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

This volume represents most aspects of the rich and growing field of nonlinear control. These proceedings contain 78 papers, including six plenary lectures, striking a balance between theory and applications. Subjects covered include feedback stabilization, nonlinear and adaptive control of electromechanical systems, nonholonomic systems. Generalized state space systems, algebraic computing in nonlinear systems theory, decoupling, linearization and model-matching and robust control are also covered.
In the last two decades, the development of specific methodologies for the control of systems described by nonlinear mathematical models has attracted an ever increasing interest. New breakthroughs have occurred which have aided the design of nonlinear control systems. However there are still limitations which must be understood, some of which were addressed at the IFAC Symposium in Capri. The emphasis was on the methodological developments, although a number of the papers were concerned with the presentation of applications of nonlinear design philosophies to actual control problems in chemical, electrical and mechanical engineering.
The series of IFAC Symposia on Nonlinear Control Systems provides the ideal forum

for leading researchers and practitioners who work in the field to discuss and evaluate the latest research and developments. This publication contains the papers presented at the 3rd IFAC Symposium in the series which was held in Tahoe City, California, USA.

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.

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.

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. A systematic computer-aided approach provides a versatile setting for the control engineer to overcome the complications of controller design for highly nonlinear systems. Computer-aided Nonlinear Control System Design provides such an approach based on the use of describing functions. The text deals with a large class of nonlinear systems without restrictions on the system order, the number of inputs and/or outputs or the number, type or arrangement of nonlinear terms. The strongly software-oriented methods detailed facilitate fulfillment of tight performance requirements and help the designer to think in purely nonlinear terms, avoiding the expedient of linearization which can impose substantial and unrealistic model limitations and drive up the cost of the final product. Design procedures are presented in a step-by-step algorithmic format each step being a functional unit with outputs that drive the other steps. This procedure may be easily implemented on a digital computer with example problems from mechatronic and aerospace design being used to demonstrate the techniques discussed. The author’s commercial MATLAB®-based environment, available separately from insert URL here, can be used to create simulations showing the results of using the computer-aided control system design ideas characterized in the text. Academic researchers and graduate students studying nonlinear control systems and control engineers dealing with nonlinear plant, particularly mechatronic or aerospace systems will find Computer-aided Nonlinear Control System Design to be of great practical assistance adding to their toolbox of techniques for dealing with system nonlinearities. A basic knowledge of calculus, nonlinear analysis and software

engineering will enable the reader to get the best from this book.
The development of computer software for nonlinear control systems has provided many benefits for teaching, research, and the development of control systems design. MATLAB is considered the dominant software platforms for linear and nonlinear control systems analysis. This book provides an easy way to learn nonlinear control systems such as feedback linearization technique and Sliding mode control (Structure variable control) which are one of the most used techniques in nonlinear control dynamical systems; therefore teachers-students and researchers are all in need to handle such techniques; and since they are too difficult for them to handle such nonlinear controllers especially for a more complicated systems such as induction motor, satellite, and vehicles dynamical models. Thus, this document it is an excellent resource for learning the principle of feedback linearization and sliding mode techniques in an easy and simple way: Provides a briefs description of the feedback linearization and sliding mode control strategies Includes a simple method on how to determine the right and appropriate controller (P-PI-PID) for feedback linearization control strategy. A Symbolic MATLAB Based function for finding the feedback linearization and sliding mode controllers are developed and tested using several examples. A simple method for finding the approximate sliding mode controller parameters is

introduced Where the program used to construct the nonlinear controller uses symbolic computations; such that the user should provide the program with the necessary functions f(x), g(x) and h(x) using the symbolic library.

Over the last 50 years or so, a number of textbooks, monographs and even popular books have been published on nonlinear control theory and design methods. In the area of classical control, for example, there exist books concerned with phase-plane analysis, describing function approach, absolute stability and so on. In the area of modern control there are those related to optimal control, using differential geometry and the differential algebra method, variable structural control, H-infinite control and so on. These books have been useful in promoting the development of automatic control science and technology. Since 1990 there have been many new results and contributions in the area of nonlinear control. This book introduces those topics to interested readers. It will also benefit automation engineers, researchers and scholars in related fields. Contents:Generalized Hamiltonian Systems (D Cheng)Continuous Finite-Time Control (T P Leung & Y Hong)Local Stabilization of Nonlinear Systems by Dynamic Output Feedback (P Chen & H Qin)Hybrid Control for Global Stabilization of a Class of Systems (J Zhao)Robust and Adaptive Control of Nonholonomic Mechanical Systems with Applications to Mobile Robots (Y M

Hu & W Huo)Introduction to Chaos Control and Anti-Control (G Chen et al.) Readership: Graduate students, researchers, designers of nonlinear control systems and controllers, and readers interested in the recent contributions to nonlinear control theory. Keywords:

A critical part of ensuring that systems are advancing alongside technology without complications is problem solving. Practical applications of problem-solving theories can model conflict and cooperation and aid in creating solutions to real-world problems. Soft-Computing-Based Nonlinear Control Systems Design is a critical scholarly publication that examines the practical applications of control theory and its applications in problem solving to fields including economics, environmental management, and financial modelling. Featuring a wide range of topics, such as fuzzy logic, nature-inspired algorithms, and cloud computing, this book is geared toward academicians, researchers, and students seeking relevant research on control theory and its practical applications.

Fifteen contributions provide an up-to-date treatment of issues in system modeling, system analysis, design and synthesis methods, and nonlinear systems. Coverage includes the application of multidimensional Laplace transforms to the modeling of nonlinear elements, a survey of customized computer algebra modeling programs for multibody dynamical systems, robust control of linear systems using a new linear programming approach, the development and testing of a new branch-and-bound algorithm fir global optimization using symbolic algebra techniques, and dynamic sliding mode control design using symbolic algebra tools.

Brings the knowledge of 24 experts in this maturing field out from the narrow confines of academic circles, and makes it accessible to graduate students and power electronics professionals alike. * Provides practicing engineers with the knowledge to predict power requirement behavior. * The insights gained from this all-inclusive compilation will ultimately lead to better design methodologies.

"Analysis and Design of Nonlinear Control Systems" provides a comprehensive and up to date introduction to nonlinear control systems, including system analysis and major control design techniques. The book is self-contained, providing sufficient mathematical foundations for understanding the contents of each chapter. Scientists and engineers engaged in the field of Nonlinear Control Systems will find it an extremely useful handy reference book. Dr. Daizhan Cheng, a professor at Institute of Systems Science, Chinese Academy of Sciences, has been working on the control of nonlinear systems for over 30 years and is currently a Fellow of IEEE and a Fellow of IFAC, he is also the chairman of Technical Committee on Control Theory, Chinese Association of Automation.

Control Systems: Classical, Modern, and AI-Based Approaches provides a broad and comprehensive study of the principles, mathematics, and applications for those studying basic control in mechanical, electrical, aerospace, and other engineering disciplines. The text builds a strong mathematical foundation of control theory of linear, nonlinear, optimal, model predictive, robust, digital, and adaptive control systems, and it addresses applications in several emerging areas, such as aircraft, electro-mechanical, and some nonengineering systems: DC motor control, steel beam thickness control, drum boiler, motional control system, chemical reactor, head-disk assembly, pitch control of an aircraft, yaw-damper control, helicopter control, and tidal power control. Decentralized control, game-theoretic control, and control of hybrid systems are discussed. Also, control systems based on artificial neural networks, fuzzy logic, and genetic algorithms, termed as AI-based systems are studied and analyzed with applications such as auto-landing aircraft, industrial process control, active suspension system, fuzzy gain scheduling, PID control, and adaptive neuro control. Numerical coverage with MATLAB® is integrated, and numerous examples and exercises are included for each chapter. Associated MATLAB® code will be made available.
Proceedings of the European Control Conference 1995, Rome, Italy 5-8 September 1995

The technical committee on mechatronics formed by the International Federation for the Theory of Machines and Mechanisms, in Prague, Czech Republic, adopted the following definition for the term: Mechatronics is the synergistic combination of precision mechanical engineering, electronic control and systems thinking in the design products and manufacturing process.Due to developments in powerful computers, including microprocessors and Application Specific Integrated Circuits (ASICS), computational techniques, diverse technologies, advances in the design process of products and other factors, the field of mechatronics has evolved as a highly powerful and most cost effective means for product realization.

In this book, modeling and control design of electric motors, namely step motors, brushless DC motors and induction motors, are considered. The book focuses on recent advances on feedback control designs for various types of electric motors, with a slight emphasis on stepper motors. For this purpose, the authors explore modeling of these devices to the extent needed to provide a high-performance controller, but at the same time one amenable to model-based nonlinear designs. The control designs focus primarily on recent robust adaptive nonlinear controllers to attain high performance. It is shown that the adaptive robust nonlinear controller on its own achieves reasonably good performance without

requiring the exact knowledge of motor parameters. While carefully tuned classical controllers often achieve required performance in many applications, it is hoped that the advocated robust and adaptive designs will lead to standard universal controllers with minimal need for fine tuning of control parameters.
This book provides a comprehensive study of multi-stage and multi-time scale design of feedback controllers for linear dynamic systems. It examines different types of controllers as can be designed for different parts of the system (subsystems) using corresponding feedback gains obtained by performing calculations (design) only with subsystem (reduced-order) matrices.The advantages of the multi-stage/multi-time scale design are presented and conditions for implementation of these controllers are established. Complete derivations and corresponding design techniques are presented for two-stage/two-time-scale, three-stage/three-time scale, and four-stage/four-time-scale systems. The techniques developed have potential applications to a large number of real physical systems. The design techniques are demonstrated on examples of mathematical models of fuel cells, especially the proton exchange membrane fuel cell.
This volume comprises selected extended papers written by prominent researchers participating in the International MultiConference of Engineers and

Computer Scientists 2015, Hong Kong, 18-20 March 2015. The conference served as a platform for discussion of frontier topics in theoretical and applied engineering and computer science, and subjects covered include communications systems, control theory and automation, bioinformatics, artificial intelligence, data mining, engineering mathematics, scientific computing, engineering physics, electrical engineering, and industrial applications. The book describes the state-of-the-art in engineering technologies and computer science and its applications, and will serve as an excellent reference for industrial and academic researchers and graduate students working in these fields.

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.

Uses real world case studies to present the key technologies of design and application of the synchronous generator excitation system This book systematically introduces the important technologies of design and application of the synchronous generator excitation system, including the three-phase bridge rectifier circuit, diode rectifier for separate excitation, brushless excitation system and the static self-stimulation excitation system. It fuses discussions on specific topics and basic theories, providing a detailed description of the theories essential for synchronous generators in the analysis of excitation systems. Design and Application of Modern Synchronous Generator Excitation Systems provides a cutting-edge examination of excitation system, addressing conventional hydro-turbines, pumped storage units, steam turbines, and nuclear power units. It looks at the features and performance of the excitation system of the 700MW hydro-turbine deployed at the Three Gorges Hydropower Plant spanning the Yangtze River in China, as well as the working principle and start-up procedure of the static frequency converter (SFC) of pumped storage units. It also expounds on the composition of the excitation transformer, power rectifier, de-excitation equipment, and automatic excitation regulator—in addition to the performance features of the excitation system of conventional 600/1000MW turbines and the excitation system of the 1000MW nuclear power unit. Presents cutting-edge technologies of the excitation system from a unique engineering perspective Offers broad appeal to power system engineers who require a better understanding of excitation systems Addresses hydro-turbines, pumped storage units, steam turbines, and nuclear power units Provides an interdisciplinary examination of a range of applications Written by a senior expert in the area of excitation systems Written by an author with over 50 years' experience, Design and Application of Modern Synchronous Generator Excitation Systems is an excellent text that offers an interdisciplinary exposition for professionals, researchers, and academics alike.

Nonlinear Control Systems and Power System DynamicsSpringer Science & Business Media

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.

The editors of this Special Issue titled “Intelligent Control in Energy Systems” have attempted to create a book containing original technical articles addressing various elements of intelligent control in energy systems. In response to our call for papers, we received 60 submissions. Of those submissions, 27 were published and 33 were rejected. In this book, we offer the 27 accepted technical articles as well as one editorial. Authors from 15 countries (China, Netherlands, Spain, Tunisia, United Sates of America, Korea, Brazil, Egypt, Denmark, Indonesia, Oman, Canada, Algeria, Mexico, and the Czech Republic) elaborate on several aspects of intelligent control in energy systems. The book covers a broad range of topics including fuzzy PID in automotive fuel cell and MPPT tracking, neural networks for fuel cell control and dynamic optimization of energy management, adaptive control on power systems, hierarchical Petri Nets in microgrid management, model predictive control for electric vehicle battery and frequency regulation in HVAC systems, deep learning for power consumption forecasting, decision trees for wind systems, risk analysis for demand side management, finite state automata for HVAC control, robust ?-synthesis for microgrids, and neuro-fuzzy systems in energy storage.

Control technology permeates every aspect of our lives. We rely on them to perform a wide variety of tasks without giving much thought to the origins of the technology or how it became such an important part of our lives. Control System Applications covers the uses of control systems, both in the common and in the uncommon areas of our lives. From the everyday to the unusual, it's all here. From process control to human-in-the-loop control, this book provides illustrations and examples of how these systems are applied. Each chapter contains an introduction to the application, a section defining terms and references, and a section on further readings that help you understand and use the techniques in your work environment. Highly readable and comprehensive, Control System Applications explores the uses of control systems. It illustrates the diversity of control systems and provides examples of how the theory can be applied to specific practical problems. It contains information about aspec ts of control that are not fully captured by the theory, such as techniques for protecting against controller failure and the role of cost and complexity in specifying controller designs.

Each number is the catalogue of a specific school or college of the University.

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 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.

Advances in Control Systems: Theory and Applications, Volume 2 provides information pertinent to the significant progress in the field of automatic control.

This book presents different methods for generating Liapunov functions, which is important in the analysis of nonlinear systems. Organized into five chapters, this volume begins with an overview of the reduction of the important method of Liapunov to a practical working tool for the analysis of complex nonlinear systems. This text then discusses applications of the rather powerful method of dynamic programming to a complex class of problems. Other chapters consider the mathematical theory of optimal control, which is often confronted with the task of solving a system of first-order ordinary differential equations. This book discusses as well the input–output relationship of multivariable linear systems or plants. The final chapter deals with a powerful technique for design by analysis of nonlinear systems. This book is a valuable resource for mathematicians and engineers.

This book provides in-depth coverage of the latest research and development activities concerning innovative wind energy technologies intended to replace fossil fuels on an economical basis. A characteristic feature of the various conversion concepts discussed is the use of tethered flying devices to substantially reduce the material consumption per installed unit and to access wind energy at higher altitudes, where the wind is more consistent. The introductory chapter describes the emergence and economic dimension of airborne wind energy. Focusing on “Fundamentals, Modeling & Simulation”, Part I includes six contributions that describe quasi-steady as well as dynamic models and simulations of airborne wind energy systems or individual components. Shifting the spotlight to “Control, Optimization & Flight State Measurement”, Part II combines one chapter on measurement techniques with five chapters on control of kite and ground stations, and two chapters on optimization. Part III on “Concept Design & Analysis” includes three chapters that present and analyze novel harvesting concepts as well as two chapters on system component design. Part IV, which centers on “Implemented Concepts”, presents five chapters on established system concepts and one chapter about a subsystem for automatic launching and landing of kites. In closing, Part V focuses with four chapters on “Technology Deployment” related to market and financing strategies, as well as on regulation and the environment. The book builds on the success of the first volume “Airborne Wind Energy” (Springer, 2013), and offers a self-contained reference guide for researchers, scientists, professionals and students. The respective chapters were contributed by a broad variety of authors: academics, practicing engineers and inventors, all of whom are experts in their respective fields.

This text emphasizes classical methods and presents essential analytical tools and strategies for the construction and development of improved design methods in nonlinear control. It offers engineering procedures for the frequency domain, as well as solved examples for clear understanding of control applications in the industrial, electrical, process, manufacturing, and automotive industries. The authors discuss Properties of nonlinear systems, stability, linearization methods, operating modes and dynamic analysis methods, phase trajectories in dynamic analysis of nonlinear systems, and harmonic linearization in dynamic analysis of nonlinear control systems operating in stabilization mode.