

Stabilization And Control Of Fractional Order Systems A Sliding Mode Approach Lecture Notes In Electrical Engineering

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*Proceedings of 2019 Chinese
Intelligent Automation
Conference - Zhidong Deng*

2019-09-07
The proceedings present
selected research papers from

the CIAC2019, held in Jiangsu, China on September 20-22, 2019. It covers a wide range of topics including intelligent control, robotics, artificial intelligence, pattern recognition, unmanned systems, IoT and machine learning. It includes original research and the latest advances in the field of intelligent automation.

Engineers and researchers from academia, industry, and government can gain valuable insights into solutions combining ideas from multiple disciplines in this field.

Advanced Synchronization Control and Bifurcation of Chaotic Fractional-Order Systems - Boulkroune, Abdesselem 2018-05-11

In the recent years, fractional-order systems have been studied by many researchers in the engineering field. It was found that many systems can be described more accurately by fractional differential equations than by integer-order models. **Advanced Synchronization Control and Bifurcation of Chaotic**

Fractional-Order Systems is a scholarly publication that explores new developments related to novel chaotic fractional-order systems, control schemes, and their applications. Featuring coverage on a wide range of topics including chaos synchronization, nonlinear control, and cryptography, this publication is geared toward engineers, IT professionals, researchers, and upper-level graduate students seeking current research on chaotic fractional-order systems and their applications in engineering and computer science.

Trends in Advanced Intelligent Control, Optimization and Automation - Wojciech Mitkowski 2017-06-06

This volume contains the proceedings of the KKA 2017 – the 19th Polish Control Conference, organized by the Department of Automatics and Biomedical Engineering, AGH University of Science and Technology in Kraków, Poland on June 18–21, 2017, under the

auspices of the Committee on Automatic Control and Robotics of the Polish Academy of Sciences, and the Commission for Engineering Sciences of the Polish Academy of Arts and Sciences. Part 1 deals with general issues of modeling and control, notably flow modeling and control, sliding mode, predictive, dual, etc. control. In turn, Part 2 focuses on optimization, estimation and prediction for control. Part 3 is concerned with autonomous vehicles, while Part 4 addresses applications. Part 5 discusses computer methods in control, and Part 6 examines fractional order calculus in the modeling and control of dynamic systems. Part 7 focuses on modern robotics. Part 8 deals with modeling and identification, while Part 9 deals with problems related to security, fault detection and diagnostics. Part 10 explores intelligent systems in automatic control, and Part 11 discusses the use of control tools and techniques in biomedical engineering. Lastly,

Part 12 considers engineering education and teaching with regard to automatic control and robotics.

Fuzzy Information and Engineering and Decision -

Bing-Yuan Cao 2017-09-15

This book introduces applications of mathematics and fuzzy mathematics in decision science, fuzzy geometric programming and fuzzy optimization as well as operations research and management, based on 44 research papers presented at three successful conferences: (1) The International Conference on Mathematics and Decision Science (ICMDS), September 12–15, 2016, Guangzhou University, Guangzhou, China (www.icodm2020.com). (2) Academic Conference on 30th Anniversary of Fuzzy Geometric Programming Advanced by Professor Cao Bingyuan and his 40 education years (ACFGPACE), July 30 to August 1, 2016, Guangzhou University, Guangzhou, China. (3) The third annual meeting of Guangdong Operational

Research Society (TAMGORS), October 22–23, 2016, Foshan University, Guangdong, China. The book is a valuable resource for students, graduates, teachers and other professionals in the field of applied mathematics, artificial intelligence and computers, fuzzy systems and decision-making, as well as operations research and management.

Stabilization and Control of Fractional Order Systems: A Sliding Mode Approach -

Bijnan Bandyopadhyay

2014-07-22

In the last two decades fractional differential equations have been used more frequently in physics, signal processing, fluid mechanics, viscoelasticity, mathematical biology, electro chemistry and many others. It opens a new and more realistic way to capture memory dependent phenomena and irregularities inside the systems by using more sophisticated mathematical analysis. This monograph is based on the authors' work on stabilization and control design for

continuous and discrete fractional order systems. The initial two chapters and some parts of the third chapter are written in tutorial fashion, presenting all the basic concepts of fractional order system and a brief overview of sliding mode control of fractional order systems. The other parts contain deal with robust finite time stability of fractional order systems, integral sliding mode control of fractional order systems, cooperative control of multi-agent systems modeled as fractional differential equation, robust stabilization of discrete fractional order systems, high performance control using soft variable structure control and contraction analysis by integer and fractional order infinitesimal variations.

Fractional-order Systems and Controls - Concepción A. Monje
2010-09-28

Fractional-order Systems and Controls details the use of fractional calculus in the description and modeling of systems, and in a range of control design and practical

applications. It is largely self-contained, covering the fundamentals of fractional calculus together with some analytical and numerical techniques and providing MATLAB® codes for the simulation of fractional-order control (FOC) systems. Many different FOC schemes are presented for control and dynamic systems problems. Practical material relating to a wide variety of applications is also provided. All the control schemes and applications are presented in the monograph with either system simulation results or real experimental results, or both. Fractional-order Systems and Controls provides readers with a basic understanding of FOC concepts and methods, so they can extend their use of FOC in other industrial system applications, thereby expanding their range of disciplines by exploiting this versatile new set of control techniques.

New Trends in Nanotechnology and Fractional Calculus Applications - Dumitru Baleanu

2010-03-14

In recent years fractional calculus has played an important role in various fields such as mechanics, electricity, chemistry, biology, economics, modeling, identification, control theory and signal processing. The scope of this book is to present the state of the art in the study of fractional systems and the application of fractional differentiation. Furthermore, the manufacture of nanowires is important for the design of nanosensors and the development of high-yield thin films is vital in procuring clean solar energy. This wide range of applications is of interest to engineers, physicists and mathematicians.

Theory and Applications of Non-integer Order Systems -

Artur Babiarz 2016-09-15

This book collects papers from the 8th Conference on Non-Integer Order Calculus and Its Applications that have been held on September 20-21, 2016 in Zakopane, Poland. The preceding two conferences were held in Szczecin, Poland

in 2015, and in Opole, Poland, in 2014. This conference provides a platform for academic exchange on the theory and application of fractional calculus between domestic and international universities, research institutes, corporate experts and scholars. The Proceedings of the 8th Conference on Non-Integer Order Calculus and Its Applications 2016 brings together rigorously reviewed contributions from leading international experts. The included papers cover novel various important aspects of mathematical foundations of fractional calculus, modeling and control of fractional systems as well as controllability, detectability, observability and stability problems for this systems.

Proceedings of the 2015 Chinese Intelligent Systems Conference - Yingmin Jia
2015-11-21

This book presents selected research papers from the 2015 Chinese Intelligent Systems Conference (CISC'15), held in Yangzhou, China. The topics

covered include multi-agent systems, evolutionary computation, artificial intelligence, complex systems, computation intelligence and soft computing, intelligent control, advanced control technology, robotics and applications, intelligent information processing, iterative learning control, and machine learning. Engineers and researchers from academia, industry and the government can gain valuable insights into solutions combining ideas from multiple disciplines in the field of intelligent systems.

Robust Adaptive Control for Fractional-Order Systems with Disturbance and Saturation - Mou Chen
2017-12-26

A treatise on investigating tracking control and synchronization control of fractional-order nonlinear systems with system uncertainties, external disturbance, and input saturation Robust Adaptive Control for Fractional-Order Systems, with Disturbance and

Saturation provides the reader with a good understanding on how to achieve tracking control and synchronization control of fractional-order nonlinear systems with system uncertainties, external disturbance, and input saturation. Although some texts have touched upon control of fractional-order systems, the issues of input saturation and disturbances have rarely been considered together. This book offers chapter coverage of fractional calculus and fractional-order systems; fractional-order PID controller and fractional-order disturbance observer; design of fractional-order controllers for nonlinear chaotic systems and some applications; sliding mode control for fractional-order nonlinear systems based on disturbance observer; disturbance observer based neural control for an uncertain fractional-order rotational mechanical system; adaptive neural tracking control for uncertain fractional-order chaotic systems subject to input saturation and

disturbance; stabilization control of continuous-time fractional positive systems based on disturbance observer; sliding mode synchronization control for fractional-order chaotic systems with disturbance; and more. Based on the approximation ability of the neural network (NN), the adaptive neural control schemes are reported for uncertain fractional-order nonlinear systems. Covers the disturbance estimation techniques that have been developed to alleviate the restriction faced by traditional feedforward control and reject the effect of external disturbances for uncertain fractional-order nonlinear systems. By combining the NN with the disturbance observer, the disturbance observer based adaptive neural control schemes have been studied for uncertain fractional-order nonlinear systems with unknown disturbances. Considers, together, the issue of input saturation and the disturbance for the control of fractional-order nonlinear

systems in the presence of system uncertainty, external disturbance, and input saturation. Robust Adaptive Control for Fractional-Order Systems, with Disturbance and Saturation can be used as a reference for the academic research on fractional-order nonlinear systems or used in Ph.D. study of control theory and engineering.

Application of Intelligent Control Algorithms to Study the Dynamics of Hybrid Power System - Dipayan Guha

2022-05-03

This book aims to systematically review and design different intelligent control algorithms for the small-signal stability assessment of HPS. With the growing consciousness of global warming and the fast depletion of natural power generation resources, the existing power system is on the verge of transitions to a “hybrid power system (HPS)” integrated with distributed energy resources. The recent results and requirements for the developments of intelligent

control algorithms have motivated the authors to introduce this book for extensively analyzing the performance of HPS against unknown/uncertain disturbances. This book introduces fractional-order resilient control methodologies for arresting small-signal instability of HPS. The prospective investigation has been performed on the MATLAB platform. This book is helpful for undergraduate, postgraduate students, and research scholars working in power system stability, control applications, and soft computing in particular.

Fractional-order Modeling and Control of Dynamic Systems - Aleksei Tepljakov

2017-02-08

This book reports on an outstanding research devoted to modeling and control of dynamic systems using fractional-order calculus. It describes the development of model-based control design methods for systems described by fractional dynamic models. More than 300 years had

passed since Newton and Leibniz developed a set of mathematical tools we now know as calculus. Ever since then the idea of non-integer derivatives and integrals, universally referred to as fractional calculus, has been of interest to many researchers. However, due to various issues, the usage of fractional-order models in real-life applications was limited. Advances in modern computer science made it possible to apply efficient numerical methods to the computation of fractional derivatives and integrals. This book describes novel methods developed by the author for fractional modeling and control, together with their successful application in real-world process control scenarios.

Computational Intelligence: Theories, Applications and Future Directions - Volume I

- Nishchal K. Verma

2018-07-31

This book presents selected proceedings of ICCI-2017, discussing theories, applications and future

directions in the field of computational intelligence (CI). ICCI-2017 brought together international researchers presenting innovative work on self-adaptive systems and methods. This volume covers the current state of the field and explores new, open research directions. The book serves as a guide for readers working to develop and validate real-time problems and related applications using computational intelligence. It focuses on systems that deal with raw data intelligently, generate qualitative information that improves decision-making, and behave as smart systems, making it a valuable resource for researchers and professionals alike.

Stabilization and Control of Fractional Order Systems: A Sliding Mode Approach -

Bandyopadhyay Bijan

2016-09-17

In the last two decades fractional differential equations have been used more frequently in physics, signal processing, fluid mechanics,

viscoelasticity, mathematical biology, electro chemistry and many others. It opens a new and more realistic way to capture memory dependent phenomena and irregularities inside the systems by using more sophisticated mathematical analysis. This monograph is based on the authors' work on stabilization and control design for continuous and discrete fractional order systems. The initial two chapters and some parts of the third chapter are written in tutorial fashion, presenting all the basic concepts of fractional order system and a brief overview of sliding mode control of fractional order systems. The other parts contain deal with robust finite time stability of fractional order systems, integral sliding mode control of fractional order systems, co-operative control of multi-agent systems modeled as fractional differential equation, robust stabilization of discrete fractional order systems, high performance control using soft variable structure control and

contraction analysis by integer and fractional order infinitesimal variations.

Fractional Modeling and Controller Design of Robotic Manipulators - Abhaya Pal Singh 2020-10-15

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 robotic manipulators. The book is also a valuable teaching and learning resource for undergraduate and postgraduate students.

The International Conference on Advanced Machine Learning Technologies and Applications (AMTA2018) - About Ella Hassanien 2018-01-25

This book presents the refereed proceedings of the third International Conference on Advanced Machine Learning Technologies and Applications, AMTA 2018, held in Cairo, Egypt, on February 22-24, 2018, and organized by the Scientific Research Group in

Egypt (SRGE). The papers cover current research in machine learning, big data, Internet of Things, biomedical engineering, fuzzy logic, security, and intelligence swarms and optimization.

Bifurcation and Chaos in Fractional-Order Systems - Marius-F. Danca 2021-01-19

This book presents a collection of seven technical papers on fractional-order complex systems, especially chaotic systems with hidden attractors and symmetries, in the research front of the field, which will be beneficial for scientific researchers, graduate students, and technical professionals to study and apply. It is also suitable for teaching lectures and for seminars to use as a reference on related topics.

Fractional Order Systems - Ivo Petráš 2019-10-29

This book is focused on fractional order systems. Historically, fractional calculus has been recognized since the inception of regular calculus, with the first written reference dated in September 1695 in a

letter from Leibniz to L'Hospital. Nowadays, fractional calculus has a wide area of applications in areas such as physics, chemistry, bioengineering, chaos theory, control systems engineering, and many others. In all those applications, we deal with fractional order systems in general. Moreover, fractional calculus plays an important role even in complex systems and therefore allows us to develop better descriptions of real-world phenomena. On that basis, fractional order systems are ubiquitous, as the whole real world around us is fractional. Due to this reason, it is urgent to consider almost all systems as fractional order systems. This Special Issue explores applications of such systems to control, synchronization, and various mathematical models, as for instance, MRI, long memory process, diffusion.

Systems, Automation, and Control - Nabil Derbel

2019-11-05

The book presents selected, extended and peer reviewed

papers from the International Multiconference on System, Automation and Control held Leipzig in 2018. These are complemented with solicited contributions by international experts. Main topics are automatic control, robotics, synthesis of automation systems. Application examples range from man-machine interaction, mechatronics, on to biological and economical models.

Advances in the Theory and Applications of Non-integer Order Systems - Wojciech

Mitkowski 2013-06-03

This volume presents various aspects of non-integer order systems, also known as fractional systems, which have recently attracted an increasing attention in the scientific community of systems science, applied mathematics, control theory. Non-integer systems have become relevant for many fields of science and technology exemplified by the modeling of signal transmission, electric noise, dielectric polarization, heat

transfer, electrochemical reactions, thermal processes, acoustics, etc. The content is divided into six parts, every of which considers one of the currently relevant problems. In the first part the Realization problem is discussed, with a special focus on positive systems. The second part considers stability of certain classes of non-integer order systems with and without delays. The third part is focused on such important aspects as controllability, observability and optimization especially in discrete time. The fourth part is focused on distributed systems where non-integer calculus leads to new and interesting results. The next part considers problems of solutions and approximations of non-integer order equations and systems. The final and most extensive part is devoted to applications. Problems from mechatronics, biomedical engineering, robotics and others are all analyzed and solved with tools from fractional systems. This volume came to fruition thanks to high

level of talks and interesting discussions at RRNR 2013 - 5th Conference on Non-integer Order Calculus and its Applications that took place at AGH University of Science and Technology in Kraków, Poland, which was organized by the Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering. Fractional-Order Nonlinear Systems - Ivo Petráš

2011-05-30

"Fractional-Order Nonlinear Systems: Modeling, Analysis and Simulation" presents a study of fractional-order chaotic systems accompanied by Matlab programs for simulating their state space trajectories, which are shown in the illustrations in the book. Description of the chaotic systems is clearly presented and their analysis and numerical solution are done in an easy-to-follow manner. Simulink models for the selected fractional-order systems are also presented. The readers will understand the fundamentals of the

fractional calculus, how real dynamical systems can be described using fractional derivatives and fractional differential equations, how such equations can be solved, and how to simulate and explore chaotic systems of fractional order. The book addresses to mathematicians, physicists, engineers, and other scientists interested in chaos phenomena or in fractional-order systems. It can be used in courses on dynamical systems, control theory, and applied mathematics at graduate or postgraduate level. Ivo Petráš is an Associate Professor of automatic control and the Director of the Institute of Control and Informatization of Production Processes, Faculty of BERG, Technical University of Košice, Slovak Republic. His main research interests include control systems, industrial automation, and applied mathematics.

Fractional Dynamics and Control - Dumitru Baleanu

2011-11-19

Fractional Dynamics and

Control provides a comprehensive overview of recent advances in the areas of nonlinear dynamics, vibration and control with analytical, numerical, and experimental results. This book provides an overview of recent discoveries in fractional control, delves into fractional variational principles and differential equations, and applies advanced techniques in fractional calculus to solving complicated mathematical and physical problems. Finally, this book also discusses the role that fractional order modeling can play in complex systems for engineering and science.

Robust Adaptive Control for Fractional-Order Systems with Disturbance and Saturation - Mou Chen

2017-10-20

A treatise on investigating tracking control and synchronization control of fractional-order nonlinear systems with system uncertainties, external disturbance, and input saturation Robust Adaptive Control for Fractional-Order

Systems, with Disturbance and Saturation provides the reader with a good understanding on how to achieve tracking control and synchronization control of fractional-order nonlinear systems with system uncertainties, external disturbance, and input saturation. Although some texts have touched upon control of fractional-order systems, the issues of input saturation and disturbances have rarely been considered together. This book offers chapter coverage of fractional calculus and fractional-order systems; fractional-order PID controller and fractional-order disturbance observer; design of fractional-order controllers for nonlinear chaotic systems and some applications; sliding mode control for fractional-order nonlinear systems based on disturbance observer; disturbance observer based neural control for an uncertain fractional-order rotational mechanical system; adaptive neural tracking control for uncertain fractional-order chaotic systems subject to

input saturation and disturbance; stabilization control of continuous-time fractional positive systems based on disturbance observer; sliding mode synchronization control for fractional-order chaotic systems with disturbance; and more. Based on the approximation ability of the neural network (NN), the adaptive neural control schemes are reported for uncertain fractional-order nonlinear systems Covers the disturbance estimation techniques that have been developed to alleviate the restriction faced by traditional feedforward control and reject the effect of external disturbances for uncertain fractional-order nonlinear systems By combining the NN with the disturbance observer, the disturbance observer based adaptive neural control schemes have been studied for uncertain fractional-order nonlinear systems with unknown disturbances Considers, together, the issue of input saturation and the disturbance for the control of

fractional-order nonlinear systems in the presence of system uncertainty, external disturbance, and input saturation. Robust Adaptive Control for Fractional-Order Systems, with Disturbance and Saturation can be used as a reference for the academic research on fractional-order nonlinear systems or used in Ph.D. study of control theory and engineering.

Theoretical Developments and Applications of Non-Integer Order Systems - Stefan Domek
2015-08-20

This volume is devoted to presentation of new results of research on systems of non-integer order, called also fractional systems. Their analysis and practical implementation have been the object of spontaneous development for a few last decades. The fractional order models can depict a physical plant better than the classical integer order ones. This covers different research fields such as insulator properties, visco-elastic materials, electrodynamic,

electrothermal, electrochemical, economic processes modelling etc. On the other hand fractional controllers often outperform their integer order counterparts. This volume contains new ideas and examples of implementation, theoretical and pure practical aspects of using a non-integer order calculus. It is divided into four parts covering: mathematical fundamentals, modeling and approximations, controllability, observability and stability problems and practical applications of fractional control systems. The first part expands the base of tools and methods of the mathematical basis for non-integer order calculus. Part two focuses on new methods and developments in process modeling and fractional derivatives approximations. In the third part a bunch of papers which raise problems of controllability, observability and stability of non-integer order systems is provided. Part four is devoted to presentation of different fractional order

control applications. This book was created thanks to many experts in the field of fractional calculus: authors, anonymous referees whose comments allowed us to improve the final form of the papers and active and inspiring discussion of the participants of RRNR'2015, the 7th Conference on Non-Integer Order Calculus and Its Applications that was organized by the Faculty of Electrical Engineering, West Pomeranian University of Technology, Szczecin, Poland.

Fractional-Order Design - Ahmed G. Radwan 2021-10-22

Fractional-Order Design: Devices, Circuits, and Systems introduces applications from the design perspective so that the reader can learn about, and get ready to, design these applications. The book also includes the different techniques employed to comprehensively and straightforwardly design fractional-order systems/devices. Furthermore, a lot of mathematics is available in the literature for solving the fractional-order

calculus for system application. However, a small portion is employed in the design of fractional-order systems. This book introduces the mathematics that has been employed explicitly for fractional-order systems. Students and scholars who wants to quickly understand the field of fractional-order systems and contribute to its different domains and applications will find this book a welcomed resource. Presents a simple and comprehensive understanding of the field of fractional-order systems Offers practical knowledge on the design of fractional-order systems for different applications Exposes users to the possible new areas of applications of fractional-order systems

Fractional Dynamical Systems - Piotr Kulczycki 2022

This book presents a wide and comprehensive spectrum of issues and problems related to fractional-order dynamical systems. It is meant to be a full-fledge, comprehensive presentation of many aspects

related to the broadly perceived fractional-order dynamical systems which constitute an extension of the traditional integer-order-type descriptions. This implies far-reaching consequences, both analytic and algorithmic, because--in general--properties of the traditional integer-order systems cannot be directly extended by a straightforward generalization to fractional-order systems, modeled by fractional-order differential equations involving derivatives of a non-integer order. This can be useful for describing and analyzing, for instance, anomalies in the behavior of various systems, chaotic behavior, etc. The book contains both analytic contributions with state-of-the-art and theoretical foundations, algorithmic implementation of tools and techniques, and--finally--some examples of relevant and successful practical applications.

*Fractional Order Systems--
Control Theory and
Applications* - Omar Naifar
2021

This book aims to bring together the latest innovative knowledge, analysis, and synthesis of fractional control problems of nonlinear systems as well as some related applications. Fractional order systems (FOS) are dynamical systems that can be modelled by a fractional differential equation carried with a non-integer derivative. In the last few decades, the growth of science and engineering systems has considerably stimulated the employment of fractional calculus in many subjects of control theory, for example, in stability, stabilization, controllability, observability, observer design, and fault estimation. The application of control theory in FOS is an important issue in many engineering applications. So, to accurately describe these systems, the fractional order differential equations have been introduced.

**Issues in Robotics and
Automation: 2012 Edition** -
2013-01-10

Issues in Robotics and
Automation / 2012 Edition is a

ScholarlyEditions™ eBook that delivers timely, authoritative, and comprehensive information about Automation Science. The editors have built Issues in Robotics and Automation: 2012 Edition on the vast information databases of ScholarlyNews.™ You can expect the information about Automation Science in this eBook to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of Issues in Robotics and Automation: 2012 Edition has been produced by the world's leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at <http://www.ScholarlyEditions.com/>.

Mathematical Treatment of

Nanomaterials and Neural Networks - Jia-Bao Liu 2021-12-03

Fault-tolerant Control and Diagnosis for Integer and Fractional-order Systems - Rafael Martínez-Guerra 2020-12-14

This book is about algebraic and differential methods, as well as fractional calculus, applied to diagnose and reject faults in nonlinear systems, which are of integer or fractional order. This represents an extension of a very important and widely studied problem in control theory, namely fault diagnosis and rejection (using differential algebraic approaches), to systems presenting fractional dynamics, i.e. systems whose dynamics are represented by derivatives and integrals of non-integer order. The authors offer a thorough overview devoted to fault diagnosis and fault-tolerant control applied to fractional-order and integer-order dynamical systems, and they introduce new methodologies for control and

observation described by fractional and integer models, together with successful simulations and real-time applications. The basic concepts and tools of mathematics required to understand the methodologies proposed are all clearly introduced and explained. Consequently, the book is useful as supplementary reading in courses of applied mathematics and nonlinear control theory. This book is meant for engineers, mathematicians, physicists and, in general, to researchers and postgraduate students in diverse areas who have a minimum knowledge of calculus. It also contains advanced topics for researchers and professionals interested in the area of states and faults estimation.

Fractional Order Motion

Controls - 2012-12-26

Covering fractional order theory, simulation and experiments, this book explains how fractional order modelling and fractional order controller design compares favourably

with traditional velocity and position control systems. The authors systematically compare the two approaches using applied fractional calculus. Stability theory in fractional order controllers design is also analysed. Presents material suitable for a variety of real-world applications, including hard disk drives, vehicular controls, robot control and micropositioners in DNA microarray analysis Includes extensive experimental results from both lab bench level tests and industrial level, mass-production-ready implementations Covers detailed derivations and numerical simulations for each case Discusses feasible design specifications, ideal for practicing engineers The book also covers key topics including: fractional order disturbance cancellation and adaptive learning control studies for external disturbances; optimization approaches for nonlinear system control and design schemes with backlash and friction. Illustrations and

experimental validations are included for each of the proposed control schemes to enable readers to develop a clear understanding of the approaches covered, and move on to apply them in real-world scenarios.

Advances in Smart Grid Technology - Pierluigi Siano
2020-09-22

This book comprises the select proceedings of the International Conference on Power Engineering Computing and Control (PECCON) 2019. This volume focuses on the different renewable energy sources which are integrated in a smart grid and their operation both in the grid connected mode and islanded mode. The contents highlight the role of power converters in the smart grid environment, battery management, electric vehicular technology and electric charging station as a load for the power network. This book can be useful for beginners, researchers as well as professionals interested in the area of smart grid technology.

Fractional Order Systems -

Riccardo Caponetto 2010

This book aims to propose implementations and applications of Fractional Order Systems (FOS). It is well known that FOS can be applied in control applications and systems modeling, and their effectiveness has been proven in many theoretical works and simulation routines. A further and mandatory step for FOS real world utilization is their hardware implementation and applications on real systems modeling. With this viewpoint, introductory chapters on FOS are included, on the definition of stability region of Fractional Order PID Controller and Chaotic FOS, followed by the practical implementation based on Microcontroller, Field Programmable Gate Array, Field Programmable Analog Array and Switched Capacitor. Another section is dedicated to FO modeling of Ionic Polymeric Metal Composite (IPMC). This new material may have applications in robotics, aerospace and biomedicine.
Mathematical Techniques of

Fractional Order Systems -

Ahmad Taher Azar 2018-06-11
Mathematical Techniques of Fractional Order Systems illustrates advances in linear and nonlinear fractional-order systems relating to many interdisciplinary applications, including biomedical, control, circuits, electromagnetics and security. The book covers the mathematical background and literature survey of fractional-order calculus and generalized fractional-order circuit theorems from different perspectives in design, analysis and realizations, nonlinear fractional-order circuits and systems, the fractional-order memristive circuits and systems in design, analysis, emulators, simulation and experimental results. It is primarily meant for researchers from academia and industry, and for those working in areas such as control engineering, electrical engineering, computer science and information technology. This book is ideal for researchers working in the area of both continuous-time

and discrete-time dynamics and chaotic systems. Discusses multidisciplinary applications with new fundamentals, modeling, analysis, design, realization and experimental results Includes circuits and systems based on new nonlinear elements Covers most of the linear and nonlinear fractional-order theorems that will solve many scientific issues for researchers Closes the gap between theoretical approaches and real-world applications Provides MATLAB® and Simulink code for many applications in the book
Recent Advances in Control Problems of Dynamical Systems and Networks - Ju H. Park 2020-08-11
This edited book introduces readers to new analytical techniques and controller design schemes used to solve the emerging “hottest” problems in dynamic control systems and networks. In recent years, the study of dynamic systems and networks has faced major changes and challenges with the rapid

advancement of IT technology, accompanied by the 4th Industrial Revolution. Many new factors that now have to be considered, and which haven't been addressed from control engineering perspectives to date, are naturally emerging as the systems become more complex and networked. The general scope of this book includes the modeling of the system itself and uncertainty elements, examining stability under various criteria, and controller design techniques to achieve specific control objectives in various dynamic systems and networks. In terms of traditional stability matters, this includes the following special issues: finite-time stability and stabilization, consensus/synchronization, fault-tolerant control, event-triggered control, and sampled-data control for classical linear/nonlinear systems, interconnected systems, fractional-order systems, switched systems, neural networks, and complex networks. In terms of

introducing graduate students and professional researchers studying control engineering and applied mathematics to the latest research trends in the areas mentioned above, this book offers an excellent guide.

Fractional Order Systems—Control Theory and Applications - Omar Naifar 2021-08-31

This book aims to bring together the latest innovative knowledge, analysis, and synthesis of fractional control problems of nonlinear systems as well as some related applications. Fractional order systems (FOS) are dynamical systems that can be modelled by a fractional differential equation carried with a non-integer derivative. In the last few decades, the growth of science and engineering systems has considerably stimulated the employment of fractional calculus in many subjects of control theory, for example, in stability, stabilization, controllability, observability, observer design, and fault estimation. The application of control theory in

FOS is an important issue in many engineering applications. So, to accurately describe these systems, the fractional order differential equations have been introduced.

Fractional Order Control and Synchronization of Chaotic Systems - Ahmad

Taher Azar 2017-02-27

The book reports on the latest advances in and applications of fractional order control and synchronization of chaotic systems, explaining the concepts involved in a clear, matter-of-fact style. It consists of 30 original contributions written by eminent scientists and active researchers in the field that address theories, methods and applications in a number of research areas related to fractional order control and synchronization of chaotic systems, such as: fractional chaotic systems, hyperchaotic systems, complex systems, fractional order discrete chaotic systems, chaos control, chaos synchronization, jerk circuits, fractional chaotic systems with hidden attractors, neural network, fuzzy logic

controllers, behavioral modeling, robust and adaptive control, sliding mode control, different types of synchronization, circuit realization of chaotic systems, etc. In addition to providing readers extensive information on chaos fundamentals, fractional calculus, fractional differential equations, fractional control and stability, the book also discusses key applications of fractional order chaotic systems, as well as multidisciplinary solutions developed via control modeling. As such, it offers the perfect reference guide for graduate students, researchers and practitioners in the areas of fractional order control systems and fractional order chaotic systems.

Nonlinear Dynamics and Applications - Santo Banerjee 2022

This book covers recent trends and applications of nonlinear dynamics in various branches of society, science, and engineering. The selected peer-reviewed contributions were presented at the International

Conference on Nonlinear Dynamics and Applications (ICNDA 2022) at Sikkim Manipal Institute of Technology (SMIT) and cover a broad swath of topics ranging from chaos theory and fractals to quantum systems and the dynamics of the COVID-19 pandemic. Organized by the SMIT Department of Mathematics, this international conference offers an interdisciplinary stage for scientists, researchers, and inventors to present and discuss the latest innovations and trends in all possible areas of nonlinear dynamics.

Distributed-Order Dynamic Systems - Zhuang Jiao
2012-02-24

Distributed-order differential equations, a generalization of fractional calculus, are of increasing importance in many fields of science and engineering from the behaviour of complex dielectric media to the modelling of nonlinear systems. This Brief will broaden the toolbox available to researchers interested in modeling, analysis, control and

filtering. It contains contextual material outlining the progression from integer-order, through fractional-order to distributed-order systems. Stability issues are addressed with graphical and numerical results highlighting the fundamental differences between constant-, integer-, and distributed-order treatments. The power of the distributed-order model is demonstrated with work on the stability of noncommensurate-order linear time-invariant systems. Generic applications of the distributed-order operator follow: signal processing and viscoelastic damping of a mass-spring set up. A new general approach to discretization of distributed-order derivatives and integrals is described. The Brief is rounded out with a consideration of likely future research and applications and with a number of MATLAB® codes to reduce repetitive coding tasks and encourage new workers in distributed-order systems.

Finite-Time Stability: An Input-

Output Approach - Francesco Amato 2018-08-01

Systematically presents the input-output finite-time stability (IO-FTS) analysis of dynamical systems, covering issues of analysis, design and robustness. The interest in finite-time control has continuously grown in the last fifteen years. This book systematically presents the input-output finite-time stability (IO-FTS) analysis of dynamical systems, with specific reference to linear time-varying systems and hybrid systems. It discusses analysis, design and robustness issues, and includes applications to real world engineering problems. While classical FTS has an important theoretical significance, IO-FTS is a more practical concept, which is more suitable for real engineering applications, the goal of the research on this topic in the coming years. Key features: Includes applications to real world engineering

problems. Input-output finite-time stability (IO-FTS) is a practical concept, useful to study the behavior of a dynamical system within a finite interval of time. Computationally tractable conditions are provided that render the technique applicable to time-invariant as well as time varying and impulsive (i.e. switching) systems. The LMIs formulation allows mixing the IO-FTS approach with existing control techniques (e. g. H_∞ control, optimal control, pole placement, etc.). This book is essential reading for university researchers as well as post-graduate engineers practicing in the field of robust process control in research centers and industries. Topics dealt with in the book could also be taught at the level of advanced control courses for graduate students in the department of electrical and computer engineering, mechanical engineering, aeronautics and astronautics, and applied mathematics.