidance Systems** Fault Diagnosis and Reconfiguration in Flight Control Systems *Flight Systems and Control* **Application of Sliding Mode Methods to the Design of Reconfigurable Flight Control Systems** *Robust Flight Control Development and Flight Test of an Augmented Thrust-only Flight Control System on an MD- 11 Transport Airplane* **Automatic Flight Control Systems** Aircraft Control Allocation **Fault Diagnosis and Reconfiguration in Flight Control Systems Manual Manipulation of Engine Throttles for Emergency Flight Control Fault Tolerant Flight Control** Fully Tuned Radial Basis Function Neural Networks for Flight Control **Airplane Flight Dynamics and Automatic Flight Controls** *A Knowledge-based System Design/information Tool for Aircraft Flight Control Systems* **Advanced Flight Dynamics with Elements of Flight Control Aircraft Dynamics and Automatic Control** Singular Perturbations and Time Scales in the Design of Digital Flight Control Systems Robust Multivariable Flight Control Automatic Flight Control

A state-of-the-art computational facility for aircraft flight control design, evaluation, and integration called CONDUIT (Control Designer's Unified Interface) has been developed. This paper describes the CONDUIT tool and case study applications to complex rotary- and fixed- wing fly-by-wire flight control problems. Control system analysis and design optimization methods are presented, including definition of design specifications and system models within CONDUIT, and the multi-objective function optimization (CONSOL-OPTCAD) used to tune the selected design parameters. Design examples are based on flight test programs for which extensive data are available for validation. CONDUIT is used to analyze baseline control laws against pertinent military handling qualities and control system specifications. In both case studies, CONDUIT successfully exploits trade-offs between forward loop and feedback dynamics to significantly improve the expected handling qualities and minimize the required actuator authority. The CONDUIT system provides a new environment for integrated control system analysis and design, and has potential for significantly reducing the time and cost of control system flight test optimization. This book provides an introduction to the pinciples of automatic flight of fixed-wing and rotary wing aircraft. Representative types of aircraft (UK and US) are used to show how these principles are applied in their systems. The revised edition includes new material on automatic flight control systems and helicopters This book provides a single comprehensive resource that reviews many of the current aircraft flight control programmes from the perspective of experienced practitioners directly involved in the projects. Each chapter discusses a specific aircraft flight programme covering the control system design considerations, control law architecture, simulation and analysis, flight test optimization and handling qualities evaluations. The programmes described have widely exploited modern interdisciplinary tools and techniques and the discussions include extensive flight test results. Many important `lessons learned' are included from the experience gained when design methods and requirements were tested and optimized in actual flight demonstration. Aircraft Control Allocation Wayne Durham, Virginia Polytechnic Institute and State University, USA Kenneth A. Bordignon, Embry-Riddle Aeronautical University, USA Roger Beck, Dynamic Concepts, Inc., USA An authoritative work on aircraft control allocation by its pioneers Aircraft Control Allocation addresses the problem of allocating supposed redundant flight controls. It provides introductory material on flight dynamics and control to provide the context, and then describes in detail the geometry of the problem. The book includes a large section on solution methods, including 'Banks' method', a previously unpublished procedure. Generalized inverses are also discussed at length. There is an introductory section on linear programming solutions, as well as an extensive and comprehensive appendix dedicated to linear programming formulations and solutions. Discrete-time, or frame-wise allocation, is presented, including rate-limiting, nonlinear data, and preferred solutions. Key features: Written by pioneers in the field of control allocation. Comprehensive explanation and discussion of the major control allocation solution methods. Extensive treatment of linear programming solutions to control allocation. A companion web site contains the code of a MATLAB/Simulink flight simulation with modules that incorporate all of the major solution methods. Includes examples based on actual aircraft. The book is a vital reference for researchers and practitioners working in aircraft control, as well as graduate students in aerospace engineering. This book provides a single comprehensive resource that reviews many of the current aircraft flight control programmes from the perspective of experienced practitioners directly involved in the projects. Each chapter discusses a specific aircraft flight programme covering the control system design considerations, control law architecture, simulation and analysis, flight test optimization and handling qualities evaluations. The programmes described have widely exploited modern interdisciplinary tools and techniques and the discussions include extensive flight test results. Many important `lessons learned' are included from the experience gained when design methods and requirements were tested and optimized in actual flight demonstration. Manual flight control system design for fighter aircraft is one of the most demanding problems in automatic control. Fighter aircraft dynamics generally have highly coupled uncertain and nonlinear dynamics. Multivariable control design techniques offer a solution to this problem. Robust Multivariable Flight Control provides the background, theory and examples for full envelope manual flight control system design. It gives a versatile framework for the application of advanced multivariable control theory to aircraft control problems. Two design case studies are presented for the manual flight control of lateral/directional axes of the VISTA-F-16 test vehicle and an F-18 trust vectoring system. They demonstrate the interplay between theory and the physical features of the systems. This book provides readers with a design approach to the automatic flight control systems (AFCS). The AFCS is the primary on-board tool for long flight operations, and is the foundation for the airspace modernization initiatives. In this text, AFCS and autopilot are employed interchangeably. It presents fundamentals of AFCS/autopilot, including primary subsystems, dynamic modeling, AFCS categories/functions/modes, servos/actuators, measurement devices, requirements, functional block diagrams, design techniques, and control laws. The book consists of six chapters. The first two chapters cover the fundamentals of AFCS and closed-loop control systems in manned and unmanned aircraft. The last four chapters present features of Attitude control systems (Hold functions), Flight path control systems (Navigation functions), Stability augmentation systems, and Command augmentation systems, respectively. Get a complete understanding of aircraft control and simulation Aircraft Control and Simulation: Dynamics, Controls Design, and Autonomous Systems, Third Edition is a comprehensive guide to aircraft control and simulation. This updated text covers flight control systems, flight dynamics, aircraft modeling, and flight simulation from both classical design and modern perspectives, as well as two new chapters on the modeling, simulation, and adaptive control of unmanned aerial vehicles. With detailed examples, including relevant MATLAB calculations and FORTRAN codes, this approachable yet detailed reference also provides access to supplementary materials, including chapter problems and an instructor's solution manual. Aircraft control, as a subject area, combines an understanding of aerodynamics with knowledge of the physical systems of an aircraft. The ability to analyze the performance of an aircraft both in the real world and in computer-simulated flight is essential to maintaining proper control and function of the aircraft. Keeping up with the skills necessary to perform this analysis is critical for you to thrive in the aircraft control field. Explore a steadily progressing list of topics, including equations of motion and aerodynamics, classical controls, and more advanced control methods Consider detailed control design examples using computer numerical tools and simulation examples Understand control design methods as they are applied to aircraft nonlinear math models Access updated content about unmanned aircraft (UAVs) Aircraft Control and Simulation: Dynamics, Controls Design, and Autonomous Systems, Third Edition is an essential reference for engineers and designers involved in the development of aircraft and aerospace systems and computer-based flight simulations, as well as upper-level undergraduate and graduate students studying mechanical and aerospace engineering. In October 1994, 22 organisations throughout Europe accepted a challenge to solve a specific robust flight control design problem. The results of that design challenge, presented at the GARTEUR Specialists' Workshop in Toulouse, France in April 1997, are reported here. Two flight control benchmarks are considered, based on the automatic landing phase of a large cargo aircraft and on the control of a military aircraft. Methods applied include: classical control; multi-objective optimisation; eigenstructure assignment; modal multi-model approach; LQ, Lyapunov and H¿-techniques; ¿-synthesis; nonlinear dynamic inversion; robust inverse dynamics estimation; model predictive control and following; and fuzzy control. Involved in the definition of the benchmarks and the evaluation process have been representatives from the European aeronautical industry, bringing a strong link with flight control law design practice. This practical new book builds on the fundamentals of flight dynamics and flight control, and embellishes these principles by assigning their relevance to the development of flight-control systems in the aircraft industry. The problem of fault diagnosis and reconfigurable control is a new and actually developing field of science and engineering. The subject becomes more interesting since there is an increasing demand for the navigation and control systems of aerospace vehicles, automated actuators etc. to be more safe and reliable. Nowadays, the problems of fault detection and isolation and reconfigurable control attract the attention the scientists in the world. The subject is emphasized in the recent international congresses such as IF AC World Congresses (San Francisco-1996, Beijing-1999, and Barcelona-2002) and lMEKO World Congresses (Tampere-1997, Osaka-1999, Vienna-2000), and also in the international conferences on fault diagnosis such as SAFEPROCESS Conferences (Hull-1997, Budapest-2000). The presented methods in the book are based on linear and nonlinear dynamic mathematical models of the systems. Technical objects and systems stated by these models are very large, and include various control systems, actuators, sensors, computer systems, communication systems, and mechanical, hydraulic, pneumatic, electrical and electronic devices. The analytical fault diagnosis techniques of these objects have been developed for several decades. Many of those techniques are based on the use of the results of modem control theory. This is natural, because it is known that fault diagnosis process in control systems is considered as a part of general control process. xxii In organization of fault diagnosis of control systems, the use of the concepts and methods of modem control theory including concepts of state space, modeling, controllability, observability, estimation, identification, and filtering is very efficient. Fully Tuned Radial Basis Function Neural Networks for Flight Control presents the use of the Radial Basis Function (RBF) neural networks for adaptive control of nonlinear systems with emphasis on flight control applications. A Lyapunov synthesis approach is used to derive the tuning rules for the RBF controller parameters in order to guarantee the stability of the closed loop system. Unlike previous methods that tune only the weights of the RBF network, this book presents the derivation of the tuning law for tuning the centers, widths, and weights of the RBF network, and compares the results with existing algorithms. It also includes a detailed review of system identification, including indirect and direct adaptive control of nonlinear systems using neural networks. Fully Tuned Radial Basis Function Neural Networks for Flight Control is an excellent resource for professionals using neural adaptive controllers for flight control applications. In this book recent results of the GARTEUR (Group for Aeronautical Research and Technology in Europe) Action Group FM (AG11) are presented. The book focuses on analysis techniques for the flight clearance of highly augmented aircrafts, including contributions of 20 European aeronautical organisations such as National Research Centers, Aerospace Industries and Universities. The tasks and requirements of the Industrial Clearance Process for Flight Control Laws are presented as well as classical and particularly new analysis methods. The different methods are evaluated and compared and their potential application to Civil Aircraft is demonstrated. The history of flight control is inseparably associated to the history of aviation itself. Since the early period, the concept of automatic flight control systems has progressed from mechanical control systems to highly advanced automatic fly-by-wire flight control systems which can be found nowadays in military jets and civil airliners. A conventional fixed-wing aircraft flight control system consists of flight control surfaces, the respective cockpit controls, connecting linkages, and the necessary operating mechanisms to control an aircraft's direction in flight. Aircraft engine controls are also considered as flight controls as they change speed. An autopilot is a system used to control the trajectory of a vehicle without constant 'hands-on' control by a human operator being required. Autopilots do not replace a human operator, but assist them in controlling the vehicle, allowing them to focus on broader aspects of operation, such as monitoring the trajectory, weather and systems. Autopilots are used in aircraft, spacecraft, missiles, and others. Autopilots have evolved significantly over time, from early autopilots that merely held an attitude to modern autopilots capable of performing automated landings under the supervision of a pilot. The autopilot in a modern large aircraft typically reads its position and the aircraft's attitude from an inertial guidance system. Automatic Flight Control Systems - Latest Developments emphases on a selection of significant research areas, such as inertial navigation, control of unmanned aircraft and helicopters, trajectory control of an unmanned space re-entry vehicle, aeroservoelastic control, adaptive flight control, and fault tolerant flight control. This book offers a complete overview of fault-tolerant flight control techniques. Discussion covers the necessary equations for the modeling of small UAVs, a complete system based on extended Kalman filters, and a nonlinear flight control and guidance system. Advanced Flight Dynamics aim to integrate the subjects of aircraft performance, trim and stability/control in a seamless manner. Advanced Flight Dynamics highlights three key and unique viewpoints. Firstly, it follows the revised and corrected aerodynamic modeling presented previously in recent textbook on Elementary Flight Dynamics. Secondly, it uses bifurcation and continuation theory, especially the Extended Bifurcation Analysis (EBA) procedure devised by the authors, to blend the subjects of aircraft performance, trim and stability, and flight control into a unified whole. Thirdly, rather than select one control design tool or another, it uses the generalized Nonlinear Dynamic Inversion (NDI) methodology to illustrate the fundamental principles of flight control. Advanced Flight Dynamics covers all the standard airplane maneuvers, various types of instabilities normally encountered in flight dynamics and illustrates them with real-life airplane data and examples, thus bridging the gap between the teaching of flight dynamics/ control theory in the university and its practice in airplane design bureaus. The expected reader group for this book would ideally be senior undergraduate and graduate students, practicing aerospace/flight simulation engineers/scientists from industry as well as researchers in various organizations. Key Features: Focus on unified nonlinear approach, with nonlinear analysis tools. Provides an up-to-date, corrected, and unified presentation of aircraft trim, stability and control analysis including nonlinear phenomena and closed-loop stability analysis. Contains a computational tool and real-life example carried through the chapters. Includes complementary nonlinear dynamic inversion control approach, with relevant aircraft examples. Fills the gap in the market for a text including non-linear flight dynamics and continuation methods. The problem of fault diagnosis and reconfigurable control is a new and actually developing field of science and engineering. The subject becomes more interesting since there is an increasing demand for the navigation and control systems of aerospace vehicles, automated actuators etc. to be more safe and reliable. Nowadays, the problems of fault detection and isolation and reconfigurable control attract the attention the scientists in the world. The subject is emphasized in the recent international congresses such as IF AC World Congresses (San Francisco-1996, Beijing-1999, and Barcelona-2002) and lMEKO World Congresses (Tampere-1997, Osaka-1999, Vienna-2000), and also in the international conferences on fault diagnosis such as SAFEPROCESS Conferences (Hull-1997, Budapest-2000). The presented methods in the book are based on linear and nonlinear dynamic mathematical models of the systems. 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A study was conducted to design an experimental flight test program for the Total In-Flight Simulator CTIFS) directed toward the interface between flying qualities requirements and flight control sytem design criteria. The eventual goal is to provide an interpretation or translation of flying qualities requirements for use by the flight control system designer. Specifically, an angle of attack and pitch rate command system matrix involving both short term and long term dynamics are specified for evaluation. A major objective of the research was to demonstrate that flying qualities criteria and flight control system configuration or architecture can be independent. Finally, additional configurations are proposed to evaluate the efficacy of dynamic decoupling. Written by leading experts in the field, this book provides the state-of-the-art in terms of fault tolerant control applicable to civil aircraft. The book consists of five parts and includes online material. "In this part, exhaustive coverage is provided of the methods for analysis and synthesis of automatic flight control systems using classical control theory. This widely used book has been updated with the latest software methods. Throughout this text, the practical (design) applications of the theory are stressed with many examples and illustrations. Aircraft stability and control characteristics are all heavily regulated by civil as well as by military airworthiness authorities for safety reasons. The role of the these safety regulations in the application of the theory is therefore stressed throughout. Airplane Flight Dynamics & Automatic Flight Controls, Part II, is an essential reference for all aeronautical engineers working in the area of stability and control, regardless of experience levels. The book minimizes reader confusion through a systematic progression of fundamentals: - Elastic airplane stability and control coefficients and derivatives - Method for determining the equilibrium and manufacturing shape of an elastic airplane - Subsonic and supersonic numerical examples of aeroelasticity effects on stability & control derivatives - Bode and root-locus plots with open and closed loop airplane applications, and coverage of inverse applications - Stability augmentation systems: pitch dampers, yaw dampers and roll dampers - Synthesis concepts of automatic flight control modes: control-stick steering, auto-pilot hold, speed control, navigation and automatic landing - Digital control systems using classical control theory applications with Z-transforms - Applications of classical control theory - Human pilot transfer functions." --Descripción del editor. Annotation Bridging the gap between academic research and real-world applications, this reference on modern flight control methods for fixed-wing aircraft deals with fundamentals of flight control systems design, then concentrates on applications based on the modern control methods used in the latest aircraft. The book is written for practicing engineers who are new to the aviation industry, postgraduate students in strategic or applied research, and advanced undergraduates. Some knowledge of classical control is assumed. Pratt is a member of IEEE and is UK Member for AIAA's Technical Committee on Guidance, Navigation and Control. Annotation c. Book News, Inc., Portland, OR (booknews.com) An emergency flight control system that uses only engine thrust, called the propulsion-controlled aircraft (PCA) system, was developed and flight tested on an MD-11 airplane. The PCA system is a thrust-only control system, which augments pilot flightpath and track commands with aircraft feedback parameters to control engine thrust. The PCA system was implemented on the MD-11 airplane using only software modifications to existing computers. Results of a 25-hr flight test show that the PCA system can be used to fly to an airport and safely land a transport airplane with an inoperative flight control system. In up-and-away operation, the PCA system served as an acceptable autopilot capable of extended flight over a range of speeds, altitudes, and configurations. PCA approaches, go-arounds, and three landings without the use of any normal flight controls were demonstrated, including ILS-coupled hands-off landings. PCA operation was used to recover from an upset condition. The PCA system was also tested at altitude with all three hydraulic systems turned off. This paper reviews the principles of throttles-only flight control, a history of accidents or incidents in which some or all flight controls were lost, the MD-11 airplane and its systems, PCA system development, operation, flight testing, and pilot comments. Burcham, Frank W., Jr. and Burken, John J. and Maine, Trindel A. and Fullerton, C. Gordon Armstrong Flight Research Center... This book covers aerospace flight control systems. Both primary and secondary flight control systems are covered in the book. The first chapters cover basic mechanism fundamentals that are relevant to flight control systems. Next is chapters on cable systems, gearing systems and power screws.

Hydraulic and electromechanical actuation are also discussed. From here, the book addresses general aspects of flight control systems, including fly by wire systems. After this secondary systems (high lift, spoilers, trim) and primary flight control for each axis are discussed - each in stand-alone chapters. Reversible, irreversible and fly by wire systems are discussed for each axis. The final chapter goes into system fault detection. This book summarizes the main achievements of the EC funded 6th Framework Program project COFCLUO – Clearance of Flight Control Laws Using Optimization. This project successfully contributed to the achievement of a top-level objective to meet society's needs for a more efficient, safer and environmentally friendly air transport by providing new techniques and tools for the clearance of flight control laws. This is an important part of the certification and qualification process of an aircraft – a costly and time-consuming process for the aeronautical industry. The overall objective of the COFCLUO project was to develop and apply optimization techniques to the clearance of flight control laws in order to improve efficiency and reliability. In the book, the new techniques are explained and benchmarked against traditional techniques currently used by the industry. The new techniques build on mathematical criteria derived from the certification and qualification requirements together with suitable models of the aircraft. The development of these criteria and models are also presented in the book. Because of wider applicability, the optimization-based clearance of flight control laws will open up the possibility to design innovative aircraft that today are out of the scope using classical clearance tools. Optimization-based clearance will not only increase safety but it will also simplify the whole certification and qualification process, thus significantly reduce cost. The achieved speedup will also support rapid modeling and prototyping and reduce "time to market". This book focuses on flight vehicles and their navigational systems, discussing different forms of flight structures and their control systems, from fixed wings to rotary crafts. Software simulation enables testing of the hardware without actual implementation, and the flight simulators, mechanics, glider development and navigation systems presented here are suitable for lab-based experimentation studies. It explores laboratory testing of flight navigational sensors, such as the magnetic, acceleration and Global Positioning System (GPS) units, and illustrates the six-axis inertial measurement unit (IMU) instrumentation as well as its data acquisition methodology. The book offers an introduction to the various unmanned aerial vehicle (UAV) systems and their accessories, including the linear quadratic regulator (LQR) method for controlling the rotorcraft. It also describes a Matrix Laboratory (MATLAB) control algorithm that simulates and runs the lab-based 3 degrees of freedom (DOF) helicopter, as well as LabVIEW software used to validate controller design and data acquisition. Lastly, the book explores future developments in aviation techniques. If normal aircraft flight controls are lost, emergency flight control may be attempted using only engines thrust. Collective thrust is used to control flightpath, and differential thrust is used to control bank angle. Flight test and simulation results on many airplanes have shown that pilot manipulation of throttles is usually adequate to maintain up-and-away flight, but is most often not capable of providing safe landings. There are techniques that will improve control and increase the chances of a survivable landing. This paper reviews the principles of throttles-only control (TOC), a history of accidents or incidents in which some or all flight controls were lost, manual TOC results for a wide range of airplanes from simulation and flight, and suggested techniques for flying with throttles only and making a survivable landing.Burcham, Frank W., Jr. and Fullerton, C. Gordon and Maine, Trindel A.Armstrong Flight Research CenterMANUAL CONTROL; ENGINE CONTROL; FLIGHT CONTROL; EMERGENCIES; AIRCRAFT CONTROL; AIRCRAFT ACCIDENTS; FLIGHT SIMULATION Aeronautical engineers concerned with the analysis of aircraft dynamics and the synthesis of aircraft flight control systems will find an indispensable tool in this analytical treatment of the subject. Approaching these two fields with the conviction that an understanding of either one can illuminate the other, the authors have summarized selected, interconnected techniques that facilitate a high level of insight into the essence of complex systems problems. These techniques are suitable for establishing nominal system designs, for forecasting off-nominal problems, and for diagnosing the root causes of problems that almost inevitably occur in the design process. A complete and self-contained work, the text discusses the early history of aircraft dynamics and control, mathematical models of linear system elements, feedback system analysis, vehicle equations of motion, longitudinal and lateral dynamics, and elementary longitudinal and lateral feedback control. The discussion concludes with such topics as the system design process, inputs and system performance assessment, and multi-loop flight control systems. Originally published in 1974. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905. An emergency flight control system using only engine thrust, called Propulsion-Controlled Aircraft (PCA), has been developed and flight tested on an MD-11 airplane. In this thrust-only control system, pilot flightpath and track commands and aircraft feedback parameters are used to control the throttles. The PCA system was installed on the MD-11 airplane using software modifications to existing computers. Flight test results show that the PCA system can be used to fly to an airport and safely land a transport airplane with an inoperative flight control system. In up-and-away operation, the PCA system served as an acceptable autopilot capable of extended flight over a range of speeds and altitudes. The PCA approaches, go-arounds, and three landings without the use of any normal flight controls have been demonstrated, including instrument landing system-coupled hands-off landings. The PCA operation was used to recover from an upset condition. In addition, PCA was tested at altitude with all three hydraulic systems turned off. This paper reviews the principles of throttles-only flight control; describes the MD-11 airplane and systems; and discusses PCA system development, operation, flight testing, and pilot comments. Observer-based sliding mode control is investigated for application to aircraft reconfigurable flight control. An overview of reconfigurable flight control is given, including a review of the current state-of-the-art within the subdisciplines of fault detection parameter identification, adaptive control schemes, and dynamic control allocation. Of the adaptive control methods reviewed, sliding mode control (SMC) appears promising due its property of invariance to matched uncertainty. An overview of SMC is given and its properties are demonstrated. Sliding mode methods, however, are difficult to implement because unmodeled parasitic dynamics cause immediate and severe instability. This presents a challenge for all practical applications with limited bandwidth actuators. One method to deal with parasitic dynamics is the use of an asymptotic observer. Observer-based SMC is investigated, and a method for selecting observer gains is offered. An additional method for shaping the feedback loop using a filter is also developed. It is shown that this SMC prefilter is equivalent to a form of model reference hedging. A complete design procedure is given which takes advantage of the sliding mode boundary layer to recast the SMC as a linear control law. Frequency domain loop shaping is then used to design the sliding manifold. Finally, three aircraft applications are demonstrated. An F-18/HARV is used to demonstrate SISO and MIMO designs. The third application is a linear six degree-of-freedom advanced tailless fighter model. The observer-based SMC is seen to provide excellent tracking with superior robustness to parameter changes and actuator failures. Reducing the theoretical methods of flight control to design practice, Practical Methods for Aircraft and Rotorcraft Flight Control Design: An Optimization-Based Approach compiles the authors' extensive experience and lessons learned into a single comprehensive resource for both academics and working flight control engineers. Is it possible to describe how fly-by-wire control systems work, without diving into engineering details? It is a significant challenge for engineers to describe fly-by-wire concepts without math or block diagrams, but generally a greater challenge for pilots to understand the engineers' equations. This is not an engineering textbook and there will be no math! Rather than describe a particular aircraft's design, it explains general concepts from a pilot's perspective. The math to design these advanced systems is complicated, but the strategies underlying their designs are easily described and understood. Knowledge of fly-by-wire principles gives professional pilots an advantage to apply the flight manual procedures for their aircraft. This book describes the fundamentals of fly-by-wire in an approachable way, including: - Problems with mechanical flight control designs - Why are four computers better than one or two? - Popular control laws - What sensors are needed, and why - Design considerations for risk mitigation

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