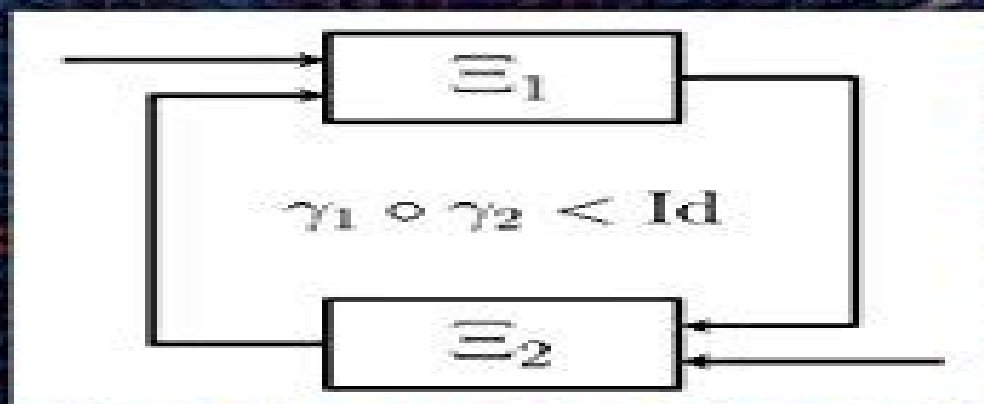


NONLINEAR CONTROL OF DYNAMIC NETWORKS



**Tengfei Liu • Zhong-Ping Jiang
David J. Hill**



CRC Press
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Nonlinear Control Of Dynamic Networks Automation And Control Engineering

Dong Sun



Nonlinear Control Of Dynamic Networks Automation And Control Engineering:

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

Optimal Networked Control Systems with MATLAB Jagannathan Sarangapani,Hao Xu,2018-09-03 Optimal Networked Control Systems with MATLAB discusses optimal controller design in discrete time for networked control systems NCS The authors apply several powerful modern control techniques in discrete time to the design of intelligent controllers for such NCS Detailed derivations rigorous stability proofs computer simulation examples and downloadable MATLAB codes are included for each case The book begins by providing background on NCS networked imperfections dynamical systems stability theory and stochastic optimal adaptive controllers in discrete time for linear and nonlinear systems It lays the foundation for reinforcement learning based optimal adaptive controller use for finite and infinite horizons The text then Introduces quantization effects for linear and nonlinear NCS describing the design of stochastic adaptive controllers for a class of linear and nonlinear systems Presents two player zero sum game theoretic formulation for linear systems in input output form enclosed by a communication network Addresses the stochastic optimal control of nonlinear NCS by using neuro dynamic programming Explores stochastic optimal design for nonlinear two player zero sum games under communication constraints Treats an event sampled distributed NCS to minimize transmission of state and control signals within the feedback loop via the communication network Covers distributed joint optimal network scheduling and

control design for wireless NCS as well as the effect of network protocols on the wireless NCS controller design An ideal reference for graduate students university researchers and practicing engineers Optimal Networked Control Systems with MATLAB instills a solid understanding of neural network controllers and how to build them **From Collective Beings to Quasi-Systems** Gianfranco Minati, Eliano Pessa, 2018-01-29 This book outlines a possible future theoretical perspective for systemics its conceptual morphology and landscape while the Good Old Fashioned Systemics GOFS era is still under way The change from GOFS to future systemics can be represented as shown in the book title by the conceptual change from Collective Beings to Quasi systems With the current advancements problems and approaches occurring in contemporary science systemics are moving beyond the traditional frameworks used in the past From Collective Beings to Coherent Quasi Systems outlines a conceptual morphology and landscape for a new theoretical perspective for systemics introducing the concept of Quasi systems Advances in domains such as theoretical physics philosophy of science cell biology neuroscience experimental economics network science and many others offer new concepts and technical tools to support the creation of a fully transdisciplinary General Theory of Change This circumstance requires a deep reformulation of systemics without forgetting the achievements of established conventions The book is divided into two parts Part I examines classic systemic issues from new theoretical perspectives and approaches A new general unified framework is introduced to help deal with topics such as dynamic structural coherence and Quasi systems This new theoretical framework is compared and contrasted with the traditional approaches Part II focuses on the process of translation into social culture of the theoretical principles models and approaches introduced in Part I This translation is urgent in post industrial societies where emergent processes and problems are still dealt with by using the classical or non systemic knowledge of the industrial phase Nonlinear Control Techniques for Electro-Hydraulic Actuators in Robotics Engineering Qing Guo, Dan Jiang, 2017-08-14 Nonlinear Control Techniques for Electro Hydraulic Actuators in Robotics Engineering meets the needs of those working in advanced electro hydraulic controls for modern mechatronic and robotic systems The non linear EHS control methods covered are proving to be more effective than traditional controllers such as PIDs The control strategies given address parametric uncertainty unknown external load disturbance single rod actuator characteristics and control saturation Theoretical and experimental validations are explained and examples provided Based on the authors cutting edge research this work is an important resource for engineers researchers and students working in EHS Networked Control Systems with Intermittent Feedback Domagoj Tolić, Sandra Hirche, 2017-03-31 Networked Control Systems NCSs are spatially distributed systems for which the communication between sensors actuators and controllers is realized by a shared wired or wireless communication network NCSs offer several advantages such as reduced installation and maintenance costs as well as greater flexibility over conventional control systems in which parts of control loops exchange information via dedicated point to point connections The principal goal of this book is to present a coherent and versatile framework applicable to various settings

investigated by the authors over the last several years This framework is applicable to nonlinear time varying dynamic plants and controllers with delayed dynamics a large class of static dynamic probabilistic and priority oriented scheduling protocols delayed noisy lossy and intermittent information exchange decentralized control problems of heterogeneous agents with time varying directed not necessarily balanced communication topologies state and output feedback off line and on line intermittent feedback optimal intermittent feedback through Approximate Dynamic Programming ADP and Reinforcement Learning RL and control systems with exogenous disturbances and modeling uncertainties

Doubly Fed Induction

Generators Edgar N. Sanchez,Riemann Ruiz-Cruz,2016-08-05 Doubly Fed Induction Generators Control for Wind Energy provides a detailed source of information on the modeling and design of controllers for the doubly fed induction generator DFIG used in wind energy applications Focusing on the use of nonlinear control techniques this book Discusses the main features and advantages of the DFIG Describes key theoretical fundamentals and the DFIG mathematical model Develops controllers using inverse optimal control sliding modes and neural networks Devises an improvement to add robustness in the presence of parametric variations Details the results of real time implementations All controllers presented in the book are tested in a laboratory prototype Comparisons between the controllers are made by analyzing statistical measures applied to the control objectives

Cooperative Control of Multi-Agent Systems Zhongkui Li,Zhisheng Duan,2017-12-19

Distributed controller design is generally a challenging task especially for multi agent systems with complex dynamics due to the interconnected effect of the agent dynamics the interaction graph among agents and the cooperative control laws Cooperative Control of Multi Agent Systems A Consensus Region Approach offers a systematic framework for designing distributed controllers for multi agent systems with general linear agent dynamics linear agent dynamics with uncertainties and Lipschitz nonlinear agent dynamics Beginning with an introduction to cooperative control and graph theory this monograph Explores the consensus control problem for continuous time and discrete time linear multi agent systems Studies the H and H2 consensus problems for linear multi agent systems subject to external disturbances Designs distributed adaptive consensus protocols for continuous time linear multi agent systems Considers the distributed tracking control problem for linear multi agent systems with a leader of nonzero control input Examines the distributed containment control problem for the case with multiple leaders Covers the robust cooperative control problem for multi agent systems with linear nominal agent dynamics subject to heterogeneous matching uncertainties Discusses the global consensus problem for Lipschitz nonlinear multi agent systems Cooperative Control of Multi Agent Systems A Consensus Region Approach provides a novel approach to designing distributed cooperative protocols for multi agent systems with complex dynamics The proposed consensus region decouples the design of the feedback gain matrices of the cooperative protocols from the communication graph and serves as a measure for the robustness of the protocols to variations of the communication graph By exploiting the decoupling feature adaptive cooperative protocols are presented that can be designed and implemented in

a fully distributed fashion **Adaptive Dynamic Programming: Single and Multiple Controllers** Ruizhuo Song, Qinglai Wei, Qing Li, 2018-12-28 This book presents a class of novel optimal control methods and games schemes based on adaptive dynamic programming techniques For systems with one control input the ADP based optimal control is designed for different objectives while for systems with multi players the optimal control inputs are proposed based on games In order to verify the effectiveness of the proposed methods the book analyzes the properties of the adaptive dynamic programming methods including convergence of the iterative value functions and the stability of the system under the iterative control laws Further to substantiate the mathematical analysis it presents various application examples which provide reference to real world practices Linear Control Theory Shankar P. Bhattacharyya, Aniruddha Datta, Lee H. Keel, 2018-10-03 Successfully classroom tested at the graduate level Linear Control Theory Structure Robustness and Optimization covers three major areas of control engineering PID control robust control and optimal control It provides balanced coverage of elegant mathematical theory and useful engineering oriented results The first part of the book develops results relating to the design of PID and first order controllers for continuous and discrete time linear systems with possible delays The second section deals with the robust stability and performance of systems under parametric and unstructured uncertainty This section describes several elegant and sharp results such as Kharitonov's theorem and its extensions the edge theorem and the mapping theorem Focusing on the optimal control of linear systems the third part discusses the standard theories of the linear quadratic regulator H_∞ and H_1 optimal control and associated results Written by recognized leaders in the field this book explains how control theory can be applied to the design of real world systems It shows that the techniques of three term controllers along with the results on robust and optimal control are invaluable to developing and solving research problems in many areas of engineering *Model-based Nonlinear Control of Aeroengines* Jiqiang Wang, Weicun Zhang, Zhongzhi Hu, 2021-08-17 This book aims to develop systematic design methodologies to model based nonlinear control of aeroengines focusing on 1 modelling of aeroengine systems both component level and identification based models will be extensively studied and compared and 2 advanced nonlinear control designs set point control transient control and limit protection control approaches will all be investigated The model based design has been one of the pivotal technologies to advanced control and health management of propulsion systems It can fulfil advanced designs such as fault tolerant control engine modes control and direct thrust control As a consequence model based design has become an important research area in the field of aeroengines due to its theoretical interests and engineering significance One of the central issues in model based controls is the tackling of nonlinearities There are publications concerning with either nonlinear modelling or nonlinear controls yet they are scattered throughout the literature It is time to provide a comprehensive summary of model based nonlinear controls Consequently a series of important results are obtained and a systematic design methodology is developed which provides consistently enhanced performance over a large flight operational envelope and it is thus expected

to provide useful guidance to practical engineering in aeroengine industry and research *Adaptive Dynamic Programming: Solltrajektorienfolgeregelung und Konvergenzbedingungen* Köpf, Florian, 2022-11-07 In diesem Werk werden erstmals zeitdiskrete und zeitkontinuierliche Methoden präsentiert und analysiert um flexible Solltrajektorien darstellungen in Adaptive Dynamic Programming Ansatz zu integrieren Zudem werden theoretische Bedingungen an den Systemzustand hergeleitet die eine zentrale Anregungseigenschaft für die Konvergenz der Adaption sicherstellen Reale Anwendungen der vorgestellten adaptiven optimalen Trajektorienfolgeregelungsmethoden offenbaren das Potenzial dieser Ansatz In this work discrete time and continuous time methods that integrate flexible reference trajectory representations into Adaptive Dynamic Programming approaches are presented and analyzed for the first time Moreover theoretical conditions on the system state are derived that ensure the persistent excitation property which is crucial for the convergence of the adaptation Real world applications of the presented adaptive optimal trajectory tracking control methods reveal their potential **Information Computing And Automation (In 3 Volumes) - Proceedings Of The International Conference** Jian Ping Li, Igor Bloshanskii, Lionel M Ni, S S Pandey, Simon X Yang, 2008-04-25 Wavelet analysis and its applications have become one of the fastest growing research areas in the past several years Wavelet theory has been employed in many fields and applications such as signal and image processing communication systems biomedical imaging radar air acoustics and endless other areas Active media technology is concerned with the development of autonomous computational or physical entities capable of perceiving reasoning adapting learning cooperating and delegating in a dynamic environment This book consists of carefully selected and received papers presented at the conference and is an attempt to capture the essence of the current state of the art in wavelet analysis and active media technology Invited papers included in this proceedings includes contributions from Prof P Zhang T D Bui and C Y Suen from Concordia University Canada Prof N A Strelkov and V L Dolnikov from Yaroslavl State University Russia Prof Chin Chen Chang and Ching Yun Chang from Taiwan Prof S S Pandey from R D University India and Prof I L Bloshanskii from Moscow State Regional University Russia **Synchronization and Control of Multiagent Systems** Dong Sun, 2018-10-09 Multiple intelligent agent systems are commonly used in research requiring complex behavior Synchronization control provides an advantage in solving the problem of multi agent coordination This book focuses on the use of synchronization control to coordinate the group behavior of multiple agents The author includes numerous real world applications Advances in Computation and Intelligence Lishan Kang, 2008-12-08 This book constitutes the refereed proceedings of the Third International Symposium on Intelligence Computation and Applications ISICA 2008 held in Wuhan China in December 2008 The 93 revised full papers were carefully reviewed and selected from about 700 submissions The papers are organized in topical sections on computational intelligence evolutionary computation evolutionary multi objective and dynamic optimization evolutionary learning systems neural networks classification and recognition bioinformatics and bioengineering evolutionary data mining and knowledge discovery intelligent GIS and control theory of intelligent

computation combinational and numerical optimization as well as real world applications

Robust Adaptive Control for Fractional-Order Systems with Disturbance and Saturation Mou Chen, Shuyi Shao, Peng Shi, 2017-10-20 A treatise on investigating tracking control and synchronization control of fractional order nonlinear systems with system uncertainties external disturbance and input saturation Robust Adaptive Control for Fractional Order Systems with Disturbance and Saturation provides the reader with a good understanding on how to achieve tracking control and synchronization control of fractional order nonlinear systems with system uncertainties external disturbance and input saturation Although some texts have touched upon control of fractional order systems the issues of input saturation and disturbances have rarely been considered together This book offers chapter coverage of fractional calculus and fractional order systems fractional order PID controller and fractional order disturbance observer design of fractional order controllers for nonlinear chaotic systems and some applications sliding mode control for fractional order nonlinear systems based on disturbance observer disturbance observer based neural control for an uncertain fractional order rotational mechanical system adaptive neural tracking control for uncertain fractional order chaotic systems subject to input saturation and disturbance stabilization control of continuous time fractional positive systems based on disturbance observer sliding mode synchronization control for fractional order chaotic systems with disturbance and more Based on the approximation ability of the neural network NN the adaptive neural control schemes are reported for uncertain fractional order nonlinear systems Covers the disturbance estimation techniques that have been developed to alleviate the restriction faced by traditional feedforward control and reject the effect of external disturbances for uncertain fractional order nonlinear systems By combining the NN with the disturbance observer the disturbance observer based adaptive neural control schemes have been studied for uncertain fractional order nonlinear systems with unknown disturbances Considers together the issue of input saturation and the disturbance for the control of fractional order nonlinear systems in the present of system uncertainty external disturbance and input saturation Robust Adaptive Control for Fractional Order Systems with Disturbance and Saturation can be used as a reference for the academic research on fractional order nonlinear systems or used in Ph D study of control theory and engineering

Scientific and Technical Aerospace Reports ,1995

Spacecraft Maneuver with Performance Guaranteed Yufeng Gao, Dongyu Li, 2023-10-21 Facing future oriented aerospace applications large scale space construction and on orbit services have rapidly developed In such emerging and increasingly complex spacecraft maneuvering and control tasks more precise control accuracy and higher performance guarantees need to be fully considered due to the need for safe close rendezvous movements This book is dedicated to solving the aerospace system s performance guaranteed and precise control challenges with the expected transient and strict steady state constraints It is designed so that the aerospace closed loop system can theoretically meet the pre defined or prescribed performance requirements with the simple parameter selection Furthermore the expected performance constraints or indicators of the aerospace system time domain performance response such as

settling time overshoot steady state error and state amplitude will be directly guaranteed in the control design Moreover this book systematically proposes a series of spacecraft performance guaranteed control algorithms based on the practical situation of the aerospace system For individual spacecraft control algorithms that consider practical problems such as control task requirements settling time constraints transient performance normalization input command constraints and optimization faced by the on orbit spacecraft are proposed to achieve the precise control objectives of the system under constraints and various complex situations For the pre combination and post combination control of multiple spacecraft game algorithms based on performance guarantees are proposed and thoroughly discussed For spacecraft formations control algorithms that consider full state constraints nonlinear uncertainties output feedback and collision avoidance are proposed This book provides the theoretical basis and simulation experience for scholars and engineers to develop high performance high precision spacecraft control algorithms Furthermore it hopes that these will contribute to the development of the world's aerospace technology

Dynamics and Control of Chemical Reactors, Distillation Columns and Batch Processes (DYCORD+ '92) J.G. Balchen,E.D. Gilles,K.V. Waller,J.B. Rawlings,2014-05-23 In addition to the three main themes chemical reactors distillation columns and batch processes this volume also addresses some of the new trends in dynamics and control methodology such as model based predictive control new methods for identification of dynamic models nonlinear control theory and the application of neural networks to identification and control Provides a useful reference source of the major advances in the field

Computational Intelligence - Volume I Hisao Ishibuchi,2015-12-30 Computational intelligence is a component of Encyclopedia of Technology Information and Systems Management Resources in the global Encyclopedia of Life Support Systems EOLSS which is an integrated compendium of twenty one Encyclopedias Computational intelligence is a rapidly growing research field including a wide variety of problem solving techniques inspired by nature Traditionally computational intelligence consists of three major research areas Neural Networks Fuzzy Systems and Evolutionary Computation Neural networks are mathematical models inspired by brains Neural networks have massively parallel network structures with many neurons and weighted connections Whereas each neuron has a simple input output relation a neural network with many neurons can realize a highly non linear complicated mapping Connection weights between neurons can be adjusted in an automated manner by a learning algorithm to realize a non linear mapping required in a particular application task Fuzzy systems are mathematical models proposed to handle inherent fuzziness in natural language For example it is very difficult to mathematically define the meaning of cold in everyday conversations such as It is cold today and Can I have cold water The meaning of cold may be different in a different situation Even in the same situation a different person may have a different meaning Fuzzy systems offer a mathematical mechanism to handle inherent fuzziness in natural language As a result fuzzy systems have been successfully applied to real world problems by extracting linguistic knowledge from human experts in the form of fuzzy IF THEN rules Evolutionary computation includes various population based search

algorithms inspired by evolution in nature Those algorithms usually have the following three mechanisms fitness evaluation to measure the quality of each solution selection to choose good solutions from the current population and variation operators to generate offspring from parents Evolutionary computation has high applicability to a wide range of optimization problems with different characteristics since it does not need any explicit mathematical formulations of objective functions For example simulation based fitness evaluation is often used in evolutionary design Subjective fitness evaluation by a human user is also often used in evolutionary art and music These volumes are aimed at the following five major target audiences University and College students Educators Professional practitioners Research personnel and Policy analysts managers and decision makers

Electric and Plug-in Hybrid Vehicle Networks Emanuele Crisostomi, Robert Shorten, Sonja Stüdtli, Fabian Wirth, 2017-10-30 This book explores the behavior of networks of electric and hybrid vehicles The topics that are covered include energy management issues for aggregates of plug in vehicles the design of sharing systems to support electro mobility context awareness in the operation of electric and hybrid vehicles and the role that this plays in a Smart City context and tools to test and design massively large scale networks of such vehicles The book also introduces new and interesting control problems that are becoming prevalent in the EV PHEV s context as well as identifying some open questions A particular focus of the book is on the opportunities afforded by networked actuation possibilities in electric and hybrid vehicles and the role that such actuation may play in air quality and emissions management

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