Gedanken vom Schlaf und den Träumen

Abstract: The objective of this dissertation is to develop control and estimation methods for electric machines based on sliding mode control theory. Major attention is paid to two types of AC machines, i.e. the induction machine (IM) and the synchronous machine, including the permanent magnet synchronous machine (PMSM). This choice may be explained by the fact that AC drives are gradually superseding DC ones for many dynamic plants in modern industrial applications. The method proposed in this dissertation for both control and observation is the so-called sliding mode approach chosen because of its robustness and ability to reduce the order of the motion models. A further advantage is that the average values of discontinuous inputs (i.e. the so-called equivalent control) in sliding modes are algebraic functions of unknown state components and parameters. These equivalent control values can be easily obtained by using low pass filters and they are useful in calculation and estimation. As real-time computation costs continually decline, both mechanical robustness and economic considerations increasingly stimulate the
replacement of mechanical sensors by software-based observation methods. These so-called sensorless systems are free of maintenance and exhibit high reliability and low cost. Elimination of encoders or resolvers on induction machine drives is a prime example. Due to the above reasons, many sensorless control schemes have been developed and described in literature. High order models of AC machines, nonlinearities in motion equations, uncertainties in model parameters and disturbances are the main obstacles hindering the development and rigorous mathematical analysis of such systems. However, their efficiency has been demonstrated by experiments and real applications. In contrast to conventional approaches, where control and observation are handled independently, the core idea of the approach proposed in this dissertation implies that they are treated as one interconnected system. This approach facilitates control system analysis and design since the speed is not an arbitrary time function any more but the solution to the known differential equations. As a result, the new structure of the observer is offered and the convergence of the observation is proven. There is one very important issue in the framework of the studies: varying of the model parameters in a wide range, in particular the rotor resistance, which may be within 30-40% because of heating. New approach is developed to identify speed, flux and rotor resistance simultaneously under the common assumption that the electromagnetic processes are faster than the mechanical ones. The developed control and estimation algorithms are tested experimentally for different types of induction machines.

Recent Trends in Sliding Mode Control

This volume presents the theory of control systems with sliding mode applied to electrical motors and power converters. It demonstrates the methodology of control design and the original algorithms of control and observation. Practically all semiconductor devices are used in power converters, that feed electrical motors, as power switches. A switching mode offers myriad attractive, inherent properties from a control viewpoint, especially a sliding mode. Sliding mode control supplies high dynamics to systems, invariability of systems to changes of their parameters and of exterior loads in combination with simplicity of design. Unlike linear control, switching sliding mode control does not replace the control system, but uses the natural properties of the control plant system effectively to ensure high control quality. This is the first text that thoroughly describes the application of the highly theoretical control design approach to synchronous drives in practice. It examines in detail the different features of various types of synchronous motors and converters with regard to sliding mode control design. It further presents a detailed analysis of control issues and mechanical coordinate observation design for various types of synchronous motors, of power converters, and various drive control structures. It also discusses the digital implementation of control, observation and identification algorithms. The potential of sliding mode control and observation are moreover demonstrated in numerical and experimental results from real control plants. This work is intended for professionals and advanced students who work in the field of electric drive control. It is also recommended to experts in control theory application, who work with sliding modes for the control of electrical motors and power converters.
Advanced Robust Nonlinear Control Approaches for Quadrotor Unmanned Aerial Vehicle

This book presents recent advanced techniques in sliding mode control and observer design for industrial power systems, focusing on their applications in polymer electrolyte membrane fuel cells and power converters. Readers will find not only valuable new fault detection and isolation techniques based on sliding mode control and observers, but also a number of robust control and estimation methodologies combined with fuzzy neural networks and extended state observer methods. The book also provides necessary experimental and simulation examples for proton exchange membrane fuel cell systems and power converter systems. Given its scope, it offers a valuable resource for undergraduate and graduate students, academics, scientists and engineers who are working in the field.

Generalized Homogeneity in Systems and Control

Currently, the modelling and control of mechatronic and robotic systems is an open and challenging field of investigation in both industry and academia. The book encompasses the kinematic and dynamic modelling, analysis, design, and control of mechatronic and robotic systems, with the scope of improving their performance, as well as simulating and testing novel devices and control architectures. A broad range of disciplines and topics are included, such as robotic manipulation, mobile systems, cable-driven robots, wearable and rehabilitation devices, variable stiffness safety-oriented mechanisms, optimization of robot performance, and energy-saving systems.

Advances in Sliding Mode Control

This book extrapolates many of the concepts that are well defined for discrete-time deterministic sliding-mode control for use with discrete-time stochastic systems. It details sliding-function designs for various categories of linear time-invariant systems and its application for control. The resulting sliding-mode control addresses robustness issues and the functional-observer approach reduces the observer order substantially. Sliding-mode control (SMC) is designed for discrete-time stochastic systems, extended so that states lie within a specified band, and able to deal with incomplete information. Functional-observer-based SMC is designed for various clauses of stochastic systems: discrete-time; discrete-time with delay; state time-delayed; and those with parametric uncertainty. Stability considerations arising because of parametric uncertainty are taken into account and, where necessary, the effects of unmatched uncertainties mitigated. A simulation example is used to explain the use of the functional-observer approach to SMC design. Discrete-Time Stochastic Sliding-Mode Control Using Functional Observation will interest all researchers working in sliding-mode control and will be of particular assistance to graduate students in understanding the changes in design philosophy that arise when changing from continuous- to discrete-time systems. It helps to pave the way for further progress in applications of discrete-time SMC.
Advanced and Optimization Based Sliding Mode Control: Theory and Applications

The main objective of this monograph is to present a broad range of well worked out, recent application studies as well as theoretical contributions in the field of sliding mode control system analysis and design. The contributions presented here include new theoretical developments as well as successful applications of variable structure controllers primarily in the field of power electronics, electric drives and motion steering systems. They enrich the current state of the art, and motivate and encourage new ideas and solutions in the sliding mode control area.

Applications of Sliding Mode Control

The sliding mode control methodology has proven effective in dealing with complex dynamical systems affected by disturbances, uncertainties and unmodeled dynamics. Robust control technology based on this methodology has been applied to many real-world problems, especially in the areas of aerospace control, electric power systems, electromechanical systems, and robotics. Sliding Mode Control and Observation represents the first textbook that starts with classical sliding mode control techniques and progresses toward newly developed higher-order sliding mode control and observation algorithms and their applications. The present volume addresses a range of sliding mode control issues, including: *Conventional sliding mode controller and observer design *Second-order sliding mode controllers and differentiators *Frequency domain analysis of conventional and second-order sliding mode controllers *Higher-order sliding mode controllers and differentiators *Higher-order sliding mode observers *Sliding mode disturbance observer based control *Numerous applications, including reusable launch vehicle and satellite formation control, blood glucose regulation, and car steering control are used as case studies Sliding Mode Control and Observation is aimed at graduate students with a basic knowledge of classical control theory and some knowledge of state-space methods and nonlinear systems, while being of interest to a wider audience of graduate students in electrical/mechanical/aerospace engineering and applied mathematics, as well as researchers in electrical, computer, chemical, civil, mechanical, aeronautical, and industrial engineering, applied mathematicians, control engineers, and physicists. Sliding Mode Control and Observation provides the necessary tools for graduate students, researchers and engineers to robustly control complex and uncertain nonlinear dynamical systems. Exercises provided at the end of each chapter make this an ideal text for an advanced course taught in control theory.

Control and Observation of Electric Machines by Sliding Modes

This monograph presents a novel method of sliding mode control for switch-regulated nonlinear systems. The Delta Sigma modulation approach allows one to implement a continuous control scheme using one or multiple, independent switches, thus effectively merging the available linear and nonlinear controller design techniques with sliding mode control. Sliding Mode Control: The Delta-Sigma Modulation Approach, combines rigorous mathematical derivation of the unique features of Sliding Mode Control
and Delta-Sigma modulation with numerous illustrative examples from diverse areas of engineering. In addition, engineering case studies demonstrate the applicability of the technique and the ease with which one can implement the exposed results. This book will appeal to researchers in control engineering and can be used as graduate-level textbook for a first course on sliding mode control.

**Sliding Mode Control and Observation**

This two-volume set of LNCS 11643 and LNCS 11644 constitutes - in conjunction with the volume LNAI 11645 - the refereed proceedings of the 15th International Conference on Intelligent Computing, ICIC 2019, held in Nanchang, China, in August 2019. The 217 full papers of the three proceedings volumes were carefully reviewed and selected from 609 submissions. The ICIC theme unifies the picture of contemporary intelligent computing techniques as an integral concept that highlights the trends in advanced computational intelligence and bridges theoretical research with applications. The theme for this conference is “Advanced Intelligent Computing Methodologies and Applications.” Papers related to this theme are especially solicited, including theories, methodologies, and applications in science and technology.

**Advances and Applications in Sliding Mode Control systems**

Force and Position Control of Mechatronic Systems provides an overview of the general concepts and technologies in the area of force and position control. Novel ideas and innovations related to this area are presented and reported in detail, and examples of applications in medical technology are given. The book begins by introducing force sensing, and modelling of contacting objects. In then moves steadily through a variety of topics, including: • disturbance observer-based force estimation; • force-based supervisory control; • stabilization systems; • controller design; and • control of tube insertion procedures. This book will be of interest to researchers, engineers and students interested in force control, particularly those with a focus on medical applications of these ideas. Advances in Industrial Control reports and encourages the transfer of technology in control engineering. The rapid development of control technology has an impact on all areas of the control discipline. The series offers an opportunity for researchers to present an extended exposition of new work in all aspects of industrial control.

**Modern Sliding Mode Control Theory**

This book is a collection of high-quality research articles. The book includes topics specific to the emerging areas of control for robotic systems, wireless communication, and development of embedded systems for robotic applications. The book integrates three important aspects of automation, namely (i) communication, (ii) control, and (iii) embedded design for robotic applications. This book is unique as it provides a unified framework for analysis, design, and deployment of the robotic applications across
various engineering and non-engineering disciplines including the three primary aspects mentioned above. Furthermore, the emerging research and development work pertaining to the deployment of intelligent, nonlinear, and embedded control for robotic system for non-standard operating environment due to the widespread application of robotics technology for societal benefit is also a focal point of the book.

**Sliding Mode Observation and Control for Semiactive Vehicle Suspensions**

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.

**Intelligent Computing Theories and Application**

This book proposes a proportional integral type sliding function, which does not facilitate the finite reaching and hence the responses of the load voltage results in an exponential steady state. To facilitate finite time reaching, it also presents the new Integral Sliding Mode Control with Finite Time Reaching (ISMCFTR). The book also extends the application of the proposed controller to another type of PEC, the DC-DC Boost converter, and also proposes the PI type sliding surface for the Zeta converter, which is non-inverting type Buck Boost converter. An important source of practical implementations, it presents practical implementations as simulation and experimental results to demonstrate the efficacy of the converter.

**Event-Triggered Sliding Mode Control**

This concise book covers modern sliding mode control theory. The authors identify key contributions defining the theoretical and applicative state-of-the-art of the sliding mode control theory and the most promising trends of the ongoing research activities.

**Emerging Technologies in Computing**
The sliding mode control paradigm has become a mature technique for the design of robust controllers for a wide class of systems including nonlinear, uncertain and time-delayed systems. This book is a collection of plenary and invited talks delivered at the 12th IEEE International Workshop on Variable Structure System held at the Indian Institute of Technology, Mumbai, India in January 2012. After the workshop, these researchers were invited to develop book chapters for this edited collection in order to reflect the latest results and open research questions in the area. The contributed chapters have been organized by the editors to reflect the various themes of sliding mode control which are the current areas of theoretical research and applications focus; namely articulation of the fundamental underpinning theory of the sliding mode design paradigm, sliding modes for decentralized system representations, control of time-delay systems, the higher order sliding mode concept, results applicable to nonlinear and underactuated systems, sliding mode observers, discrete sliding mode control together with cutting edge research contributions in the application of the sliding mode concept to real world problems. This book provides the reader with a clear and complete picture of the current trends in Variable Structure Systems and Sliding Mode Control Theory.

**Intelligent Computing Methodologies**

This book compiles recent developments on sliding mode control theory and its applications. Each chapter presented in the book proposes new dimension in the sliding mode control theory such as higher order sliding mode control, event triggered sliding mode control, networked control, higher order discrete-time sliding mode control and sliding mode control for multi-agent systems. Special emphasis has been given to practical solutions to design involving new types of sliding mode control. This book is a reference guide for graduate students and researchers working in the domain for designing sliding mode controllers. The book is also useful to professional engineers working in the field to design robust controllers for various applications.

**Control of Marine Vehicles**

**Sliding Mode Control for Synchronous Electric Drives**

This book constitutes the refereed conference proceedings of the Third International Conference on Emerging Technologies in Computing, iCEtiC 2020, held in London, UK, in August 2020. Due to COVID-19 pandemic the conference was held virtually. The 25 revised full papers were reviewed and selected from 65 submissions and are organized in topical sections covering blockchain and cloud computing; security, wireless sensor networks and IoT; AI, big data and data analytics; emerging technologies in engineering, education and sustainable development.

**Force and Position Control of Mechatronic Systems**
Sliding Mode Control for Synchronous Electric Drives

This thesis investigates the application of robust, nonlinear observation and control strategies, namely sliding mode observation and control (SMOC), to semiactive vehicle suspensions using a model reference approach. The vehicle suspension models include realistic nonlinearities in the spring and magnetorheological (MR) damper elements, and the nonlinear reference models incorporateskyhook damping. Since full state measurement is difficult to achieve in practice, a sliding mode observer (SMO) that requires only suspension deflection as a measured input is developed. The performance and robustness of sliding mode control (SMC), SMO, and SMOC is demonstrated through comprehensive computer simulations and compared to popular alternatives. The results of these simulations reveal the benefits of sliding mode observation and control for improved ride quality, and should be directly transferable to commercial semiactive vehicle suspension implementations.

Sliding Mode Control

This monograph introduces the theory of generalized homogeneous systems governed by differential equations in both Euclidean (finite-dimensional) and Banach/Hilbert (infinite-dimensional) spaces. It develops methods of stability and robustness analysis, control design, state estimation and discretization of homogeneous control systems. Generalized Homogeneity in Systems and Control is structured in two parts. Part I discusses various models of control systems and related tools for their analysis, including Lyapunov functions. Part II deals with the analysis and design of homogeneous control systems. Some of the key features of the text include: mathematical models of dynamical systems in finite-dimensional and infinite-dimensional spaces; the theory of linear dilations in Banach spaces; homogeneous control and estimation; simple methods for an "upgrade" of existing linear control laws; numerical schemes for a consistent digital implementation of homogeneous algorithms; and experiments confirming an improvement of PID controllers. The advanced mathematical material will be of interest to researchers, mathematicians working in control theory and mathematically oriented control engineers.

Emerging Trends in Sliding Mode Control

This book describes the advances and applications in Sliding mode control (SMC) which is widely used as a powerful method to tackle uncertain nonlinear systems. The book is organized into 21 chapters which have been organised by the editors to reflect the various themes of sliding mode control. The book provides the reader with a broad range of material from first principles up to the current state of the art in the area of SMC and observation presented in a clear, matter-of-fact style. As such it is appropriate for graduate students with a basic knowledge of classical control theory and some knowledge of state-space methods and nonlinear systems. The resulting design procedures are emphasized using Matlab/Simulink software.
Communication and Control for Robotic Systems

Control of Power Electronic Converters and Systems, Volume 3, explores emerging topics in the control of power electronics and converters, including the theory behind control, and the practical operation, modeling, and control of basic power system models. This book introduces the most important controller design methods, including both analog and digital procedures. This reference explains the dynamic characterization of terminal behavior for converters, as well as preserving the stability and power quality of modern power systems. Useful for engineers in emerging applications of power electronic converters and those combining control design methods into different applications in power electronics technology. Addressing controller interactions - in light of increasing renewable energy integration and related challenges with stability and power quality - is becoming more frequent in power converters and passive components. Discusses different applications and their control in integrated renewable energy systems Introduces the most important controller design methods, both in analog and digital Describes different important applications to be used in future industrial products Explains the dynamic characterization of terminal behavior for converters

Sliding Modes in Control and Optimization

This book reflects the latest developments in variable structure systems (VSS) and sliding mode control (SMC), highlighting advances in various branches of the VSS/SMC field, e.g., from conventional SMC to high-order SMC, from the continuous-time domain to the discrete-time domain, from theories to applications, etc. The book consists of three parts and 16 chapters: in the first part, new VSS/SMC algorithms are proposed and their properties are analyzed, while the second focuses on the use of VSS/SMC techniques to solve a variety of control problems; the third part examines the applications of VSS/SMC to real-time systems. The book introduces postgraduates and researchers to the state-of-the-art in VSS/SMC field, including the theory, methodology, and applications. Relative academic disciplines include Automation, Mathematics, Electrical Engineering, Mechanical Engineering, Instrument Science and Engineering, Electronic Engineering, Computer Science and Technology, Transportation Engineering, Energy and Power Engineering, etc.

Advanced, Contemporary Control

This volume presents the theory of control systems with sliding mode applied to electrical motors and power converters. It demonstrates the methodology of control design and the original algorithms of control and observation. Practically all semiconductor devices are used in power converters, that feed electrical motors, as power switches. A switch

Robust Output LQ Optimal Control via Integral Sliding Modes
This book presents essential studies and applications in the context of sliding mode control, highlighting the latest findings from interdisciplinary theoretical studies, ranging from computational algorithm development to representative applications. Readers will learn how to easily tailor the techniques to accommodate their ad hoc applications. To make the content as accessible as possible, the book employs a clear route in each paper, moving from background to motivation, to quantitative development (equations), and lastly to case studies/illustrations/tutorials (simulations, experiences, curves, tables, etc.). Though primarily intended for graduate students, professors and researchers from related fields, the book will also benefit engineers and scientists from industry.

Applications of Sliding Mode Control in Science and Engineering

This book extrapolates many of the concepts that are well defined for discrete-time deterministic sliding-mode control for use with discrete-time stochastic systems. It details sliding-function designs for various categories of linear time-invariant systems and its application for control. The resulting sliding-mode control addresses robustness issues and the functional-observer approach reduces the observer order substantially. Sliding-mode control (SMC) is designed for discrete-time stochastic systems, extended so that states lie within a specified band, and able to deal with incomplete information. Functional-observer-based SMC is designed for various clauses of stochastic systems: discrete-time; discrete-time with delay; state time-delayed; and those with parametric uncertainty. Stability considerations arising because of parametric uncertainty are taken into account and, where necessary, the effects of unmatched uncertainties mitigated. A simulation example is used to explain the use of the functional-observer approach to SMC design. Discrete-Time Stochastic Sliding-Mode Control Using Functional Observation will interest all researchers working in sliding-mode control and will be of particular assistance to graduate students in understanding the changes in design philosophy that arise when changing from continuous- to discrete-time systems. It helps to pave the way for further progress in applications of discrete-time SMC.

Sliding Mode Control

Advanced Control Systems: Theory and Applications provides an overview of advanced research lines in control systems as well as in design, development and implementation methodologies for perspective control systems and their components in different areas of industrial and special applications. It consists of extended versions of the selected papers presented at the XXV International Conference on Automatic Control “Automatics 2018” (September 18-19, 2018, Lviv, Ukraine) which is the main Ukrainian Control Conference organized by Ukrainian Association on Automatic Control (National member organization of IFAC) and Lviv National University “Lvivska Politechnica.” More than 100 papers were presented at the conference with topics including: mathematical problems of control, optimization and game theory; control and identification under uncertainty; automated control of technical, technological and biotechnical objects; controlling the aerospace craft, marine vessels and other moving objects;
intelligent control and information processing; mechatronics and robotics; information measuring technologies in automation; automation and IT training of personnel; the Internet of things and the latest technologies. The book is divided into two main parts, the first concerning theory (7 chapters) and the second concerning applications (7 chapters) of advanced control systems. The first part “Advances in Theoretical Research on Automatic Control” consists of theoretical research results which deal with descriptor control impulsive delay systems, motion control in condition of conflict, inverse dynamic models, invariant relations in optimal control, robust adaptive control, bio-inspired algorithms, optimization of fuzzy control systems, and extremal routing problem with constraints and complicated cost functions. The second part “Advances in Control Systems Applications” is based on the chapters which consider different aspects of practical implementation of advanced control systems, in particular, special cases in determining the spacecraft position and attitude using computer vision system, the spacecraft orientation by information from a system of stellar sensors, control synthesis of rotational and spatial spacecraft motion at approaching stage of docking, intelligent algorithms for the automation of complex biotechnical objects, an automatic control system for the slow pyrolysis of organic substances with variable composition, simulation complex of hierarchical systems based on the foresight and cognitive modelling, and advanced identification of impulse processes in cognitive maps. The chapters have been structured to provide an easy-to-follow introduction to the topics that are addressed, including the most relevant references, so that anyone interested in this field can get started in the area. This book may be useful for researchers and students who are interested in advanced control systems.

Modelling and Control of Mechatronic and Robotic Systems

This two-volume set of LNCS 12836 and LNCS 12837 constitutes - in conjunction with the volume LNAI 12838 - the refereed proceedings of the 17th International Conference on Intelligent Computing, ICIC 2021, held in Shenzhen, China in August 2021. The 192 full papers of the three proceedings volumes were carefully reviewed and selected from 458 submissions. The ICIC theme unifies the picture of contemporary intelligent computing techniques as an integral concept that highlights the trends in advanced computational intelligence and bridges theoretical research with applications. The theme for this conference is “Advanced Intelligent Computing Methodologies and Applications.” The papers are organized in the following subsections: Intelligent Computing in Computer Vision, Intelligent Control and Automation, Intelligent Modeling Technologies for Smart Cities, Machine Learning, and Theoretical Computational Intelligence and Applications.

Control of Power Electronic Converters and Systems

Sliding-mode Control of PEM Fuel Cells demonstrates the application of higher-order sliding-mode control to PEMFC dynamics showing the advantages of sliding modes. The book introduces the theory of fuel cells and sliding-mode control. It contextualises PEMFCs both in terms of their development and within the hydrogen economy and today’s energy production situation as a whole. It then discusses fuel-cell operation principles, the mathematical background of high-order sliding-mode control and to a feasibility
study for the use of sliding modes in the control of an automotive fuel stack. Part II presents experimental results of sliding-mode-control application to laboratory fuel cells and deals with subsystem-based modelling, detailed design, and observability and controllability. Simulation results are contrasted with empirical data and performance, robustness and implementation issues are treated in depth. Possibilities for future research are also laid out.

**Sliding-Mode Control of PEM Fuel Cells**

This two-volume set (CCIS 915 and CCIS 916) constitutes the refereed proceedings of the 5th Workshop on Engineering Applications, WEA 2018, held in Medellin, Colombia, in October 2018. The 41 revised full papers presented in this volume were carefully reviewed and selected from 101 submissions. The papers are organized in topical sections such as green logistics and optimization, Internet of Things (IoT), digital signal processing (DSP), network applications, miscellaneous applications.

**Sliding Mode Control Methodology in the Applications of Industrial Power Systems**

This textbook offers a comprehensive introduction to the control of marine vehicles, from fundamental to advanced concepts, including robust control techniques for handling model uncertainty, environmental disturbances, and actuator limitations. Starting with an introductory chapter that extensively reviews automatic control and dynamic modeling techniques for ocean vehicles, the first part of the book presents in-depth information on the analysis and control of linear time invariant systems. The concepts discussed are developed progressively, providing a basis for understanding more complex techniques and stimulating readers’ intuition. In addition, selected examples illustrating the main concepts, the corresponding MATLAB® code, and problems are included in each chapter. In turn, the second part of the book offers comprehensive coverage on the stability and control of nonlinear systems. Following the same intuitive approach, it guides readers from the fundamentals to more advanced techniques, which culminate in integrator backstepping, adaptive and sliding mode control. Leveraging the author's considerable teaching and research experience, the book offers a good balance of theory and stimulating questions. Not only does it provide a valuable resource for undergraduate and graduate students; it will also benefit practitioners who want to review the foundational concepts underpinning some of the latest advanced marine vehicle control techniques, for use in their own applications.

**Discrete-Time Stochastic Sliding Mode Control Using Functional Observation**

This edited monograph provides a comprehensive and in-depth analysis of sliding mode control, focusing on event-triggered implementation. The technique allows to prefix the steady-state bounds of the system, and this is independent of any boundary disturbances. The idea of event-triggered SMC is developed for both single input / single output and multi-input / multi-output linear systems. Moreover, the reader learns how to apply this method to nonlinear systems. The book primarily addresses research
experts in the field of sliding mode control, but the book may also be beneficial for graduate students.

**Advances in Spacecraft Attitude Control**

*This book describes recent advances in the theory, properties, methods and applications of SMC, including a discussion about the advantages and disadvantages of different SMC algorithms.*

**Advances in Variable Structure Systems and Sliding Mode Control—Theory and Applications**

*This book presents the proceedings of the 20th Polish Control Conference. A triennial event that was first held in 1958, the conference successfully combines its long tradition with a modern approach to shed light on problems in control engineering, automation, robotics and a wide range of applications in these disciplines. The book presents new theoretical results concerning the steering of dynamical systems, as well as industrial case studies and worked solutions to real-world problems in contemporary engineering. It particularly focuses on the modelling, identification, analysis and design of automation systems; however, it also addresses the evaluation of their performance, efficiency and reliability. Other topics include fault-tolerant control in robotics, automated manufacturing, mechatronics and industrial systems. Moreover, it discusses data processing and transfer issues, covering a variety of methodologies, including model predictive, robust and adaptive techniques, as well as algebraic and geometric methods, and fractional order calculus approaches. The book also examines essential application areas, such as transportation and autonomous intelligent vehicle systems, robotic arms, mobile manipulators, cyber-physical systems, electric drives and both surface and underwater marine vessels. Lastly, it explores biological and medical applications of the control-theory-inspired methods.*

**Discrete-Time Stochastic Sliding Mode Control Using Functional Observation**

*Gathering 20 chapters contributed by respected experts, this book reports on the latest advances in and applications of sliding mode control in science and engineering. The respective chapters address applications of sliding mode control in the broad areas of chaos theory, robotics, electrical engineering, physics, chemical engineering, memristors, mechanical engineering, environmental engineering, finance, and biology. Special emphasis has been given to papers that offer practical solutions, and which examine design and modeling involving new types of sliding mode control such as higher order sliding mode control, terminal sliding mode control, super-twisting sliding mode control, and integral sliding mode control. This book serves as a unique reference guide to sliding mode control and its recent applications for graduate students and researchers with a basic knowledge of electrical and control systems engineering.*
Fault Tolerant Control Schemes Using Integral Sliding Modes

The book is devoted to systems with discontinuous control. The study of discontinuous dynamic systems is a multifacet problem which embraces mathematical, control theoretic and application aspects. Times and again, this problem has been approached by mathematicians, physicists and engineers, each profession treating it from its own positions. Interestingly, the results obtained by specialists in different disciplines have almost always had a significant effect upon the development of the control theory. It suffices to mention works on the theory of oscillations of discontinuous nonlinear systems, mathematical studies in ordinary differential equations with discontinuous righthand parts or variational problems in nonclassic statements. The unremitting interest to discontinuous control systems enhanced by their effective application to solution of problems most diverse in their physical nature and functional purpose is, in the author’s opinion, a cogent argument in favour of the importance of this area of studies. It seems a useful effort to consider, from a control theoretic viewpoint, the mathematical and application aspects of the theory of discontinuous dynamic systems and determine their place within the scope of the present-day control theory. The first attempt was made by the author in 1975-1976 in his course on "The Theory of Discontinuous Dynamic Systems" and "The Theory of Variable Structure Systems" read to post-graduates at the University of Illinois, USA, and then presented in 1978-1979 at the seminars held in the Laboratory of Systems with Discontinuous Control at the Institute of Control Sciences in Moscow.

Applied Computer Sciences in Engineering

A compendium of the authors’ recently published results, this book discusses sliding mode control of uncertain nonlinear systems, with a particular emphasis on advanced and optimization based algorithms. The authors survey classical sliding mode control theory and introduce four new methods of advanced sliding mode control. They analyze classical theory and advanced algorithms, with numerical results complementing the theoretical treatment. Case studies examine applications of the algorithms to complex robotics and power grid problems. Advanced and Optimization Based Sliding Mode Control: Theory and Applications is the first book to systematize the theory of optimization based higher order sliding mode control and illustrate advanced algorithms and their applications to real problems. It presents systematic treatment of event-triggered and model based event-triggered sliding mode control schemes, including schemes in combination with model predictive control, and presents adaptive algorithms as well as algorithms capable of dealing with state and input constraints. Additionally, the book includes simulations and experimental results obtained by applying the presented control strategies to real complex systems. This book is suitable for students and researchers interested in control theory. It will also be attractive to practitioners interested in implementing the illustrated strategies. It is accessible to anyone with a basic knowledge of control engineering, process physics, and applied mathematics.

Sliding Mode Controllers for Power Electronic Converters
Spacecraft attitude maneuvers comply with Euler’s moment equations, a set of three nonlinear, coupled differential equations. Nonlinearities complicate the mathematical treatment of the seemingly simple action of rotating, and these complications lead to a robust lineage of research. This book is meant for basic scientifically inclined readers, and commences with a chapter on the basics of spaceflight and leverages this remediation to reveal very advanced topics to new spaceflight enthusiasts. The topics learned from reading this text will prepare students and faculties to investigate interesting spaceflight problems in an era where cube satellites have made such investigations attainable by even small universities. It is the fondest hope of the editor and authors that readers enjoy this book.

Advanced Control Systems - Theory and Applications

Featuring original research from well-known experts in the field of sliding mode control, this book presents new design schemes for a useful and practical optimal control with very few impractical assumptions. The results presented allow optimal control theory to grow in its applicability to real-world systems. On the cutting-edge of optimal control research, this book is an excellent resource for both graduate students and researchers in engineering, mathematics, and optimal control.

Copyright code: c40137a8b6c4abd531e07a98917138a6