Nonlinear Power Flow Control Design Utilizing Exergy Entropy Static And Dynamic Stability And Lyapunov Analysis Understanding Complex Systems

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CONTROLO 2020
Analysis, Control and Optimal Operations in Hybrid Power Systems
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Efficient Solvers for Power Flow Equations : Parametric Solutions with Accuracy Control Assessment

JACKSON ANNA

Robust Control for Grid Voltage Stability: High Penetration of Renewable Energy Springer Nature Enables readers to master and apply the operator-theoretic approach Control of nonlinear systems is a multidisciplinary field involving electrical engineering, computer science, and control engineering. Specifically, this book addresses uncertain nonlinearity. Beginning with how real plants are modeled as operator-based plants, the author develops a systematic methodology that enables readers to understand a quantitative stability result, a critical factor in any nonlinear control system's stability and performance. Operator-Based Nonlinear Control Systems: Design and Applications focuses on the operator-theoretic approach, offering detailed examples on how to apply it to network controlled systems. In addition to current research results, the author explores future research directions and applications of the operator-theoretic approach. The book begins with an introduction that defines nonlinear systems. Next, it covers: Robust right coprime factorization for nonlinear plants with uncertainties Robust stability of operator-based nonlinear control systems Tracking issues and fault detection issues in nonlinear control systems Operator-based nonlinear control systems with smart actuators Nonlinear feedback control for large-scale systems using a distributed control system device Throughout the book, discussions of actual applications help readers understand how the operator-theoretic approach works in practice. Operator-Based Nonlinear Control Systems is recommended for students and professionals in control theory engineering and applied mathematics. Working with this expertly written and organized book, they will learn how to obtain robust right coprime factorization for modeled plants. Moreover, they will discover state-of-the-technology research results on robust stability conditions as well as the latest system output tracking and fault detection issues that are challenging today's researchers.

Hierarchical Nonlinear Switching Control Design with

Applications to Propulsion Systems Springer
This book deals specifically with control theories relevant to the design of control units for switched power electronics devices, for the most part represented by DC–DC converters and supplies, by rectifiers of different kinds and by inverters with varying topologies. The theoretical methods for designing controllers in linear and nonlinear systems are accompanied by multiple case studies and examples showing their application in the emerging field of power electronics.
Nonlinear Process Control Birkhäuser
Microgrids Presents microgrid methodologies in modeling, stability, and control, supported by real-time simulations and experimental studies Microgrids: Dynamic Modeling, Stability and Control, provides comprehensive coverage of microgrid modeling, stability, and control, alongside new relevant perspectives and research outcomes, with vital information on several microgrid modeling methods, stability analysis methodologies and control synthesis approaches that are supported by real-time simulations and experimental studies for active learning in professionals and students alike. This book is divided into two parts: individual microgrids and interconnected microgrids. Both parts provide individual chapters on modeling, stability, and control, providing comprehensive information on the background, concepts, and architecture, supported by several examples and corresponding source codes/simulation files. Communication based control and cyber security of microgrids are addressed and new outcomes and advances in interconnected microgrids are discussed. Summarizing the outcome of more than 15 years of the authors' teaching, research, and projects, Microgrids: Dynamic Modeling, Stability and Control covers specific sample topics such as: Microgrid dynamic modeling, covering microgrid components modeling, DC and AC microgrids modeling examples, reduced-order models, and model validation Microgrid stability analysis, covering stability analysis methods, islanded/grid connected/interconnected microgrid stability Microgrids control, covering hierarchical control structure, communication-based control, cyber-resilient control, advanced control theory applications, virtual inertia control and data-driven control Modeling, analysis of stability challenges, and emergency control of large-scale interconnected microgrids Synchronization stability of interconnected microgrids, covering control requirements of synchronous microgrids and inrush power analysis With comprehensive, complete, and accessible coverage of the subject, Microgrids: Dynamic Modeling, Stability and Control is the ideal reference for professionals (engineers, developers) and students working with power/smart grids, renewable energy, and power systems, to enable a more effective use of their microgrids or interconnected microgrids.
Control Design Techniques in Power Electronics Devices John Wiley & Sons
Provides students with an understanding of the

modeling and practice in power system stability analysis and control design, as well as the computational tools used by commercial vendors Bringing together wind, FACTS, HVDC, and several other modern elements, this book gives readers everything they need to know about power systems. It makes learning complex power system concepts, models, and dynamics simpler and more efficient while providing modern viewpoints of power system analysis. Power System Modeling, Computation, and Control provides students with a new and detailed analysis of voltage stability; a simple example illustrating the BCU method of transient stability analysis; and one of only a few derivations of the transient synchronous machine model. It offers a discussion on reactive power consumption of induction motors during start-up to illustrate the low-voltage phenomenon observed in urban load centers. Damping controller designs using power system stabilizer, HVDC systems, static var compensator, and thyristor-controlled series compensation are also examined. In addition, there are chapters covering flexible AC transmission Systems (FACTS)—including both thyristor and voltage-sourced converter technology—and wind turbine generation and modeling. Simplifies the learning of complex power system concepts, models, and dynamics Provides chapters on power flow solution, voltage stability, simulation methods, transient stability, small signal stability, synchronous machine models (steady-state and dynamic models), excitation systems, and power system stabilizer design Includes advanced analysis of voltage stability, voltage recovery during motor starts, FACTS and their operation, damping control design using various control equipment, wind turbine models, and control Contains numerous examples, tables, figures of block diagrams, MATLAB plots, and problems involving real systems Written by experienced educators whose previous books and papers are used extensively by the international scientific community Power System Modeling, Computation, and Control is an ideal textbook for graduate students of the subject, as well as for power system engineers and control design professionals.

Microgrids John Wiley & Sons

This book covers the most recent developments in adaptive dynamic programming (ADP). The text begins with a thorough background review of ADP making sure that readers are sufficiently familiar with the fundamentals. In the core of the book, the authors address first discrete- and then continuous-time systems. Coverage of discrete-time systems starts with a more general form of value iteration to demonstrate its convergence, optimality, and stability with complete and thorough theoretical analysis. A more realistic form of value iteration is studied where value function approximations are assumed to have finite errors. Adaptive Dynamic Programming also details another avenue of the ADP approach: policy iteration. Both basic and generalized forms of policy-iteration-based ADP are studied with complete and thorough theoretical analysis in terms of

convergence, optimality, stability, and error bounds. Among continuous-time systems, the control of affine and nonaffine nonlinear systems is studied using the ADP approach which is then extended to other branches of control theory including decentralized control, robust and guaranteed cost control, and game theory. In the last part of the book the real-world significance of ADP theory is presented, focusing on three application examples developed from the authors' work: • renewable energy scheduling for smart power grids;• coal gasification processes; and• water–gas shift reactions. Researchers studying intelligent control methods and practitioners looking to apply them in the chemical-process and power-supply industries will find much to interest them in this thorough treatment of an advanced approach to control.

Nonlinear Power Flow Control Design John Wiley & Sons

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.

Applications of Nonlinear Control Springer

This book offers a timely and comprehensive snapshot of research and developments in the field of control engineering. Covering a wide range of theoretical and practical issues, the contributions describes a number of different control approaches, such adaptive control, fuzzy and neuro-fuzzy control, remote and robust control systems, real time an fault tolerant control, among others. Sensors and actuators, measurement systems, renewable energy systems, aerospace systems as well as industrial control and automation, are also comprehensively covered. Based on the proceedings of the 14th APCA International Conference on Automatic Control and Soft Computing, held on July 1-3, 2020, in Bragança, Portugal, the book offers a timely and thoroughly survey of the latest research in the field of control, and a source of inspiration for researchers and professionals worldwide.

Unified Power Flow Controller Technology and Application Springer Science & Business Media

This book intends to report new optimal control results with critic intelligence for complex discrete-time systems, which covers the novel control theory, advanced control methods, and typical applications for wastewater treatment systems. Therein, combining with artificial intelligence techniques, such as neural networks and reinforcement learning, the novel intelligent critic control theory as well as a series of advanced optimal regulation and trajectory tracking strategies are established for discrete-time nonlinear systems,

followed by application verifications to complex wastewater treatment processes. Consequently, developing such kind of critic intelligence approaches is of great significance for nonlinear optimization and wastewater recycling. The book is likely to be of interest to researchers and practitioners as well as graduate students in automation, computer science, and process industry who wish to learn core principles, methods, algorithms, and applications in the field of intelligent optimal control. It is beneficial to promote the development of intelligent optimal control approaches and the construction of high-level intelligent systems.

Nonlinear Control of Engineering Systems Springer

The Power Flow model is extensively used to predict the behavior of electric grids and results in solving a nonlinear algebraic system of equations. Modeling the grid is essential for design optimization and control. Both applications require a fast response for multiple queries to a parametric family of power flow problems. Different solvers have been introduced especially designed for the algebraic nonlinear power flow equations, providing efficient solutions for single problems, even when the number of degrees of freedom is considerably large. However, there is no existing methodology providing an explicit solution of the Parametric Power Flow problem (viz. a computational vademecum, explicit in terms of the parameters). This work aims precisely at designing algorithms producing computational vademecums for the Parametric Power Flow problem. Once these solutions are available, solving for different values of the parameters is an extremely fast (real-time) post-process and therefore both the optimal design and the control problem can readily be addressed. In a first phase, a new family of iteratives solvers for the non-parametric version of the problem is devised. The method is based on a hybrid formulation of the problem combined with an alternated search directions scheme. These methods are designed such that it can be generalized to deal with the parametric version of the problem following a Proper Generalized Decomposition (PGD) strategy. The solver for the parametric problem is conceived by performing the operations involving the unknowns in a PGD fashion. The algorithm follows the basic steps of the algebraic solver, but some operations are carried out in a PGD framework, that is requiring a nested iterative algorithm. The PGD solver is accompanied with an error assessment technique that allows monitoring the convergence of the iterative procedures and deciding the number of terms required to meet the accuracy prescriptions. Different examples of realistic grids and standard benchmark tests are used to demonstrate the performance of the proposed methodologies.

Advances in Control Techniques for Smart Grid Applications CRC Press

Fuel Cells: Modeling, Control, and Applications describes advanced research results on modeling and control designs for fuel cells and their hybrid energy systems. Filled with simulation examples and test results, it provides detailed discussions on fuel cell modeling,

analysis, and nonlinear control. The book begins with an introduction to fuel cells and fuel cell power systems as well as the fundamentals of fuel cell systems and their components. It then presents the linear and nonlinear modeling of fuel cell dynamics, before discussing typical approaches of linear and nonlinear modeling and control design methods for fuel cells. The authors also explore the Simulink implementation of fuel cells, including the modeling of PEM fuel cells and control designs. They cover the applications of fuel cells in vehicles, utility power systems, stand-alone systems, and hybrid renewable energy systems. The book concludes with the modeling and analysis of hybrid renewable energy systems, which integrate fuel cells, wind power, and solar power. Mathematical preliminaries on linear and nonlinear control are provided in an appendix. With the need for alternative power well established, we are seeing unprecedented research in fuel cell technology. Written by scientists directly involved with the research, this book presents approaches and achievements in the linear and nonlinear modeling and control design of PEM fuel cells.

Power Flow Control Solutions for a Modern Grid Using SMART Power Flow Controllers Springer Science & Business Media

This practical yet rigorous book provides a development of nonlinear, Lyapunov-based tools and their use in the solution of control-theoretic problems. Rich in motivating examples and new design techniques, the text balances theoretical foundations and real-world implementation.

Nonlinear Control Synthesis for Electrical Power Systems Using Controllable Series Capacitors Springer Nature

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.

Nonrecursive Control Design for Nonlinear Systems Springer

Unified Power Flow Controller Technology and Application provides comprehensive coverage on UPFC technology, providing a range of topics, including design principle, control and protection, and insulation coordination. It summarizes all the most up-to-date research and practical achievements that are related to UPFC and MMC technology, including test techniques for main components, closed-loop test techniques for control and protection systems, and onsite techniques for implementing UPFC projects. The book is an essential reference book for both academics and engineers working in power system protection control, power system planning engineers, and HVDC FACTS related areas. Readers will not only obtain the detailed information regarding theoretical analysis and practical application of UPFC, but also the control mechanism of advanced MMC technology, both of which are not common topics in previously published books. Shows how to use modular multilevel converters (MMC) to implement UPFC that lead to cost-effective and reliable systems Draws from the most up-to-date research and

practical applications Teaches electromechanical/electro magnetic transient simulation techniques and real-time closed-loop simulation test techniques of the MMC based UPFC

Adaptive Dynamic Programming with Applications in Optimal Control Springer Science & Business Media

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.

Nonlinear Power Flow Control Design World Scientific

Initial material for this book was developed over a period of several years through the introduction in the mid-seventies of a graduate-level course en titled, "Control and Operation of Interconnected Power Systems," at the Georgia Institute of Technology. Subsequent involvement with the utility industry and in teaching continuing education courses on modern power sys tem control and operation contributed to the complimentary treatment of the dynamic aspects of this overall topic. In effect, we have evolved a textbook that provides a thorough under standing of fudamentals as needed by a graduate student with a prior back ground in power systems analysis at the undergraduate level, and in system theory concepts normally provided at the beginning of the graduate level in electrical engineering. It is also designed to provide the depth needed both by the serious graduate student and the power industry engineer involved in the activities of energy control centers and short-term operations planning. As explained in Chapter 2, the entire book can be covered in a two quarter course sequence. The

bulk of the material may be covered in one semester. For a two-semester offering, we recommend that students be in volved in some project work to further their depth of understanding. Utility and consulting industry engineers should concentrate on the more advanced concepts and developments usually available at the latter half of each chap ter.

Fuel Cells Springer Science & Business Media

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 Control Systems and Power System Dynamics Springer

The purpose of this book is to give an exposition of recently adaptive PI/PD/PID control design for nonlinear systems. Since PI/PD/PID control is simple in structure and inexpensive in implementation, it has been undoubtedly the most widely employed controller in industry. In fact, PI/PD/PID controllers are sufficient for many control problems, particularly when process dynamics are benign and the performance requirements are modest. The book focuses on how to design general PI/PD/PID controller with self-tuning gains for different systems, which includes SISO nonlinear system, SISO nonaffine system and MIMO nonlinear system.

Planning and Operation of Active Distribution Networks John Wiley & Sons

Nonlinear Process Control assembles the latest theoretical and practical research on design, analysis and application of nonlinear process control strategies. It presents detailed coverage of all three major elements of nonlinear process control: identification, controller design, and state estimation. Nonlinear Process Control reflects the contributions of eleven leading researchers in the field. It is an ideal textbook for graduate courses in process control, as well as a concise, up-to-date reference for control engineers.

IEEE Transmission and Distribution Conference and Exposition MDPI

The extended and revised second edition of this successful monograph presents advanced modeling, analysis and control techniques of Flexible AC Transmission Systems (FACTS). The book covers comprehensively a range of power-system control

problems: from steady-state voltage and power flow control, to voltage and reactive power control, to voltage stability control, to small signal stability control using FACTS controllers. In the six years since the first edition of the book has been published research on the FACTS has continued to flourish while renewable energy has developed into a mature and booming global green business. The second edition reflects the new developments in converter configuration, smart grid technologies, super power grid developments worldwide, new approaches for FACTS control design, new controllers for distribution system control, and power electronic controllers in wind generation operation and control. The latest trends of VSC-HVDC with multilevel architecture have been included and four completely new chapters have been added devoted to Multi-Agent Systems for Coordinated Control of FACTS-devices, Power System Stability Control using FACTS with Multiple Operating Points, Control of a Looping Device in a Distribution System, and Power Electronic Control for Wind Generation.

CONTROLO 2020

Springer Nature

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.