
ROBUST CONTROL OF NONLINEAR UNCERTAIN SYSTEMS



Zhihua Qu

WILEY SERIES IN NONLINEAR SCIENCE

Robust Control Of Nonlinear Uncertain Systems

R Barnett



Robust Control Of Nonlinear Uncertain Systems:

Robust Control of Nonlinear Uncertain Systems Zhihua Qu, 1998-04-29 This timely work presents the definitive treatment of stability analysis and robust control design for nonlinear uncertain systems While other books on the subject deal with robust control in linear systems this is the first book to tackle robust control design for such nonlinear entities as power systems robotics and more It combines examples proofs and applications clearly showing how to build high performance and better control into systems that are too complex to be modeled accurately A unique feature of this book is its Lyapunov based approach to control design which is the only universal approach for nonlinear systems The Lyapunov direct method is used here to develop all design procedures to correlate leading techniques in the field to the structural properties of uncertain systems and to compare robust and nonrobust types of controls such as adaptive control learning control and optimal control The subject is introduced with a self contained treatment of the nonlinear stability theory originally proposed by Lyapunov and LaSalle Emphasizing the basics the introductory chapters incorporate three types of solutions stability concepts and various theorems The main body of the text offers a comprehensive treatment for current design methods including state space robust control designs properties of various robust controllers input output control and discrete robust control designs In Robust Control of Nonlinear Uncertain Systems author Zhihua Qu presents the complete set of control design procedures for nonlinear uncertain systems including backward recursive design forward recursive design recursive interlacing design feedback linearization nonlinear optimal control and sub optimal control Also featured here is the breakthrough recursive interlacing design that facilitates robust control for uncertain systems with all cascaded feedback and feedforward dynamics Throughout Professor Qu presents the pros and cons of specific methods rationales for choosing particular design parameters and tips on questions of stability performance and systems structure For engineers and graduate students in mechanical electrical and aerospace engineering Robust Control of Nonlinear Uncertain Systems imparts the technical know how for effective design explores key theoretical issues in control and provides insight into future trends in the field

Robust Control Designs for Nonlinear Uncertain Systems Joseph Kaloust, 1995 The analysis and design of robust controllers are developed using Lyapunov's direct method Five different controllers are proposed designed and simulated for a certain class of nonlinear systems

Nonlinear Dynamical Systems and Control Wassim M. Haddad, VijaySekhar Chellaboina, 2011-09-19 *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

Development of Robust Control Based on Sliding Mode for Nonlinear Uncertain Systems Xinming Yan,2016 This work deals with the development of control laws for nonlinear uncertain systems based on sliding mode theory The standard sliding mode control approaches are state feedback ones in which the sliding variable and its time derivatives are required This first objective of this thesis is to propose high order sliding mode control laws with a reduced use of sliding variable time derivatives The contributions are made for the second and third order sliding mode control The second objective is to combine the proposed control laws with a gain adaptation mechanism The use of adaptive gain law allows to simplify the tuning process to reduce the convergence time and to improve the accuracy Finally the applicability of the proposed approaches is shown on IRCCyN pneumatic benchmark Applications are also made on 3DOF flying system Perspectives in Robust Control S.O.Reza Moheimani,2001-03-30 This book is based on a workshop entitled Robust Control workshop 2000 The workshop was held in Newcastle Australia from the 6th to the 8th December 2000 Chapters of the book are written by some of the leading researchers in the field of Robust Control They cover a variety of topics all related to Robust Control and analysis of uncertain systems Robust Control Design Using H- ∞ Methods Ian R. Petersen,Valery A. Ugrinovskii,Andrey V. Savkin,2012-12-06 This is a unified collection of important recent results for the design of robust controllers for uncertain systems primarily based on H ∞ control theory or its stochastic counterpart risk sensitive control theory Two practical applications are used to illustrate the methods throughout *Robust Control* Andrzej Bartoszewicz,2011-04-11 The main objective of this monograph is to present a broad range of well worked out recent theoretical and application studies in the field of robust control system analysis and design The contributions presented here include but are not limited to robust PID H infinity sliding mode fault tolerant fuzzy and QFT based control systems They advance the current progress in the field and motivate and encourage new ideas and solutions in the robust control area **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

Uncertainty in Complex Networked Systems Tamer Başar, 2018-12-14 The chapters in this volume and the volume itself celebrate the life and research of Roberto Tempo a leader in the study of complex networked systems their analysis and control under uncertainty and robust designs Contributors include authorities on uncertainty in systems robustness networked and network systems social networks distributed and randomized algorithms and multi agent systems all fields that Roberto Tempo made vital contributions to Additionally at least one author of each chapter was a research collaborator of Roberto Tempo s This volume is structured in three parts The first covers robustness and includes topics like time invariant uncertainties robust static output feedback design and the uncertainty quartet The second part is focused on randomization and probabilistic methods which covers topics such as compressive sensing and stochastic optimization Finally the third part deals with distributed systems and algorithms and explores matters involving mathematical sociology fault diagnoses and PageRank computation Each chapter presents exposition provides new results and identifies fruitful future directions in research This book will serve as a valuable reference volume to researchers interested in uncertainty complexity robustness optimization algorithms and networked systems

Robust Control of Nonlinear Time-varying Mismatched Uncertain Systems Wei Hua Wang, 1998 Analysis and Decision Making in Uncertain Systems Zdzislaw Bubnicki, 2004-01-09 A unified and systematic description of analysis and decision problems within a wide class of uncertain systems described by traditional mathematical methods and by relational knowledge representations Prof Bubnicki takes a unique approach to stability and stabilization of uncertain systems

Boundary Control of Flexible Three-Dimensional Euler-Bernoulli Beams Ning Ji, Jinkun Liu, 2022-03-24 This book focuses on vibration suppression of flexible three dimensional Euler Bernoulli beams modeled by PDEs Boundary control strategy and several control methods are proposed to stabilize the closed loop system Besides some

common engineering problems such as input constraint and output constraint are also considered in the control scheme design This book offers a comprehensive introduction of the modeling process controller design stability analysis and numerical simulation The detailed MATLAB codes in each chapter are also provided which can make readers better understand the control flow of the system This book is mainly targeted for researchers senior undergraduate students and postgraduate students in the field of control theory and control engineering

Deterministic Learning Theory for Identification, Recognition, and Control Cong Wang, David J. Hill, 2018-10-03 Deterministic Learning Theory for Identification Recognition and Control presents a unified conceptual framework for knowledge acquisition representation and knowledge utilization in uncertain dynamic environments It provides systematic design approaches for identification recognition and control of linear uncertain systems Unlike many books currently available that focus on statistical principles this book stresses learning through closed loop neural control effective representation and recognition of temporal patterns in a deterministic way A Deterministic View of Learning in Dynamic Environments The authors begin with an introduction to the concepts of deterministic learning theory followed by a discussion of the persistent excitation property of RBF networks They describe the elements of deterministic learning and address dynamical pattern recognition and pattern based control processes The results are applicable to areas such as detection and isolation of oscillation faults ECG EEG pattern recognition robot learning and control and security analysis and control of power systems A New Model of Information Processing This book elucidates a learning theory which is developed using concepts and tools from the discipline of systems and control Fundamental knowledge about system dynamics is obtained from dynamical processes and is then utilized to achieve rapid recognition of dynamical patterns and pattern based closed loop control via the so called internal and dynamical matching of system dynamics This actually represents a new model of information processing i e a model of dynamical parallel distributed processing DPDP

Adaptive Control Systems Gang Feng, Rogelio Lozano, 1999-05-10 Adaptive control is no longer just an important theoretical field of study but is also providing solutions to real world problems Adaptive techniques will transform the world of control The leading world practitioners of adaptive control have contributed to this handbook which is the most important work yet in this field Not only are techniques described in theory but detailed control algorithms are given making this a practical cookbook of adaptive control for both control professionals and practising engineers The book presents the most advanced techniques and algorithms of adaptive control These include various robust techniques performance enhancement techniques techniques with less a priori knowledge nonlinear adaptive control techniques and intelligent adaptive techniques Each technique described has been developed to provide a practical solution to a real life problem This volume will therefore not only advance the field of adaptive control as an area of study but will also show how the potential of this technology can be realised and offer significant benefits Practical cookbook of adaptive control Contains important research

Neural Information Processing Derong Liu, Shengli Xie, Yuanqing

Li,Dongbin Zhao,El-Sayed M. El-Alfy,2017-11-07 The six volume set LNCS 10634 LNCS 10635 LNCS 10636 LNCS 10637 LNCS 10638 and LNCS 10639 constitutes the proceedings of the 24rd International Conference on Neural Information Processing ICONIP 2017 held in Guangzhou China in November 2017 The 563 full papers presented were carefully reviewed and selected from 856 submissions The 6 volumes are organized in topical sections on Machine Learning Reinforcement Learning Big Data Analysis Deep Learning Brain Computer Interface Computational Finance Computer Vision Neurodynamics Sensory Perception and Decision Making Computational Intelligence Neural Data Analysis Biomedical Engineering Emotion and Bayesian Networks Data Mining Time Series Analysis Social Networks Bioinformatics Information Security and Social Cognition Robotics and Control Pattern Recognition Neuromorphic Hardware and Speech Processing

European Control Conference 1993 ,1993-06-28 Proceedings of the European Control Conference 1993 Groningen Netherlands June 28 July 1 1993 Applied Mechanics Reviews ,1992 *Sliding Mode Control Methodology in the Applications of Industrial Power Systems* Jianxing Liu,Yabin Gao,Yunfei Yin,Jiahui Wang,Wensheng Luo,Guanghui Sun,2019-10-23 This book presents recent advanced techniques in sliding mode control and observer design for industrial power systems focusing on their applications in polymer electrolyte membrane fuel cells and power converters Readers will find not only valuable new fault detection and isolation techniques based on sliding mode control and observers but also a number of robust control and estimation methodologies combined with fuzzy neural networks and extended state observer methods The book also provides necessary experimental and simulation examples for proton exchange membrane fuel cell systems and power converter systems Given its scope it offers a valuable resource for undergraduate and graduate students academics scientists and engineers who are working in the field *Stability Analysis of Markovian Jump Systems* Yu Kang,Yun-Bo Zhao,Ping Zhao,2017-09-08 This book focuses on the stability analysis of Markovian jump systems MJSs with various settings and discusses its applications in several different areas It also presents general definitions of the necessary concepts and an overview of the recent developments in MJSs Further it addresses the general robust problem of Markovian jump linear systems MJLSs the asynchronous stability of a class of nonlinear systems the robust adaptive control scheme for a class of nonlinear uncertain MJSs the practical stability of MJSs and its applications as a modelling tool for networked control systems Markovian based control for wheeled mobile manipulators and the jump linear quadratic JLQ problem of a class of continuous time MJLSs It is a valuable resource for researchers and graduate students in the field of control theory and engineering

Control Systems Theory with Engineering Applications Sergey E. Lyshevski,2012-12-06 Dynamics systems living organisms electromechanical and industrial systems chemical and technological processes market and ecology and so forth can be considered and analyzed using information and systems theories For example adaptive human behavior can be studied using automatic feedback control As an illustrative example the driver controls a car changing the speed and steering wheels using incoming information such as traffic and road conditions This book focuses on the most important and

manageable topics in applied multivariable control with application to a wide class of electromechanical dynamic systems. A large spectrum of systems familiar to electrical, mechanical, and aerospace students, engineers, and scholars are thoroughly studied to build the bridge between theory and practice as well as to illustrate the practical application of control theory through illustrative examples. It is the author's goal to write a book that can be used to teach undergraduate and graduate classes in automatic control and nonlinear control at electrical, mechanical, and aerospace engineering departments. The book is also addressed to engineers and scholars, and the examples considered allow one to implement the theory in a great variety of industrial systems. The main purpose of this book is to help the reader grasp the nature and significance of multivariable control.

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