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Optimal Control Applications in Electric Power Systems

**G. S. Christensen, M. E. El-Hawary,
and S. A. Soliman**

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Optimal Control Applications In Electric Power Systems

James A. Momoh



Optimal Control Applications In Electric Power Systems:

Optimal Control Applications in Electric Power Systems G.S. Christensen, M.E. El-Hawary, S.A. Soliman, 2013-11-21

Significant advances in the field of optimal control have been made over the past few decades. These advances have been well documented in numerous fine publications and have motivated a number of innovations in electric power system engineering but they have not yet been collected in book form. Our purpose in writing this book is to provide a description of some of the applications of optimal control techniques to practical power system problems. The book is designed for advanced undergraduate courses in electric power systems as well as graduate courses in electrical engineering, applied mathematics, and industrial engineering. It is also intended as a self-study aid for practicing personnel involved in the planning and operation of electric power systems for utilities, manufacturers, and consulting and government regulatory agencies. The book consists of seven chapters. It begins with an introductory chapter that briefly reviews the history of optimal control and its power system applications and also provides an outline of the text. The second chapter is entitled "Some Optimal Control Techniques"; its intent is to introduce fundamental concepts of optimal control theory that are relevant to the applications treated in the following chapters. Emphasis is given to clear methodical development rather than rigorous formal proofs. Topics discussed include variational calculus, Pontryagin's maximum principle, and geometric methods employing functional analysis. A number of solved examples are included to illustrate the techniques.

Optimal Control Applications in Electric Power Systems Stefano Pietrosanti, William Holderbaum, 2018-04 **Power Systems: Modelling and Control**

Applications A. J. Calvaer, 2014-05-23 The control of power systems and power plants is a subject of worldwide interest which continues to sustain a high level of research, development, and application. Papers pertaining to areas directly related to power systems and representing the state of the art methods are included in this volume. The topics covered include security analysis, dynamic state estimation, voltage control, power plant control, stability analysis, data communication, expert systems, and training simulators for power plants. This interchange between those involved in the research and those involved in the practical applications of new ideas and developments provide a comprehensive reference source for all involved in the power industry.

Intelligent Control for Electric Power Systems and Electric Vehicles G. Rigatos, M. Abbaszadeh, M. Hamida, P.

Siano, 2024-10-30 The present monograph offers a detailed and in-depth analysis of the topic of Intelligent Control for Electric Power Systems and Electric Vehicles. First, nonlinear optimal control and Lie algebra-based control, control based on approximate linearization and global linearization-based control concepts, is analyzed. Next, differential flatness theory and flatness-based control methods, global linearization-based control with the use of differential flatness theory, and flatness-based control of nonlinear dynamical systems in cascading loops is treated. Following the control theoretic part, control of DC and PMSM electric motors, control of DC motors through a DC-DC converter, and control of permanent magnet brushless DC motors is presented. Besides control of VSI-fed three-phase and multi-phase PMSMs, nonlinear optimal control VSI-fed

three phase PMSMs and Nonlinear optimal control VSI fed six phase PMSMs is explained Additionally Control of energy conversion chains based on PMSMs Control of wind turbine and PMSM based electric power unit and Control of a PMSM driven gas compression unit is studied Besides Control of energy conversion chains based on Induction Machines Control of the VSI fed three phase induction motor Control of an induction motor driven gas compressor and Control of induction generator based shipboard microgrids is explained Next Control of multi phase machines in gas processing and power units Control of gas compressors actuated by 5 phase PMSMs and Control of 6 phase induction generators in renewable energy units is introduced Moreover Control of Spherical Permanent Magnet Synchronous Motors and Switched Reluctance Motors Control of spherical permanent magnet synchronous motors Control of switched reluctance motors for electric traction and Adaptive control for switched reluctance motors is analyzed Furthermore Control of traction and powertrains in Electric Vehicles and Hybrid Electric Vehicles Control of multi phase motors in the traction system in electric vehicles and Control of synchronous machines and converters in power chains of hybrid electric vehicles is explained Finally Control of renewable power units and heat management units Control of residential microgrids with Wind Generators Fuel Cells and PVs and Control of heat pumps for thermal management in electric vehicles is treated The new control methods which are proposed by the monograph treat the control problem of the complex nonlinear dynamics of electric power systems and electric vehicles without the need for complicated state space model transformations and changes of state variables The proposed control schemes are modular and scalable and can be applied to a large class of dynamic models of electric power systems and electric vehicles They have a clear and easy to implement algorithmic part while they also exhibit a moderate computational load The proposed control schemes foster the optimized exploitation of renewable energy sources and the reliable integration of renewable energy units in the power grid Besides they support the transition to electromotion and the deployment of the use of electric vehicles The manuscript is suitable for teaching nonlinear control estimation and fault diagnosis topics with emphasis to electric power systems and to electric vehicle traction and propulsion systems both at late undergraduate and postgraduate levels

Control System Applications William S. Levine, 2018-10-24 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 aspects

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 *Control Applications of Nonlinear Programming and Optimization* 1989 H.B. Siguerdidjane,P. Bernhard,2014-07-04 These Proceedings provide valuable information on the exchange of ideas between scientists who apply nonlinear programming and optimization to real world control problems and those who develop new methods algorithms and software The papers deal with windshear problems optimization of aircraft and spacecraft trajectories optimal control for robots the optimization of urban traffic control general mechanical systems multilevel inventory systems and robust control **Advanced Anomaly Detection Technologies and Applications in Energy**

Systems Tinghui Ouyang,Yusen He,Xun Shen,Zhenhao Tang,Yahui Zhang,2025-02-17 Anomaly detection is an important topic which has been well studied in diverse research areas and application domains It generally involves detection of abnormal data unhealthy status fault diagnosis and can be helpful to guarantee industrial systems stability security and economy As development of intelligent industries and sensor systems grows large amounts of data become easily available and challenges arise in industrial systems anomaly detection One typical case is the study within energy related systems like thermal energy renewable energy study e g wind energy photovoltaic electric vehicles and so on These systems can involve various data formats and more complex data structures making anomaly data detection a challenge Currently under the development of deep learning and big data analytics many promising results have been achieved in energy systems anomaly data detection However many challenging problems remain unsolved due to the complex nature of energy industries New techniques and advanced engineering applications on anomaly detection in energy systems still appeal to a wide range of scholars and industries **Advances in Applied Nonlinear Optimal Control** Gerasimos Rigatos,Electra

Karapanou,2020-11-19 This volume discusses advances in applied nonlinear optimal control comprising both theoretical analysis of the developed control methods and case studies about their use in robotics mechatronics electric power generation power electronics micro electronics biological systems biomedical systems financial systems and industrial production processes The advantages of the nonlinear optimal control approaches which are developed here are that by applying approximate linearization of the controlled systems state space description one can avoid the elaborated state variables transformations diffeomorphisms which are required by global linearization based control methods The book also applies the control input directly to the power unit of the controlled systems and not on an equivalent linearized description thus avoiding the inverse transformations met in global linearization based control methods and the potential appearance of singularity problems The method adopted here also retains the known advantages of optimal control that is the best trade off between accurate tracking of reference setpoints and moderate variations of the control inputs The book s findings on nonlinear optimal control are a substantial contribution to the areas of nonlinear control and complex dynamical systems and will find use in several research and engineering disciplines and in practical applications **Applied Mechanics Reviews**

,1981 Advances in Robust Control and Applications Nabil Derbel,Ahmed Said Nouri,Quanmin Zhu,2023-09-12 The book presents recent applications and developments in the field of control of industrial systems covering a wide range of modeling and feedback control using various robust approaches such as fuzzy systems sliding mode control and H infinity This book provides insights into theory applications and perspectives relevant to the field of robotic systems exoskeletons power systems photovoltaic systems etc as well as general methodologies and paradigms around them Each chapter provides an enriched understanding of a research topic along with a balanced treatment of the relevant theories methods or applications It reports on the latest advances in the field This book is a good reference for graduate students researchers educators engineers and scientists and contains a total of 15 chapters divided into five parts as follows The first part of this book focuses on the application of fuzzy control to robotic systems and consists of three chapters The second part of this book proposes the control of lower and upper limb exoskeletons and includes two chapters The third part is dedicated to the control of power systems and comprises three chapters The fourth part deals with various approaches to the modeling and control of industrial processes and comprises four chapters The fifth and final part describes observers and fault tolerant control systems and comprises five chapters **1995 IEEE Conference on Control Applications** IEEE Control Systems Society,1995 The ... IEEE Conference on Control Applications ,1992 **Computer Software for Industrial Control** E. J. Kompass,Theodore Joseph Williams,1981 **Nuclear Science Abstracts** ,1975-07 **SIAM Journal on Control and Optimization** Society for Industrial and Applied Mathematics,1983 *Microcomputers* Engineering Information, Inc,1983 Journal of Dynamic Systems, Measurement, and Control ,1979 *Fifth International Conference on Power System Management and Control* ,2002 Comprehensive Dissertation Index, 1861-1972: Engineering: civil, electrical, and industrial Xerox University Microfilms,1973 Electric Power System Applications of Optimization James A. Momoh,2017-12-19 As the demand for energy continues to grow optimization has risen to the forefront of power engineering research and development Continuing in the bestselling tradition of the first edition *Electric Power System Applications of Optimization* Second Edition presents the theoretical background of optimization from a practical power system point of view exploring advanced techniques new directions and continuous application problems The book provides both the analytical formulation of optimization and various algorithmic issues that arise in the application of various methods in power system planning and operation The second edition adds new functions involving market programs pricing reliability and advances in intelligent systems with implemented algorithms and illustrative examples It describes recent developments in the field of Adaptive Critics Design and practical applications of approximate dynamic programming To round out the coverage the final chapter combines fundamental theories and theorems from functional optimization optimal control and dynamic programming to explain new Adaptive Dynamic Programming concepts and variants With its one of a kind integration of cornerstone optimization principles with application examples this second edition propels power engineers to new

discoveries in providing optimal supplies of energy

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