Adaptive Control Of Helicopter Pitch Angle And Velocity

This book shares important findings on the application of robotics in industry using advanced mechanisms, including software and hardware. It presents a collection of recent trends and research on various advanced computing paradigms such as soft computing, robotics, smart automation, power control, and uncertainty analysis. The book constitutes the proceedings of the 1st International Conference on Application of Robotics in Industry using Advanced Mechanisms (ARIAM2019), which offered a platform for sharing original research findings, presenting innovative ideas and applications, and comparing notes on various aspects of robotics. The contributions highlight the latest research and industrial applications of robotics, and discuss approaches to improving the smooth functioning of industries. Moreover, they focus on designing solutions for complex engineering problems and designing system components or processes to meet specific needs, with due considerations for public health and safety, including cultural, societal, and environmental considerations. Taken together, they offer a valuable resource for researchers, scientists, engineers, professionals and students alike.

This volume is dedicated to Professor Okyay Kaynak to commemorate his life time impactful research and scholarly achievements and outstanding services to profession. The 21 invited chapters have been written by leading researchers who, in the past, have had association with Professor Kaynak as either his students and associates or colleagues and collaborators. The focal theme of the volume is the Sliding Modes covering a broad scope of topics from theoretical investigations to their significant applications from Control to Intelligent Mechatronics.

In Hubschraubern kommen mitunter aufwändige regelungstechnische Verfahren zum Einsatz, um ein intuitiv steuerbares und stabiles Verhalten der Maschine zu erzeugen. Klassische Ansätze in der Entwicklung setzen dabei auf Iterationen aus Systemidentifikation und Auslegung des Systems im Frequenzbereich. In diesem Buch wird vor dem Hintergrund der nur zu gerne unterschätzten Problematik der begrenzten Bandbreiten eine robuste adaptive Regelung eingeführt. Dazu wird ein hochfrequent-aktualisierender L1-adaptiver Regler entsprechend angepasst, ein neues adaptives Gesetz der Ausgangsrückführung eingeführt, eine neue Strategie zur Auslegung der Zustandsrückführung vorgestellt, und für den sicherheitskritischen Aspekt Effekte von Ungenauigkeiten im Rechentakt und von Sensorrauschen evaluiert. Während klassische Ansätze durch nichtlineare Optimierung weitestgehend automatisierbar sind und dennoch die Notwendigkeit wiederholter Flugtests nicht verhindern können, ist der L1-adaptive Regler bei entsprechendem Systemverständnis besonders geeignet, Entwicklungszeiten zu verkürzen. Strenge mathematische Beweise untermauern die Stabilität und Robustheit der eingeführten Algorithmen, wobei die Flugeigenschaften in einem Forschungssimulator verifiziert werden. Often, very complex controller techniques are applied to helicopters for generating an intuitively controllable and stable behavior of the aircraft. In legacy controllers, a number of iterations of system identification and loop shaping methods in frequency domain have to be conducted. In this book, a robust adaptive control theory is introduced, with the often underestimated fact of only limited available bandwidths in mind. To this end, the high-frequency adapting L1-adaptive controller is adjusted, a new adaptive law for output feedback is introduced, a new strategy for defining the design of a state feedback controller is proposed, and effects of uncertainties in the processor clock rate and of sensor noise are evaluated for taking the safety critical nature of the system into account. While legacy approaches can be automated by nonlinear optimization techniques and yet cannot eliminate the necessity of repeated flight tests, the L1-adaptive controller is particularly suitable to reduce development time, provided a sufficiently deep understanding of the system is available. Rigorous mathematical proofs substantiate the stability and robustness of the algorithms as shown, while performance and handling qualities are verified in a research simulator.

Modelling and Control of Mini-Flying Machines is an exposition of models developed to assist in the motion control of various types of mini-aircraft: • Planar Vertical Take-off and Landing aircraft; • helicopters; • quadrotor mini-rotorcraft; • other fixed-wing aircraft; • blimps. For each of these it propounds: • detailed models derived from Euler-Lagrange methods; • appropriate nonlinear control strategies and convergence properties; • real-time experimental comparisons of the performance of control algorithms; • review of the principal sensors, on-board electronics, real-time architecture and communications systems for mini-flying machine control, including discussion of their performance; • detailed explanation of the use of the Kalman filter to flying machine localization. To researchers and students in nonlinear control and its applications Modelling and Control of Mini-Flying Machines provides valuable insights to the application of real-time nonlinear techniques in an always challenging area.

This book synthesizes the results of the seventh in a successful series of workshops that were established by Shanghai Jiao Tong University and Technische Universität Berlin, bringing together researchers from both universities in order to present research results to an international community. Aspects covered here include, among others, Models and specification; Simulation of different properties; Middleware for distributed real-time systems; Signal Analysis; Control methods; Applications in airborne and medical systems.

This book gathers papers presented during the 4th International Conference on Electrical Engineering and Control Applications. It covers new control system models, troubleshooting tips and complex system requirements, such as increased speed, precision and remote capabilities. Additionally, the papers discuss not only the engineering aspects of signal processing and various practical issues in the broad field of information transmission, but also novel technologies for communication networks and modern antenna design. This book is intended for researchers, engineers and advanced postgraduate students in the fields of control and electrical engineering, computer science and signal processing, as well as mechanical and chemical engineering.

The present edited volume is of special importance, and for various reasons. First of all, it is one of the most comprehensive and multifaceted coverage of broadly per ceived fuzzy control in the literature. The editors have succeeded to collect papers from leading scholars and researchers on various subjects related to the topic of the volume. What is relevant and original is that - as opposed to so many volumes on fuzzy control published by virtually all major publishing houses that are strongly technically oriented and covering a narrow spectrum of issues relevant to fuzzy con trol itself - the editors have adopted a more general and far sighted approach. Basically, the perspective assumed in the volume is that though fuzzy control has reached such a level of maturity and implementability that it has become a part of in dustrial practice, science and academic research still have a relevant role to play in this area. One should however take into account that by their very nature, the role of science and academic research is very peculiar and going beyond straightforward ap plications, ad hoc solutions, "quick and dirty" tools and techniques, etc. that are usu ally effective and efficient for solving practical problems. This does not mean that as pects of practical implementations should not be accounted for by scholars and re searchers.

This book presents a series of innovative technologies and research results on adaptive control of dynamic systems with quantization, uncertainty, and nonlinearity, including the theoretical success and practical development such as the approaches for stability analysis, the compensation of quantization, the treatment of subsystem interactions, and the improvement of system tracking and transient performance. Novel solutions by adopting backstepping design tools to a number of hotspots and challenging problems in the area of adaptive control are provided. In the first three chapters, the general design procedures and stability analysis of backstepping controllers and the basic descriptions and properties of quantizers are introduced as preliminary knowledge for this book. In the remainder of this book, adaptive control schemes are introduced to compensate for the effects of input quantization, state quantization, both input and state/output quantization for uncertain nonlinear systems and are applied to helicopter systems and DC Microgrid. Discussion remarks are provided in each chapter highlighting new approaches and contributions to emphasize the novelty of the presented design and analysis methods. Simulation results are also given in each chapter to show the effectiveness of these methods. This book is helpful to learn and understand the fundamental backstepping schemes for state feedback control and output feedback control. It can be used as a reference book or a textbook on adaptive quantized control for students with some background in feedback control systems. Researchers, graduate students, and engineers in the fields of control, information, and communication, electrical engineering, mechanical engineering, computer science, and others will benefit from this book.

Robust and Adaptive ControlWith Aerospace ApplicationsSpringer Science & Business Media

This book discusses key concepts, challenges and potential solutions in connection with established and emerging topics in advanced computing, renewable energy and network communications. Gathering edited papers presented at MARC 2018 on July 19, 2018, it will help researchers pursue and promote advanced research in the fields of electrical engineering, communication, computing and manufacturing.

The twenty-first century could be called the 'Multifunctional Materials Age'. The inspiration for multifunctional materials comes from nature, and therefore these are often referred to as bio-inspired materials. Bio-inspired materials encompass smart materials and structures, multifunctional materials and nano-structured materials. This is a dawn of revolutionary materials that may provide a 'quantum jump' in performance and multi-capability. This book focuses on smart materials, structures and systems, which are also referred to as intelligent, adaptive, active, sensory and metamorphic. The purpose of these materials from the perspective of smart systems is their ability to minimize life-cycle cost and/or expand the performance envelope. The ultimate goal is to develop biologically inspired multifunctional materials with the capability to adapt their structural characteristics (stiffness, damping, viscosity, etc.) as required, monitor their health condition, perform self-diagnosis and self-repair, morph their shape and undergo significant controlled motion over a wide range of operating conditions.

This book summarizes the main results achieved in a four-year European Project on nonlinear and adaptive control. The project involves leading researchers from top-notch institutions: Imperial College London (Prof A Astolfi), Lund University (Prof A Rantzer), Supelec Paris (Prof R Ortega), University of Technology of Compiegne (Prof R Lozano), Grenoble Polytechnic (Prof C Canudas de Wit), University of Twente (Prof A van der Schaft), Politecnico of Milan (Prof S Bittanti), and Polytechnic University of Valencia (Prof P Albertos).The book also provides an introduction to theoretical advances in nonlinear and adaptive control and an overview of novel applications of advanced control theory, particularly topics on the control of partially known systems, under-actuated systems, and bioreactors.

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in Scientific and technical aerospace reports (STAR) and International aerospace abstracts (IAA)

Recent advances in sensor and microcomputer technology and in control and aeroydynamics theories has made small unmanned aerial vehicles a reality. The small size, low cost and manoueverbility of these systems has positioned them to be potential solutions in a large class of applications. However, the small size of these vehicles pose significant challenges. The small sensors used on these systems are much noisier than their larger counterparts. The compact structure of these vehicles also makes them more vulnerable to environmental effects. This work develops several different control strategies for two sUAV platforms and provides the rationale for judging each of the controllers based on a derivation of the dynamics, simulation studies and experimental results where possible. First, the coaxial helicopter platform is considered. This sUAV's dual rotor system (along with its stabilizer bar technology) provides the ideal platform for safe, stable flight in a compact form factor. However, the inherent stability of the vehicle is achieved at the cost of weaker control authority and therefore an inability to achieve aggressive trajectories especially when faced with heavy wind disturbances. Three different linear control strategies are derived for this platform. PID, LQR and H[infin] methods are tested in simulation studies. While the PID method is simple and intuitive, the LQR method is better at handling the decoupling required in the system. However the frequency domain design of the H[infin] control method is better at suppressing disturbances and tracking more aggressive trajectories. The dynamics of the quadrotor are much faster than those of the coaxial helicopter. In the quadrotor, four independent fixed pitch rotors provide the required thrust. Differences between each of the rotors creates moments in the roll, pitch and yaw directions. This system greatly simplifies the mechanical complexity of the UAV, making quadrotors cheaper to maintain and more accessible. The quadrotor dynamics are derived in this work. Due to the lack of any mechanical stabilization system, these quadrotor dynamics are not inherently damped around hover. As such, the focus of the controller development is on using nonlinear techniques. Linear quadratic regulation methods are derived and shown to be inadequate when used in zones moderately outside hover. Within nonlinear methods, feedback linearization techniques are developed for the quadrotor using an inner/outer loop decoupling structure that avoids more complex variants of the feedback linearization methodology. Most nonlinear control methods (including feedback linearization) assume perfect knowledge of vehicle parameters. In this regard, simulation studies show that when this assumption is violated the results of the flight significantly deteriorate for quadrotors flying using the feedback linearization method. With this in mind, an adaptation law is devised around the nonlinear control method that actively modifies the plant parameters in an effort to drive tracking errors to zero. In simple cases with sufficiently rich trajectory requirements the parameters are able to adapt to the correct values (as verified by simulation studies). It can also adapt to changing parameters in flight to ensure that vehicle stability and controller performance is not compromised. However, the direct adaptive control method devised in this work has the added benefit of being able to modify plant parameters to suppress the effects of external disturbances as well. This is clearly shown when wind disturbances are applied to the quadrotor simulations. Finally, the nonlinear quadrotor controllers devised above are tested on a custom built quadrotor and autopilot platform. While the custom quadrotor is able to fly using the standard control methods, the specific controllers devised here are tested on a test bench that constrains the movement of the vehicle. The results of the tests show that the controller is able to sufficiently change the necessary parameter to ensure effective tracking in the presence of unmodelled disturbances and measurement error.

This book gathers high-quality papers presented at the International Symposium on Optomechatronic Technology (ISOT 2018), which was organized by the International Society for Optomechatronics (ISOM) and Centro de Investigaciones en Óptica (CIO) in Cancun, Mexico on November 5–8, 2018. The respective papers address the evolution of optomechatronic devices and systems, and their implementation in problem-solving and various other applications. Moreover, they cover a broad range of topics at the interface of optical, mechanical and electrical technologies and methods.

This edited book aims at presenting current research activities in the field of robust variable-structure systems. The scope equally comprises highlighting novel methodological aspects as well as presenting the use of variable-structure techniques in industrial applications including their efficient implementation on hardware for real-time control. The target audience primarily comprises research experts in the field of control theory and nonlinear dynamics but the book may also be beneficial for graduate students.

This proceedings volume brings together some 189 peer-reviewed papers presented at the International Conference on Information Technology and Computer Application Engineering, held 27-28 August 2013, in Hong Kong, China. Specific topics under consideration include Control, Robotics, and Automation, Information Technology, Intelligent Computing and Telecommunication, Computer Science and Engineering, Computer Education and Application and other related topics. This book provides readers a state-of-the-art survey of recent innovations and research worldwide in Information Technology and Computer Application Engineering, in so-doing furthering the development and growth of these research fields, strengthening international academic cooperation and communication, and promoting the fruitful exchange of research ideas. This volume will be of interest to professionals and academics alike, serving as a broad overview of the latest advances in the dynamic field of Information Technology and Computer Application Engineering.

Written as a result of a seven year research project using computational intelligence techniques for solving mineral processing problems at the U.S. Bureau of Mines, this book is about intelligent, adaptive process control. It brings together ideas from the field of computational intelligence , a part of the larger field of artificial intelligence, including fuzzy mathematics, genetic algorithms, and neural networks and uses these ideas to develop a generic architecture for accomplishing adaptive process control. In the development of this architecture, the requisite tools are described and then demonstrated on a number of problems. Moreover, most of the examples are of interest in industrial settings (although some simple examples are provided in the beginning so that the reader can focus on technique and not be overburdened with the complexity of the problems being solved.) The focus of Practical Applications of Computational Intelligence for Adaptive Control is on practical applications. It provides practicing engineers and scientists with the information they need to solve process control problems in industry and academia. If the reader is interested in solving difficult control problems or interested in the mechanics of basic computational intelligence techniques, then this book is an excellent place to start.

This major work is the first to treat the active control of both sound and vibration in a unified way. It outlines the fundamental concepts, explains how a reliable and stable system can be designed and implemented, and details the pitfalls . It covers sound in ducts, sound radiation, sound transmission into enclosures, structural vibration and isolation, electronic control system design, and sensors and actuators.

This is Volume III of a three volume set constituting the refereed proceedings of the Third International Symposium on Neural Networks, ISNN 2006. 616 revised papers are organized in topical sections on neurobiological analysis, theoretical analysis, neurodynamic optimization, learning algorithms, model design, kernel methods, data preprocessing, pattern classification, computer vision, image and signal processing, system modeling, robotic systems, transportation systems, communication networks, information security, fault detection, financial analysis, bioinformatics, biomedical and industrial applications, and more.

This book focuses on the applications of robust and adaptive control approaches to practical systems. The proposed control systems hold two important features: (1) The system is robust with the variation in plant parameters and disturbances (2) The system adapts to parametric uncertainties even in the unknown plant structure by self-training and self-estimating the unknown factors. The various kinds of robust adaptive controls represented in this book are composed of sliding mode control, model-reference adaptive control, gain-scheduling, H-infinity, modelpredictive control, fuzzy logic, neural networks, machine learning, and so on. The control objects are very abundant, from cranes, aircrafts, and wind turbines to automobile, medical and sport machines, combustion engines, and electrical machines.

This book at hand is an appropriate addition to the field of fractional calculus applied to control systems. If an engineer or a researcher wishes to delve into fractional-order systems, then this book has many collections of such systems to work upon, and this book also tells the reader about how one can convert an integer-order system into an appropriate fractional-order one through an efficient and simple algorithm. If the reader further wants to explore the controller design for the fractional-order systems, then for them, this book provides a variety of controller design strategies. The use of fractional-order derivatives and integrals in control theory leads to better results than integer-order approaches and hence provides solid motivation for further development of control theory. Fractional-order models are more useful than the integer-order models when accuracy is of paramount importance. Real-time experimental validation of controller design strategies for the fractional-order plants is available. This book is beneficial to the academic institutes for postgraduate and advanced research-level that need a specific textbook on fractional control and its applications in srobotic manipulators. The book is also a valuable teaching and learning resource for undergraduate and postgraduate students.

Robust and Adaptive Control shows the reader how to produce consistent and accurate controllers that operate in the presence of uncertainties and unforeseen events. Driven by aerospace applications the focus of the book is primarily on continuous-dynamical systems. The text is a three-part treatment, beginning with robust and optimal linear control methods and moving on to a self-contained presentation of the design and analysis of model reference adaptive control (MRAC) for nonlinear uncertain dynamical systems. Recent extensions and modifications to MRAC design are included, as are guidelines for combining robust optimal and MRAC controllers. Features of the text include: · case studies that demonstrate the benefits of robust and adaptive control for piloted, autonomous and experimental aerial platforms; · detailed background material for each chapter to motivate theoretical developments; · realistic examples and simulation data illustrating key features of the methods described; and · problem solutions for instructors and MATLAB® code provided electronically. The theoretical content and practical applications reported address real-life aerospace problems, being based on numerous transitions of control-theoretic results into operational systems and airborne vehicles that are drawn from the authors' extensive professional experience with The Boeing Company. The systems covered are challenging, often open-loop unstable, with uncertainties in their dynamics, and thus requiring both persistently reliable control and the ability to track commands either from a pilot or a guidance computer. Readers are assumed to have a basic understanding of root locus, Bode diagrams, and Nyquist plots, as well as linear algebra, ordinary differential equations, and the use of state-space methods in analysis and modeling of dynamical systems. Robust and Adaptive Control is intended to methodically teach senior undergraduate and graduate students how to construct stable and predictable control algorithms for realistic industrial applications. Practicing engineers and academic researchers will also find the book of great instructional value.