Nonlinear Control Systems And Power System Dynamics The International Series On Asian Studies In Computer And Information Science

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Nonlinear and Adaptive Control Systems - Zhengtao Ding 2013
Nonlinear and Adaptive Control Systems treats nonlinear control and adaptive control in a unified framework, presenting the major results at a moderate mathematical level, suitable to MSc students and engineers with undergraduate degrees.

Linear and Nonlinear Multivariable Feedback Control - Oleg Gasparyan 2008-03-03
Automatic feedback control systems play crucial roles in many fields, including manufacturing industries, communications, naval and space systems. At its simplest, a control system represents a feedback loop in which the difference between the ideal (input) and actual (output) signals is used to modify the behaviour of the system. Control systems are in our homes, computers, cars and toys. Basic control principles can also be found in areas such as medicine, biology and economics, where feedback mechanisms are ever present. Linear and Nonlinear Multivariable Feedback Control presents a highly original, unified control theory of both linear and nonlinear multivariable (also known as multi-input multi-output (MIMO)) feedback systems as a straightforward extension of classical control theory. It shows how the classical engineering methods look in the multidimensional case and how practising engineers or researchers can apply them to the analysis and design of linear and nonlinear MIMO systems. This comprehensive book: uses a fresh approach, bridging the gap between classical and modern, linear and nonlinear multivariable control theories; includes vital nonlinear topics such as limit cycle prediction and forced oscillations analysis on the basis of the describing function method and absolute stability analysis by means of the primary classical frequency-domain criteria (e.g. Popov, circle or parabolic criteria); reinforces the main themes with practical worked examples solved by a special MATLAB-based graphical user interface, as well as with problems, questions and exercises on an accompanying website. The approaches presented in Linear and Nonlinear

Multivariable Feedback Control form an invaluable resource for graduate and undergraduate students studying multivariable feedback control as well as those studying classical or modern control theories. The book also provides a useful reference for researchers, experts and practitioners working in industry

Analysis, Control and Optimal Operations in Hybrid Power Systems - Nicu Bizon 2013-11-30

Nonlinear and Adaptive Control Design - Miroslav Krstic 1995-06-14

Using a pedagogical style along with detailed proofs and illustrative examples, this book opens a view to the largely unexplored area of nonlinear systems with uncertainties. The focus is on adaptive nonlinear control results introduced with the new recursive design methodology--adaptive backstepping. Describes basic tools for nonadaptive backstepping design with state and output feedbacks.

Power System Wide-area Stability Analysis and Control - Jing Ma 2018-05-10

An essential guide to the stability and control of power systems integrating large-scale renewable energy sources The rapid development of smart grids and the integration of large scale renewable energy have added daunting new layers of complexity to the long-standing problem of power system stability control. This book offers a systematic stochastic analysis of these nonlinear problems and provides comprehensive countermeasures to improve power system performance and control with large-scale, hybrid power systems. Power system stability analysis and control is by no means a new topic. But the integration of large scale renewable energy sources has added many new challenges which must be addressed, especially in the areas of time variance, time delay, and uncertainties. Robust, adaptive control strategies and countermeasures are the key to avoiding inadequate, excessive, or lost loads within hybrid power systems. Written by an internationally recognized innovator in the field this book describes the latest theory and methods for handling power system angle stability within power networks. Dr. Jing Ma analyzes and provides control strategies for large scale power systems and outlines state-of-the-art solutions to the entire range of challenges facing today's power systems engineers. Features nonlinear, stochastic analysis of power system stability and control Offers proven countermeasures to optimizing power system performance Focuses on nonlinear time-variance, long time-delays, high uncertainties and comprehensive countermeasures Emphasizes methods for analyzing and addressing time variance and delay when integrating large-scale renewable energy Includes rigorous algorithms and simulations for the design of analysis and control modeling Power System Wide-area Stability Analysis and Control is must-reading for researchers studying power system stability analysis and control, engineers working on power system dynamics and stability, and graduate students in electrical engineering interested in the burgeoning field of smart, wide-area power systems.

Adaptive Learning Methods for Nonlinear System Modeling - Danilo Comminiello 2018-06-11

Adaptive Learning Methods for Nonlinear System Modeling presents some of the recent advances on adaptive algorithms and machine learning methods designed for nonlinear system modeling and identification. Real-life problems always entail a certain degree of nonlinearity, which makes linear models a non-optimal choice. This book mainly focuses on those methodologies for nonlinear modeling that involve any adaptive learning approaches to process data coming from an unknown nonlinear system. By learning from available data, such methods aim at estimating the nonlinearity introduced by the unknown system. In particular, the methods presented in this book are based on online learning approaches, which process the data example-by-example and allow to model even complex nonlinearities, e.g., showing time-varying and dynamic behaviors. Possible fields of applications of such algorithms includes distributed sensor networks, wireless communications, channel identification, predictive maintenance, wind prediction, network security, vehicular networks, active noise control, information forensics and security, tracking control in mobile robots, power systems, and nonlinear modeling in big data, among many others. This book serves as a crucial resource for researchers, PhD and post-graduate students working in the areas of machine learning, signal processing, adaptive filtering, nonlinear control, system identification, cooperative systems, computational intelligence. This book may be also of interest to the industry market and practitioners working with a wide variety of nonlinear systems. Presents the key trends and future perspectives in the field of nonlinear signal processing and adaptive learning. Introduces novel solutions and improvements over the state-of-the-art methods in the very exciting area of online and adaptive nonlinear identification. Helps readers understand important methods that are effective in nonlinear system modelling, suggesting the right methodology to address particular issues.

Dynamic Estimation and Control of Power Systems - Abhinav Kumar Singh 2018-10-04

Dynamic estimation and control is a fast growing and widely researched field of study that lays the foundation for a new generation of technologies that can dynamically, adaptively and automatically stabilize power systems. This book provides a comprehensive introduction to research techniques for real-time estimation and control of power systems. Dynamic Estimation and Control of Power Systems coherently and concisely explains key concepts in a step by step manner, beginning with the fundamentals and building up to the latest developments of the field. Each chapter features examples to illustrate the main ideas, and effective research tools are presented for signal processing-based estimation of the dynamic states and subsequent control, both centralized and decentralized, as well as linear and nonlinear. Detailed mathematical proofs are included for readers who desire a deeper technical understanding of the methods. This book is an ideal research reference for engineers and researchers working on monitoring and stability of modern grids, as well as postgraduate students studying these topics. It serves to deliver a clear understanding of the tools needed for estimation and control, while also acting as a basis for readers to further develop new and improved approaches in their own research. Offers the first concise, single resource on dynamic estimation and control of power systems Provides both an understanding of estimation and control concepts and a comparison of results Includes detailed case-studies, including MATLAB codes, to explain and demonstrate the concepts presented

IEEE/PES Transmission and Distribution Conference and Exposition - 2002

Systems and Control Theory for Power Systems - Joe H. Chow 1995-02-24

The articles in this volume cover power system model reduction, transient and voltage stability, nonlinear control, robust stability, computation and optimization and have been written by some of the leading researchers in these areas. This book should be of interest to power and control engineers, and applied mathematicians.

Nonlinear Systems - Shankar Sastry 2013-04-18

There has been much excitement over the emergence of new mathematical techniques for the analysis and control of nonlinear systems. In addition, great technological advances have bolstered the impact of analytic advances and produced many new problems and applications which are nonlinear in an essential way. This book lays out in a concise mathematical framework the tools and methods of analysis which underlie this diversity of applications.

Backstepping Control of Nonlinear

Dynamical Systems - Sundarapandian Vaidyanathan 2020-08-15
Backstepping Control of Nonlinear Dynamical Systems addresses both the fundamentals of backstepping control and advances in the field. The latest techniques explored include 'active backstepping control', 'adaptive backstepping control', 'fuzzy backstepping control' and 'adaptive fuzzy backstepping control'. The reference book provides numerous simulations using MATLAB and circuit design. These illustrate the main results of theory and applications of backstepping control of nonlinear control systems. Backstepping control encompasses varied aspects of mechanical engineering and has many different applications within the field. For example, the book covers aspects related to robot manipulators, aircraft flight control systems, power systems, mechanical systems, biological systems and chaotic systems. This multifaceted view of subject areas means that this useful reference resource will be ideal for a large cross section of the mechanical engineering community. Details the real-world applications of backstepping control Gives an up-to-date insight into the theory, uses and application of backstepping control Bridges the gaps for different fields of engineering, including mechanical engineering, aeronautical engineering, electrical engineering, communications engineering, robotics and biomedical instrumentation

Phasors for Measurement and Control - Gerard Ledwich 2021-02-09
This book is focused on the development of Phasor Measurement Units (PMUs) as a tool to analyse and control power systems. The book develops a nonlinear system-wide approach to control using PMU signals and provides numerous examples of different power systems to demonstrate the robustness of the approach in comparison to heuristic optimization. Some of the applicable controls include: · Excitation systems;· Wind power;· Static VAR compensators;· High evoltage DC; and· Inverter dynamics. For the operation of transmission and distribution systems, the book explains the dynamics of power systems and explores how well-established tools such as energy-based control and Kalman filters can address many of the existing and developing issues in their operation. By providing a thorough guide to PMUs, this book enables readers to fully understand the potential benefits their implementation can bring.

Nonlinear Control of Dynamic Networks - Tengfei Liu 2018-09-03
Significant progress has been made on nonlinear control systems in the past two decades. However, many of the existing nonlinear control methods cannot be readily used to cope with communication and networking issues without nontrivial modifications. For example, small quantization errors may cause the performance of a "well-designed" nonlinear control system to deteriorate. Motivated by the need for new tools to solve complex problems resulting from smart power grids, biological processes, distributed computing networks, transportation networks, robotic systems, and other cutting-edge control applications, Nonlinear Control of Dynamic Networks tackles newly arising theoretical and real-world challenges for stability analysis and control design, including nonlinearity, dimensionality, uncertainty, and information constraints as well as behaviors stemming from quantization, data-sampling, and impulses. Delivering a systematic review of the nonlinear small-gain theorems, the text: Supplies novel cyclic-small-gain theorems for large-scale nonlinear dynamic networks Offers a cyclic-small-gain framework for nonlinear control with static or dynamic quantization Contains a combination of cyclic-small-gain and set-valued map designs for robust control of nonlinear uncertain systems subject to sensor noise Presents a cyclic-small-gain result in directed graphs and distributed control of nonlinear multi-agent systems with fixed or dynamically changing topology Based on the authors' recent research, Nonlinear Control of Dynamic Networks provides a unified framework for

robust, quantized, and distributed control under information constraints. Suggesting avenues for further exploration, the book encourages readers to take into consideration more communication and networking issues in control designs to better handle the arising challenges.

Converter-Based Dynamics and Control of Modern Power Systems - Antonello Monti 2020-10-22

Converter-Based Dynamics and Control of Modern Power Systems addresses the ongoing changes and challenges in rotating masses of synchronous generators, which are transforming dynamics of the electrical system. These changes make it more important to consider and understand the role of power electronic systems and their characteristics in shaping the subtleties of the grid and this book fills that knowledge gap. Balancing theory, discussion, diagrams, mathematics, and data, this reference provides the information needed to acquire a thorough overview of resilience issues and frequency definition and estimation in modern power systems. This book offers an overview of classical power system dynamics and identifies ways of establishing future challenges and how they can be considered at a global level to overcome potential problems. The book is designed to prepare future engineers for operating a system that will be driven by electronics and less by electromechanical systems. Includes theory on the emerging topic of electrical grids based on power electronics Creates a good bridge between traditional theory and modern theory to support researchers and engineers Links the two fields of power systems and power electronics in electrical engineering

Nonlinear Control Systems and Power System Dynamics - Qiang Lu 2013-04-17

Nonlinear Control Systems and Power System Dynamics presents a comprehensive description of nonlinear control of electric power systems using nonlinear control theory, which is developed by the differential geometric approach and nonlinear robust control method. This book explains in detail the concepts, theorems and algorithms in nonlinear control theory, illustrated by step-by-step examples. In addition, all the mathematical formulation involved in deriving the nonlinear control laws of power systems are sufficiently presented. Considerations and cautions involved in applying nonlinear control theory to practical engineering control designs are discussed and special attention is given to the implementation of nonlinear control laws using microprocessors. Nonlinear Control Systems and Power System Dynamics serves as a text for advanced level courses and is an excellent reference for engineers and researchers who are interested in the application of modern nonlinear control theory to practical engineering control designs.

Power System Dynamics and Control - Harry G. Kwatny 2016-06-02

Whereas power systems have traditionally been designed with a focus on protecting them from routine component failures and atypical user demand, we now also confront the fact that deliberate attack intended to cause maximum disruption is a real possibility. In response to this changing environment, new concepts and tools have emerged that address many of the issues facing power system operation today. This book is aimed at introducing these ideas to practicing power systems engineers, control systems engineers interested in power systems, and graduate students in these areas. The ideas are examined with an emphasis on how they can be applied to improve our understanding of power system behavior and help design better control systems. The book is supplemented by a Mathematica package enabling readers to work out nontrivial examples and problems. Also included is a set of Mathematica tutorial notebooks providing detailed solutions of the worked examples in the text. In addition to Mathematica, simulations are carried out using Simulink with Stateflow.

Analysis, Control and Optimal Operations in Hybrid Power Systems - Nicu Bizon 2013-11-26

The book's text focuses on explaining and analyzing the dynamic performance of linear and nonlinear systems, in particular for Power Systems (PS) including Hybrid Power Sources (HPS). The system stability is important for both PS operation and planning. Placing emphasis on understanding the underlying stability principles, the book opens with an exploration of basic concepts using mathematical models and case studies from linear and nonlinear system, and continues with complex models and algorithms from field of PS. The book's features include: (1) progressive approach from simplicity to complexity, (2) deeper look into advanced aspects of stability theory, (3) detailed description of system stability using state space energy conservation principle, (4) review of some research in the field of PS stability analysis, (5) advanced models and algorithms for Transmission Network Expansion Planning (TNEP), (6) Stability enhancement including the use of Power System Stabilizer (PSS) and Flexible Alternative Current Transmission Systems (FACTS), and (7) examination of the influence of nonlinear control on fuel cell HPS dynamics. The book will be easy to read and understand and will be an essential resource for both undergraduate and graduate students in electrical engineering as well as to the PhDs and engineers from this field. It is also a clear and comprehensive reference text for undergraduate students, postgraduate and research students studying power systems, and also for practicing engineers and researchers who are working in electricity companies or in the development of power system technologies. All will appreciate the authors' accessible approach in introduction the power system dynamics and stability from both a mathematical and engineering viewpoint.

Renewable Energy Systems - Ahmad Taher Azar 2021-09-09

Renewable Energy Systems: Modelling, Optimization and Control aims to cross-pollinate recent advances in the study of renewable energy control systems by bringing together diverse scientific breakthroughs on the modeling, control and optimization of renewable energy systems by leading researchers. The book brings together the most comprehensive collection of modeling, control theorems and optimization techniques to help solve many scientific issues for researchers in renewable energy and control engineering. Many multidisciplinary applications are discussed, including new fundamentals, modeling, analysis, design, realization and experimental results. The book also covers new circuits and systems to help researchers solve many nonlinear problems. This book fills the gaps between different interdisciplinary applications, ranging from mathematical concepts, modeling, and analysis, up to the realization and experimental work. Covers modeling, control theorems and optimization techniques which will solve many scientific issues for researchers in renewable energy Discusses many multidisciplinary applications with new fundamentals, modeling, analysis, design, realization and experimental results Includes new circuits and systems, helping researchers solve many nonlinear problems

Science in China - 2008

Nonlinear Control Systems - Alberto Isidori 2013-04-17

The purpose of this book is to present a self-contained description of the fun damentals of the theory of nonlinear control systems, with special emphasis on the differential geometric approach. The book is intended as a graduate text as weil as a reference to scientists and engineers involved in the analysis and design of feedback systems. The first version of this book was written in 1983, while I was teach ing at the Department of Systems Science and Mathematics at Washington University in St. Louis. This new edition integrates my subsequent teaching experience gained at the University of Illinois in Urbana-Champaign in 1987, at the Carl-Cranz Gesellschaft in Oberpfaffenhofen in 1987, at the University of California in Berkeley in

1988. In addition to a major rearrangement of the last two Chapters of the first version, this new edition incorporates two additional Chapters at a more elementary level and an exposition of some relevant research findings which have occurred since 1985.

Nonlinear Power Flow Control Design - Rush D. Robinett III 2011-08-10

This book presents an innovative control system design process motivated by renewable energy electric grid integration problems. The concepts developed result from the convergence of research and development goals which have important concepts in common: exergy flow, limit cycles, and balance between competing power flows. A unique set of criteria is proposed to design controllers for a class of nonlinear systems. A combination of thermodynamics with Hamiltonian systems provides the theoretical foundation which is then realized in a series of connected case studies. It allows the process of control design to be viewed as a power flow control problem, balancing the power flowing into a system against that being dissipated within it and dependent on the power being stored in it – an interplay between kinetic and potential energies. Human factors and the sustainability of self-organizing systems are dealt with as advanced topics.

Power System Dynamics - Jan Machowski 2020-02-25

An authoritative guide to the most up-to-date information on power system dynamics The revised third edition of Power System Dynamics and Stability contains a comprehensive, state-of-the-art review of information on the topic. The third edition continues the successful approach of the first and second editions by progressing from simplicity to complexity. It places the emphasis first on understanding the underlying physical principles before proceeding to more complex models and algorithms. The book is illustrated by a large number of diagrams and examples. The third edition of Power System Dynamics and Stability explores the influence of wind farms and virtual power plants, power plants inertia and control strategy on power system stability. The authors—noted experts on the topic—cover a range of new and expanded topics including: Wide-area monitoring and control systems. Improvement of power system stability by optimization of control systems parameters. Impact of renewable energy sources on power system dynamics. The role of power system stability in planning of power system operation and transmission network expansion. Real regulators of synchronous generators and field tests. Selectivity of power system protections at power swings in power system. Criteria for switching operations in transmission networks. Influence of automatic control of a tap changing step-up transformer on the power capability area of the generating unit. Mathematical models of power system components such as HVDC links, wind and photovoltaic power plants. Data of sample (benchmark) test systems. Power System Dynamics: Stability and Control, Third Edition is an essential resource for students of electrical engineering and for practicing engineers and researchers who need the most current information available on the topic.

Nonlinear Control Systems - Horacio Márquez 2003-04-25

Provides complete coverage of both the Lyapunov and Input-Output stability theories, ina readable, concise manner. * Supplies an introduction to the popular backstepping approach to nonlinear control design * Gives a thorough discussion of the concept of input-to-state stability * Includes a discussion of the fundamentals of feedback linearization and related results. * Details complete coverage of the fundamentals of dissipative system's theory and its application in the so-called L2gain control prooblem, for the first time in an introductory level textbook. * Contains a thorough discussion of nonlinear observers, a very important problem, not commonly encountered in textbooksat this level. *An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department.

Nonlinear Control Synthesis for Electrical Power Systems Using Controllable Series Capacitors - Ravi N. Banavar 2012

In this work we derive asymptotically stabilizing control laws for electrical power systems using two nonlinear control synthesis techniques. For this transient stabilization problem the actuator considered is a power electronic device, a controllable series capacitor (CSC). The power system is described using two different nonlinear models - the second order swing equation and the third order flux-decay model. To start with, the CSC is modeled by the injection model which is based on the assumption that the CSC dynamics is very fast as compared to the dynamics of the power system and hence can be approximated by an algebraic equation. Here, by neglecting the CSC dynamics, the input vector $g(x)$ in the open loop system takes a complex form - the injection model. Using this model, interconnection and damping assignment passivity-based control (IDA-PBC) methodology is demonstrated on two power systems: a single machine infinite bus (SMIB) system and a two machine system. Further, IDA-PBC is used to derive stabilizing controllers for power systems, where the CSC dynamics are included as a first order system. Next, we consider a different control methodology, immersion and invariance (I & I), to synthesize an asymptotically stabilizing control law for the SMIB system with a CSC. The CSC is described by a first order system. As a generalization of I & I, we incorporate the power balance algebraic constraints in the load bus to the SMIB swing equation, and extend the design philosophy to a class of differential algebraic systems. The proposed result is then demonstrated on another example: a two-machine system with two load buses and a CSC. The controller performances are validated through simulations for all cases.

Applications of Nonlinear Control - Meral Altınay 2012-06-13

A trend of investigation of Nonlinear Control Systems has been present over the last few decades. As a result the methods for its analysis and design have improved rapidly. This book includes nonlinear design topics such as Feedback Linearization, Lyapunov Based Control, Adaptive Control, Optimal Control and Robust Control. All chapters discuss different applications that are basically independent of each other. The book will provide the reader with information on modern control techniques and results which cover a very wide application area. Each chapter attempts to demonstrate how one would apply these techniques to real-world systems through both simulations and experimental settings.

Nonlinear Control of Dynamic Networks - Tengfei Liu 2014-04-07

Significant progress has been made on nonlinear control systems in the past two decades. However, many of the existing nonlinear control methods cannot be readily used to cope with communication and networking issues without nontrivial modifications. For example, small quantization errors may cause the performance of a "well-designed" nonlinear control system to deteriorate. Motivated by the need for new tools to solve complex problems resulting from smart power grids, biological processes, distributed computing networks, transportation networks, robotic systems, and other cutting-edge control applications, Nonlinear Control of Dynamic Networks tackles newly arising theoretical and real-world challenges for stability analysis and control design, including nonlinearity, dimensionality, uncertainty, and information constraints as well as behaviors stemming from quantization, data-sampling, and impulses. Delivering a systematic review of the nonlinear small-gain theorems, the text: Supplies novel cyclic-small-gain theorems for large-scale nonlinear dynamic networks Offers a cyclic-small-gain framework for nonlinear control with static or dynamic quantization Contains a combination of cyclic-small-gain and set-valued map designs for robust control of nonlinear uncertain systems subject to sensor noise Presents a cyclic-small-gain result in directed graphs and distributed control of nonlinear multi-agent systems with fixed or dynamically changing topology Based on the authors’ recent research, Nonlinear Control of Dynamic Networks provides a unified framework for robust, quantized, and distributed control under information constraints. Suggesting avenues for further exploration, the book encourages readers to take into consideration more communication and networking issues in control designs to better handle the arising challenges.

Design of Nonlinear Control Systems with the Highest Derivative in Feedback - Valery D. Yurkevich 2004

This unique book presents an analytical uniform design methodology of continuous-time or discrete-time nonlinear control system design which guarantees desired transient performances in the presence of plant parameter variations and unknown external disturbances. All results are illustrated with numerical simulations, their practical importance is highlighted, and they may be used for real-time control system design in robotics, mechatronics, chemical reactors, electrical and electro-mechanical systems as well as aircraft control systems. The book is easy reading and is suitable for teaching.

Optimisation, Optimal Control and Nonlinear Dynamics in Electrical Power, Energy Storage and Renewable Energy Systems - Victor Becerra 2022

The electrical power system is undergoing a revolution enabled by advances in telecommunications, computer hardware and software, measurement, metering systems, IoT, and power electronics. Furthermore, the increasing integration of intermittent renewable energy sources, energy storage devices, and electric vehicles and the drive for energy efficiency have pushed power systems to modernise and adopt new technologies. The resulting smart grid is characterised, in part, by a bi-directional flow of energy and information. The evolution of the power grid, as well as its interconnection with energy storage systems and renewable energy sources, has created new opportunities for optimising not only their techno-economic aspects at the planning stages but also their control and operation. However, new challenges emerge in the optimization of these systems due to their complexity and nonlinear dynamic behaviour as well as the uncertainties involved.This volume is a selection of 20 papers carefully made by the editors from the MDPI topic "Optimisation, Optimal Control and Nonlinear Dynamics in Electrical Power, Energy Storage and Renewable Energy Systems", which was closed in April 2022. The selected papers address the above challenges and exemplify the significant benefits that optimisation and nonlinear control techniques can bring to modern power and energy systems.

Enhancement of Power System Dynamic Stability Using Variable Structure Control Techniques - Vidana Gamage Don Chandana Samarasinghe 1996

Nonlinear Control Systems II - Alberto Isidori 1999-09-22

This eagerly awaited follow-up to Nonlinear Control Systems incorporates recent advances in the design of feedback laws, for the purpose of globally stabilizing nonlinear systems via state or output feedback. The author is one of the most prominent researchers in the field.

Advances and Applications in Nonlinear Control Systems - Sundarapandian Vaidyanathan 2016-03-17

The book reports on the latest advances and applications of nonlinear control systems. It consists of 30 contributed chapters by subject experts who are specialized in the various topics addressed in this book. The special chapters have been brought out in the broad areas of nonlinear control systems such as robotics, nonlinear circuits, power systems, memristors, underwater vehicles, chemical processes, observer design, output regulation, backstepping control, sliding mode control, time-delayed control, variables structure control, robust adaptive control, fuzzy logic control, chaos, hyperchaos, jerk systems, hyperjerk systems, chaos control, chaos synchronization, etc. Special importance was given to chapters offering practical solutions, modeling and novel control methods for the recent research problems in nonlinear control systems. This book will serve as a reference book for graduate students and researchers with a basic knowledge of electrical and control systems engineering. The resulting design procedures on the nonlinear control systems are emphasized using MATLAB software.

Power System Control and Stability - Paul M. Anderson 2003

This title describes the mechanical system that drives the electric generators, and the dynamic reaction between the prime mover and generator systems.

Inter-area Oscillations in Power Systems - Arturo Roman Messina 2009-04-21

The study of complex dynamic processes governed by nonlinear and nonstationary characteristics is a problem of great importance in the analysis and control of power system oscillatory behavior. Power system dynamic processes are highly random, nonlinear to some extent, and intrinsically nonstationary even over short time intervals as in the case of severe transient oscillations in which switching events and control actions interact in a complex manner. Phenomena observed in power system oscillatory dynamics are diverse and complex. Measured ambient data are known to exhibit noisy, nonstationary fluctuations resulting primarily from small magnitude, random changes in load, driven by low-scale motions or nonlinear trends originating from slow control actions or changes in operating conditions. Forced oscillations resulting from major cascading events, on the other hand, may contain motions with a broad range of scales and can be highly nonlinear and time-varying. Prediction of temporal dynamics, with the ultimate application to real-time system monitoring, protection and control, remains a major research challenge due to the complexity of the driving dynamic and control processes operating on various temporal scales that can become dynamically involved. An understanding of system dynamics is critical for reliable inference of the underlying mechanisms in the observed oscillations and is needed for the development of effective wide-area measurement and control systems, and for improved operational reliability.

Nonlinear Control and Filtering Using Differential Flatness Approaches - Gerasimos G. Rigatos 2015-06-05

This monograph presents recent advances in differential flatness theory and analyzes its use for nonlinear control and estimation. It shows how differential flatness theory can provide solutions to complicated control problems, such as those appearing in highly nonlinear multivariable systems and distributed-parameter systems. Furthermore, it shows that differential flatness theory makes it possible to perform filtering and state estimation for a wide class of nonlinear dynamical systems and provides several descriptive test cases. The book focuses on the design of nonlinear adaptive controllers and nonlinear filters, using exact linearization based on differential flatness theory. The adaptive controllers obtained can be applied to a wide class of nonlinear systems with unknown dynamics, and assure reliable functioning of the control loop under uncertainty and varying operating conditions. The filters obtained outperform other nonlinear filters in terms of accuracy of estimation and computation speed. The book presents a series of application examples to confirm the efficiency of the proposed nonlinear filtering and adaptive control schemes for various electromechanical systems. These include: · industrial robots; · mobile robots and autonomous vehicles; · electric power generation; · electric motors and actuators; · power electronics; · internal combustion engines; · distributed-parameter systems; and · communication systems. Differential Flatness Approaches to Nonlinear Control and Filtering will be a useful reference for academic researchers studying advanced problems in nonlinear control and nonlinear dynamics, and for engineers working on control applications in electromechanical systems.

Nonlinear Control Synthesis for Electrical Power Systems Using Controllable Series Capacitors - N S Manjarekar 2012-02-10

In this work we derive asymptotically stabilizing control laws for electrical power systems using two nonlinear control synthesis techniques. For this transient stabilization problem the actuator considered is a power electronic device, a controllable series capacitor (CSC). The power system is described using two different nonlinear models - the second order swing equation and the third order flux-decay model. To start with, the CSC is modeled by the injection model which is based on the assumption that the CSC dynamics is very fast as compared to the dynamics of the power system and hence can be approximated by an algebraic equation. Here, by neglecting the CSC dynamics, the input vector $g(x)$ in the open loop system takes a complex form - the injection model. Using this model, interconnection and damping assignment passivity-based control (IDA-PBC) methodology is demonstrated on two power systems: a single machine infinite bus (SMIB) system and a two machine system. Further, IDA-PBC is used to derive stabilizing controllers for power systems, where the CSC dynamics are included as a first order system. Next, we consider a different control methodology, immersion and invariance (I\&I), to synthesize an asymptotically stabilizing control law for the SMIB system with a CSC. The CSC is described by a first order system. As a generalization of I\&I, we incorporate the power balance algebraic constraints in the load bus to the SMIB swing equation, and extend the design philosophy to a class of differential algebraic systems. The proposed result is then demonstrated on another example: a two-machine system with two load buses and a CSC. The controller performances are validated through simulations for all cases.

Applied Nonlinear Control - Jean-Jacques E. Slotine 1991

In this work, the authors present a global perspective on the methods available for analysis and design of non-linear control systems and detail specific applications. They provide a tutorial exposition of the major non-linear systems analysis techniques followed by a discussion of available non-linear design methods.

Optimisation, Optimal Control and Nonlinear Dynamics in Electrical Power, Energy Storage and Renewable Energy Systems - Victor Becerra 2022-10-31

The electrical power system is undergoing a revolution enabled by advances in telecommunications, computer hardware and software, measurement, metering systems, IoT, and power electronics. Furthermore, the increasing integration of intermittent renewable energy sources, energy storage devices, and electric vehicles and the drive for energy efficiency have pushed power systems to modernise and adopt new technologies. The resulting smart grid is characterised, in part, by a bi-directional flow of energy and information. The evolution of the power grid, as well as its interconnection with energy storage systems and renewable energy sources, has created new opportunities for optimising not only their techno-economic aspects at the planning stages but also their control and operation. However, new challenges emerge in the optimization of these systems due to their complexity and nonlinear dynamic behaviour as well as the uncertainties involved. This volume is a selection of 20 papers carefully made by the editors from the MDPI topic "Optimisation, Optimal Control and Nonlinear Dynamics in Electrical Power, Energy Storage and Renewable Energy Systems", which was closed in April 2022. The selected papers address the above challenges and exemplify the significant benefits that optimisation and nonlinear control techniques can bring to modern power and energy systems.

Power System Dynamics and Stability - Peter W. Sauer 1998

For a one-semester senior or beginning graduate level course in power system dynamics. This text begins with the fundamental laws for basic devices and systems in a mathematical modeling context. It includes systematic derivations of standard synchronous machine models with their fundamental controls. These individual models are interconnected for system analysis and simulation. Singular perturbation is used to derive and explain reduced-order models.

Nonlinear and Optimal Control Systems - Thomas L. Vincent 1997-06-23

Designed for one-semester introductory senior-or graduate-level course, the authors provide the student with an introduction of analysis techniques used in the design of nonlinear and optimal feedback control systems. There is special emphasis on the fundamental topics of stability, controllability, and optimality, and on the corresponding geometry associated with these topics. Each chapter contains several examples and a variety of exercises.

Nonlinear Control of Dynamic Networks - Tengfei Liu 2018-09-03

Significant progress has been made on nonlinear control systems in the past two decades. However, many of the existing nonlinear control methods cannot be readily used to cope with communication and networking issues without nontrivial modifications. For example, small quantization errors may cause the performance of a "well-designed" nonlinear control system to deteriorate. Motivated by the need for new tools to solve complex problems resulting from smart power grids, biological processes, distributed computing networks, transportation networks, robotic systems, and other cutting-edge control applications, Nonlinear Control of Dynamic Networks tackles newly arising theoretical and real-world challenges for stability analysis and control design, including nonlinearity, dimensionality, uncertainty, and information constraints as well as behaviors stemming from quantization, data-sampling, and impulses. Delivering a systematic review of the nonlinear small-gain theorems, the text: Supplies novel cyclic-small-gain theorems for large-scale nonlinear dynamic networks Offers a cyclic-small-gain framework for nonlinear control with static or dynamic quantization Contains a combination of cyclic-small-gain and set-valued map designs for robust control of nonlinear uncertain systems subject to sensor noise Presents a cyclic-small-gain result in directed graphs and distributed control of nonlinear multi-agent systems with fixed or dynamically changing topology Based on the authors’ recent research, Nonlinear Control of Dynamic Networks provides a unified framework for robust, quantized, and distributed control under information constraints. Suggesting avenues for further exploration, the book encourages readers to take into consideration more communication and networking issues in control designs to better handle the arising challenges.