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Industrial Control Systems Applications of Neural Adaptive Control Technology Constructive Nonlinear Control Robust Nonlinear Control Design Nonlinear Control Systems using MATLAB® Uniform Output Regulation of Nonlinear Systems General Problem of the Stability Of Motion Advances and Applications in Nonlinear Control Systems Design of Nonlinear Control Systems with the Highest Derivative in Feedback Systems and Control Control of Nonlinear and Hybrid Process Systems

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Nonlinear Control Design presents a self-contained introduction to nonlinear feedback control design for continuous time, finite-dimensional uncertain systems. It deals with nonlinear systems affected by uncertainties such as unknown constant parameters, time-varying disturbances, and uncertain nonlinearities. Both state feedback and output feedback are addressed. Differential geometric techniques are used to identify classes of nonlinear systems considered and to design feedback algorithms. Adaptive versions of these controls are developed in the presence of unknown parameters while robust versions are designed in the presence of time-varying disturbances. These control algorithms are applied to significant physical control problems from electric motor drives, robotics, aerospace,

power systems and are illustrated through worked examples. The text is illustrated throughout with over 100 exercises, more than 75 worked examples and 12 physical examples. Singular perturbations and time-scale techniques were introduced to control engineering in the late 1960s and have since become common tools for the modeling, analysis, and design of control systems. In this SIAM Classics edition of the 1986 book, the original text is reprinted in its entirety (along with a new preface), providing once again the theoretical foundation for representative control applications. This book continues to be essential in many ways. It lays down the foundation of singular perturbation theory for linear and nonlinear systems, it presents the methodology in a pedagogical way that is not available anywhere else, and it illustrates the theory with many solved examples, including various physical examples and applications. So while new developments may go beyond the topics covered in this book, they are still based on the methodology described here, which continues to be their common starting point. This book presents high-quality original contributions on positive systems, including those with positivity in compartmental switched systems, Markovian jump systems, Boolean networks, interval observer design, fault detection, and delay systems. It comprises a selection of the best papers from POSTA 2018, the 6th International Conference on Positive Systems, which was held in Hangzhou, China, in August 2018. The POSTA conference series represents a targeted response to the growing need for research that reports on and critically discusses a wide range of topics concerning the theory and applications of positive systems. The book offers

valuable insights for researchers in applied mathematics, control theory and their applications. The text of this edition has been revised to bring it into line with current teaching, including an expansion of the material on bifurcations and chaos. It is directed towards practical applications of the theory with examples and problems. This book presents the results of the second workshop on Neural Adaptive Control Technology, NACT II, held on September 9-10, 1996, in Berlin. The workshop was organised in connection with a three-year European-Union-funded Basic Research Project in the ESPRIT framework, called NACT, a collaboration between Daimler-Benz (Germany) and the University of Glasgow (Scotland).The NACT project, which began on 1 April 1994, is a study of the fundamental properties of neural-network-based adaptive control systems. Where possible, links with traditional adaptive control systems are exploited. A major aim is to develop a systematic engineering procedure for designing neural controllers for nonlinear dynamic systems. The techniques developed are being evaluated on concrete industrial problems from within the Daimler-Benz group of companies.The aim of the workshop was to bring together selected invited specialists in the fields of adaptive control, nonlinear systems and neural networks. The first workshop (NACT I) took place in Glasgow in May 1995 and was mainly devoted to theoretical issues of neural adaptive control. Besides monitoring further development of theory, the NACT II workshop was focused on industrial applications and software tools. This context dictated the focus of the book and guided the editors in the choice of the papers and their subsequent reshaping into

substantive book chapters. Thus, with the project having progressed into its applications stage, emphasis is put on the transfer of theory of neural adaptive engineering into industrial practice. The contributors are therefore both renowned academics and practitioners from major industrial users of neurocontrol. Mathematics is playing an ever more important role in the physical and biological sciences, provoking a blurring of boundaries between scientific disciplines and a resurgence bf interest in the modern as well as the clas sical techniques of applied mathematics. This renewal of interest, both in research and teaching, has led to the establishment of the series: Texts in Applied Mat!!ematics (TAM). The development of new courses is a natural consequence of a high level of excitement oil the research frontier as newer techniques, such as numerical and symbolic cotnputer systems, dynamical systems, and chaos, mix with and reinforce the traditional methods of applied mathematics. Thus, the purpose of this textbook series is to meet the current and future needs of these advances and encourage the teaching of new courses. TAM will publish textbooks suitable for use in advanced undergraduate and beginning graduate courses, and will complement the Applied Math ematical Sciences (AMS) series, which will focus on advanced textbooks and research level monographs. Preface to the Second Edition This book covers those topics necessary for a clear understanding of the qualitative theory of ordinary differential equations and the concept of a dynamical system. It is written for advanced undergraduates and for beginning graduate students. It begins with a study of linear systems of ordinary differential equations, a topic

already familiar to the student who has completed a first course in differential equations. Thepastthree decadeshaveseenrapiddevelopmentin the areaofmodelpredtive control with respect to both theoretical and application aspects. Over these 30 years, model predictive control for linear systems has been widely applied, especially in the area of process control. However, today's applications often require driving the process over a wide region and close to the boundaries of - erability, while satisfying constraints and achieving near-optimal performance. Consequently, the application of linear control methods does not always lead to satisfactory performance, and here nonlinear methods must be employed. This is one of the reasons why nonlinear model predictive control (NMPC) has - joyed signi?cant attention over the past years,with a number of recent advances on both the theoretical and application frontier. Additionally, the widespread availability and steadily increasing power of today's computers, as well as the development of specially tailored numerical solution methods for NMPC, bring thepracticalapplicabilityofNMPCwithinreachevenforveryfastsystems has led to a series of new, exciting developments, along with new challenges in the area of NMPC. Upper-level undergraduate text introduces aspects of optimal control theory: dynamic programming, Pontryagin's minimum principle, and numerical techniques for trajectory optimization. Numerous figures, tables. Solution guide available upon request. 1970 edition. Constructive Nonlinear Control presents a broad repertoire of constructive nonlinear designs not available in other works by widening the class of systems and design tools. Several streams of nonlinear

control theory are merged and directed towards a constructive solution of the feedback stabilization problem. Analysis, geometric and asymptotic concepts are assembled as design tools for a wide variety of nonlinear phenomena and structures. Geometry serves as a guide for the construction of design procedures whilst analysis provides the robustness which geometry lacks. New recursive designs remove earlier restrictions on feedback passivation. Recursive Lyapunov designs for feedback, feedforward and interlaced structures result in feedback systems with optimality properties and stability margins. The design-oriented approach will make this work a valuable tool for all those who have an interest in control theory. With respect to the first edition as Volume 218 in the Lecture Notes in Con trol and Information Sciences series the basic idea of the second edition has remained the same: to provide a compact presentation of some basic ideas in the classical theory of input-output and closed-loop stability, together with a choice of contributions to the recent theory of nonlinear robust and 1foo control and passivity-based control. Nevertheless, some parts of the book have been thoroughly revised and/or expanded, in order to have a more balanced presen tation of the theory and to include some of the new developments which have been taken place since the appearance of the first edition. I soon realized, how ever, that it is not possible to give a broad exposition of the existing literature in this area without affecting the spirit of the book, which is precisely aimed at a compact presentation. So as a result the second edition still reflects very much my personal taste and research interests. I trust that others will write books

emphasizing different aspects. Major changes with respect to the first edition are the following: • A new section has been added in Chapter 2 relating L2-gain and passivity via scattering, emphasizing a coordinate-free, geometric, treatment. • The section on stability in Chapter 3 has been thoroughly expanded, also incorporating some recent results presented in [182J. For a first course on nonlinear control that can be taught in one semester ¿ This book emerges from the award-winning book, Nonlinear Systems, but has a distinctly different mission and¿organization. While Nonlinear Systems was intended as a reference and a text on nonlinear system analysis and its application to control, this streamlined book is intended as a text for a first course on nonlinear control. In Nonlinear Control, author Hassan K. Khalil employs a writing style that is intended to make the book accessible to a wider audience without compromising the rigor of the presentation. ¿ Teaching and Learning Experience This program will provide a better teaching and learning experience-for you and your students. It will help: Provide an Accessible Approach to Nonlinear Control: This streamlined book is intended as a text for a first course on nonlinear control that can be taught in one semester. Support Learning: Over 250 end-of-chapter exercises give students plenty of opportunities to put theory into action. This softcover book summarizes Lyapunov design techniques for nonlinear systems and raises important issues concerning large-signal robustness and performance. The authors have been the first to address some of these issues, and they report their findings in this text. The researcher who wishes to enter the field of robust nonlinear control could use this book as a

source of new research topics. For those already active in the field, the book may serve as a reference to a recent body of significant work. Finally, the design engineer faced with a nonlinear control problem will benefit from the techniques presented here. Nonlinear Output Regulation: Theory and Applications provides a comprehensive and in-depth treatment of the nonlinear output regulation problem. It contains up-to-date research results and algorithms and tools for approaching and solving the output regulation problem and related problems, such as robust stabilization of nonlinear systems. Output regulation is a general mathematical formulation of many control problems encountered in daily life including cruise control of automobiles, landing and takeoff of aircraft, manipulation of robot arms, orbiting of satellites, and speed regulation of motors. The book provides a self-contained treatment starting with an introduction to the linear output regulation problem and a review of the fundamental nonlinear control theory. The author's presentation strikes a balance between the theoretical foundation of the problem and the practical applications of the theory. The book is accompanied by many examples, including practical case studies with numerical simulations based on MATLAB/SIMULINK. Audience: graduate students, professors, and researchers in applied mathematics, electrical engineering, mechanical engineering, and aerospace engineering. The book can be used in a graduate-level control systems course as well as by control design engineers in industry. For a first-year graduate-level course on nonlinear systems. It may also be used for self-study or reference by engineers and applied mathematicians.

The text is written to build the level of mathematical sophistication from chapter to chapter. It has been reorganized into four parts: Basic analysis, Analysis of feedback systems, Advanced analysis, and Nonlinear feedback control. The editors of this book have incorporated contributions from a diverse group of leading researchers in the field of nonlinear systems. To enrich the scope of the content, this book contains a valuable selection of works on fractional differential equations.The book aims to provide an overview of the current knowledge on nonlinear systems and some aspects of fractional calculus. The main subject areas are divided into two theoretical and applied sections. Nonlinear systems are useful for researchers in mathematics, applied mathematics, and physics, as well as graduate students who are studying these systems with reference to their theory and application. This book is also an ideal complement to the specific literature on engineering, biology, health science, and other applied science areas. The opportunity given by IntechOpen to offer this book under the open access system contributes to disseminating the field of nonlinear systems to a wide range of researchers. This study of the nonlinear output regulation problem embraces local as well as global cases, covering such aspects as controller design and practical implementation issues. From the reviews: "The authors treat the problem of output regulation for a nonlinear control system...[they] develop a global approach to output regulation along familiar lines....I found the book to be ambitious and rigorous, tackling some hard conceptual issues." --IEEE TRANSACTIONS ON AUTOMATIC CONTROL For over a quarter of a century,

high-gain observers have been used extensively in the design of output feedback control of nonlinear systems. This book presents a clear, unified treatment of the theory of high-gain observers and their use in feedback control. Also provided is a discussion of the separation principle for nonlinear systems; this differs from other separation results in the literature in that recovery of stability as well as performance of state feedback controllers is given. The author provides a detailed discussion of applications of high-gain observers to adaptive control and regulation problems and recent results on the extended high-gain observers. In addition, the author addresses two challenges that face the implementation of high-gain observers: high dimension and measurement noise. Low-power observers are presented for high-dimensional systems. The effect of measurement noise is characterized and techniques to reduce that effect are presented. The book ends with discussion of digital implementation of the observers. Readers will find comprehensive coverage of the main results on high-gain observers; rigorous, self-contained proofs of all results; and numerous examples that illustrate and provide motivation for the results. The book is intended for engineers and applied mathematicians who design or research feedback control systems. 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. Nonlinear Dynamical Systems and Control presents and develops an extensive treatment of stability analysis and control design of nonlinear dynamical systems, with an emphasis on Lyapunov-based methods. Dynamical system theory lies at the heart of mathematical sciences and engineering. The application of dynamical systems has crossed interdisciplinary boundaries from chemistry to biochemistry to chemical kinetics, from medicine to biology to population genetics, from economics to sociology to psychology, and from physics to mechanics to engineering. The increasingly complex nature of engineering systems requiring feedback control to obtain a desired system behavior also gives rise to dynamical systems. Wassim Haddad and VijaySekhar Chellaboina provide an exhaustive treatment of nonlinear systems theory and control using the highest standards of exposition and rigor. This graduate-level textbook goes well beyond standard treatments by developing Lyapunov stability theory, partial stability, boundedness, input-to-state stability, input-output stability,

finite-time stability, semistability, stability of sets and periodic orbits, and stability theorems via vector Lyapunov functions. A complete and thorough treatment of dissipativity theory, absolute stability theory, stability of feedback systems, optimal control, disturbance rejection control, and robust control for nonlinear dynamical systems is also given. This book is an indispensable resource for applied mathematicians, dynamical systems theorists, control theorists, and engineers. For a first-year graduate-level course on nonlinear systems. It may also be used for self-study or reference by engineers and applied mathematicians. The text is written to build the level of mathematical sophistication from chapter to chapter. It has been reorganized into four parts: Basic analysis, Analysis of feedback systems, Advanced analysis, and Nonlinear feedback control. The objective of the EU Nonlinear Control Network Workshop was to bring together scientists who are already active in nonlinear control and young researchers working in this field. This book presents selectively invited contributions from the workshop, some describing state-of-the-art subjects that already have a status of maturity while others propose promising future directions in nonlinear control. Amongst others, following topics of nonlinear and adaptive control are included: adaptive and robust control, applications in physical systems, distributed parameter systems, disturbance attenuation, dynamic feedback, optimal control, sliding mode control, and tracking and motion planning. Observer Design for Nonlinear Systems deals with the design of observers for the large class of nonlinear continuous-time models. It contains a unified overview of a

broad range of general designs, including the most recent results and their proofs, such as the homogeneous and nonlinear Luenberger design techniques. The book starts from the observation that most observer designs consist in looking for a reversible change of coordinates transforming the expression of the system dynamics into some specific structures, called normal forms, for which an observer is known. Therefore, the problem of observer design is broken down into three sub-problems: • What are the available normal forms and their associated observers?• Under which conditions can a system be transformed into one of these forms and through which transformation? • How can an inverse transformation that recovers an estimate in the given initial coordinates be achieved? This organisation allows the book to structure results within a united framework, highlighting the importance of the choice of the observer coordinates for nonlinear systems. In particular, the first part covers state-affine forms with their Luenberger or Kalman designs, and triangular forms with their homogeneous high-gain designs. The second part addresses the transformation into linear forms through linearization by output injection or in the context of a nonlinear Luenberger design, and into triangular forms under the well-known uniform and differential observability assumptions. Finally, the third part presents some recently developed methods for avoiding the numerically challenging inversion of the transformation. Observer Design for Nonlinear Systems addresses students and researchers looking for an introduction to or an overview of the state of the art in observer design for nonlinear continuous-time dynamical systems. The book gathers the

most important results focusing on a large and diffuse literature on general observer designs with global convergence, and is a valuable source of information for academics and practitioners. When M. Vidyasagar wrote the first edition of Nonlinear Systems Analysis, most control theorists considered the subject of nonlinear systems a mystery. Since then, advances in the application of differential geometric methods to nonlinear analysis have matured to a stage where every control theorist needs to possess knowledge of the basic techniques because virtually all physical systems are nonlinear in nature. The second edition, now republished in SIAM's Classics in Applied Mathematics series, provides a rigorous mathematical analysis of the behavior of nonlinear control systems under a variety of situations. It develops nonlinear generalizations of a large number of techniques and methods widely used in linear control theory. The book contains three extensive chapters devoted to the key topics of Lyapunov stability, input-output stability, and the treatment of differential geometric control theory. Audience: this text is designed for use at the graduate level in the area of nonlinear systems and as a resource for professional researchers and practitioners working in areas such as robotics, spacecraft control, motor control, and power systems. This book makes more widely accessible the text of Lyapunov's major memoir of the general problem of the stability of motion. Translated by A. T. Fuller (University of Cambridge), the work is now available for the first time in the English language, and marked the centenary of the Russian publication in the late 1800s. Including a biography of Lyapunov and a

comprehensive bibliography of his work, this excellent volume will prove to be of fundamental interest to all those concerned with the concept of the stability of motion, boundaries of stability, and with nonlinear dynamics. 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. The purpose of this fantastically useful book is to lay out an overview on possible tools for state reconstruction in nonlinear systems. Here, basic observability notions and observer structures are recalled, together with ingredients for advanced designs on this basis. The problem of state reconstruction in dynamical systems, known as observer problem, is crucial for controlling or even merely monitoring processes. For linear systems, the theory has been well established for several years, so this book attempts to tackle the problem for non-linear systems. 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. 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. 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. Instructor's Solutions Manual to Accompany Systems and Control is a supplement to Zak's main text. It contains solutions to all of the end-of-chapter problems and it is available free of charge to adopting professors. This book presents methods to study the controllability and the stabilization of nonlinear control systems in finite and infinite dimensions. The emphasis is put on specific phenomena due to nonlinearities. In particular, many examples are given where nonlinearities turn out to be essential to get controllability or stabilization. Various methods are presented to study the controllability or to construct stabilizing feedback laws. The power of these methods is illustrated by numerous examples coming from such areas as celestial mechanics, fluid mechanics, and quantum mechanics. The book is addressed to graduate students in mathematics or control theory, and to mathematicians or engineers with an interest in nonlinear control systems governed by ordinary or partial differential equations. Nonlinear Industrial Control Systems presents a range of mostly optimisation-based methods for severely nonlinear systems; it discusses feedforward and feedback control and tracking control systems design. The plant models and design algorithms are provided in a MATLAB® toolbox that enable both academic examples and industrial application studies to be repeated and evaluated, taking into account practical application and implementation problems. The text makes nonlinear control theory accessible to readers

having only a background in linear systems, and concentrates on real applications of nonlinear control. It covers: different ways of modelling nonlinear systems including state space, polynomial-based, linear parameter varying, state-dependent and hybrid; design techniques for nonlinear optimal control including generalised-minimum-variance, model predictive control, quadratic-Gaussian, factorised and H? design methods; design philosophies that are suitable for aerospace, automotive, marine, process-control, energy systems, robotics, servo systems and manufacturing; steps in design procedures that are illustrated in design studies to define cost-functions and cope with problems such as disturbance rejection, uncertainties and integral wind-up; and baseline non-optimal control techniques such as nonlinear Smith predictors, feedback linearization, sliding mode control and nonlinear PID. Nonlinear Industrial Control Systems is valuable to engineers in industry dealing with actual nonlinear systems. It provides students with a comprehensive range of techniques and examples for solving real nonlinear control design problems. 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. 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. This book employs the powerful and popular adaptive backstepping control technology to design controllers for dynamic uncertain systems with non-smooth nonlinearities. Various cases including systems with time-varying parameters, multi-

inputs and multi-outputs, backlash, dead-zone, hysteresis and saturation are considered in design and analysis. For multi-inputs and multi-outputs systems, both centralized and decentralized controls are addressed. This book not only presents recent research results including theoretical success and practical development such as the proof of system stability and the improvement of system tracking and transient performance, but also gives self-contained coverage of fundamentals on the backstepping approach illustrated with simple examples. Detail description of methodologies for the construction of adaptive laws, feedback control laws and associated Lyapunov functions is systematically provided in each case. Approaches used for the analysis of system stability and tracking and transient performances are elaborated. Two case studies are presented to show how the presented theories are applied. This monograph provides insight and fundamental understanding into the feedback control of nonlinear and hybrid process systems. It presents state-of-the-art methods for the synthesis of nonlinear feedback controllers for nonlinear and hybrid systems with uncertainty, constraints and time-delays with numerous applications, especially to chemical processes. It covers both state feedback and output feedback (including state estimator design) controller designs. Control of Nonlinear and Hybrid Process Systems includes numerous comments and remarks providing insight and fundamental understanding into the feedback control of nonlinear and hybrid systems, as well as applications that demonstrate the implementation and effectiveness of the presented control methods. The book includes many detailed examples which can be easily

modified by a control engineer to be tailored to a specific application. This book is useful for researchers in control systems theory, graduate students pursuing their degree in control systems and control engineers. 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.

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