

NONLINEAR CONTROLLABILITY AND OPTIMAL CONTROL

edited by
H. J. Sussmann

Nonlinear Controllability And Optimal Control

Peter Chen, Victor Martinez-Luaces



Nonlinear Controllability And Optimal Control:

Nonlinear Controllability and Optimal Control Sussmann, 2017-11-22 This outstanding reference presents current state of the art research on important problems of finite dimensional nonlinear optimal control and controllability theory It presents an overview of a broad variety of new techniques useful in solving classical control theory problems Written and edited by renowned mathematicians at the forefront of research in this evolving field *Nonlinear Controllability and Optimal Control* provides detailed coverage of the construction of solutions of differential inclusions by means of directionally continuous sections Lie algebraic conditions for local controllability the use of the Campbell Hausdorff series to derive properties of optimal trajectories the Fuller phenomenon the theory of orbits and more Containing more than 1 300 display equations this exemplary instructive reference is an invaluable source for mathematical researchers and applied mathematicians electrical and electronics aerospace mechanical control systems and computer engineers and graduate students in these disciplines

Nonlinear and Optimal Control Systems Thomas L. Vincent, Walter J. Grantham, 1997-06-23 Designed for one semester introductory senior or graduate level course the authors provide the student with an introduction of analysis techniques used in the design of nonlinear and optimal feedback control systems There is special emphasis on the fundamental topics of stability controllability and optimality and on the corresponding geometry associated with these topics Each chapter contains several examples and a variety of exercises

Controllability of Switched Linear Systems and the Optimal Control of Nonlinear Systems Ying Yang (Ph. D.), 1996

Control and Observer Design for Nonlinear Finite and Infinite Dimensional Systems Thomas Meurer, Knut Graichen, Ernst-Dieter Gilles, 2005-09-19 This volume presents a well balanced combination of state of the art theoretical results in the field of nonlinear controller and observer design combined with industrial applications stemming from mechatronics electrical bio chemical engineering and fluid dynamics The unique combination of results of finite as well as infinite dimensional systems makes this book a remarkable contribution addressing postgraduates researchers and engineers both at universities and in industry The contributions to this book were presented at the Symposium on Nonlinear Control and Observer Design From Theory to Applications SYNCOD held September 15 16 2005 at the University of Stuttgart Germany The conference and this book are dedicated to the 65th birthday of Prof Dr Ing Dr h c Michael Zeitz to honor his life long research and contributions on the fields of nonlinear control and observer design

Tautological Control Systems Andrew D. Lewis, 2014-07-22 This brief presents a description of a new modelling framework for nonlinear geometric control theory The framework is intended to be and shown to be feedback invariant As such Tautological Control Systems provides a platform for understanding fundamental structural problems in geometric control theory Part of the novelty of the text stems from the variety of regularity classes e g Lipschitz finitely differentiable smooth real analytic with which it deals in a comprehensive and unified manner The treatment of the important real analytic class especially reflects recent work on real analytic topologies by the author Applied mathematicians interested in nonlinear

and geometric control theory will find this brief of interest as a starting point for work in which feedback invariance is important Graduate students working in control theory may also find Tautological Control Systems to be a stimulating starting point for their research

Aspects of Soft Computing, Intelligent Robotics and Control János

Fodor, 2009-08-20 Soft computing as a collection of techniques exploiting approximation and tolerance for imprecision and uncertainty in traditionally intractable problems has become very effective and popular especially because of the synergy derived from its components The integration of constituent technologies provides complementary methods that allow developing flexible computing tools and solving complex problems A wide area of natural applications of soft computing techniques consists of the control of dynamic systems including robots Loosely speaking control can be understood as driving a process to attain a desired goal Intelligent control can be seen as an extension of this concept to include autonomous human like interactions of a machine with the environment Intelligent robots can be characterized by the ability to operate in an uncertain changing environment with the help of appropriate sensing They have the power to autonomously plan and execute motion sequences to achieve a goal specified by a human user without detailed instructions In this volume leading specialists address various theoretical and practical aspects in soft computing intelligent robotics and control The problems discussed are taken from fuzzy systems neural networks interactive evolutionary computation intelligent mobile robotics and intelligent control of linear and nonlinear dynamic systems

Nonlinear Systems and Matrix Analysis - Recent

Advances in Theory and Applications Peter Chen, Victor Martinez-Luaces, 2024-11-27 Nonlinear system analysis is of interest to engineers sociologists physicists mathematicians and many other scientists since most systems are inherently nonlinear in nature In mathematics a nonlinear system does not satisfy the superposition principle such as in a linear system Therefore the theories underlining nonlinear analysis and their applications need to be developed on their own merit The first section of this book is a collection of examples reporting recent advances in both theory and applications of nonlinear system analysis The contents of each chapter will provide in depth foresight to interested readers As numerical linearization to a set of matrix equations is still the principal method used to solve a nonlinear system matrix analysis is the topic of the second section of this book The matrices have invaded practically all areas of mathematics the experimental and social sciences engineering and technology This volume updates purely mathematical theoretical aspects and it also presents concrete examples of the wide range of applications of matrix theory in other disciplines

Analysis of Controlled

Dynamical Systems B. Bonnard, B. Bride, J.P. Gauthier, I. Kupka, 2013-03-07 The conference Analysis of Controlled Dynamical Systems was held in July 1990 at the University of LYON FRANCE About hundred participants attended this conference which lasted four days There were 50 speakers from departments of Engineering and Mathematics in east and west Europe USA and USSR The general subject of the conference was system theory The main topics were optimal control structure and control of nonlinear systems stabilization and observers differential algebra and systems theory nonlinear aspects of Hoc

theory rigid and flexible mechanical systems nonlinear analysis of signals We are indebted to the scientific committee John BAILLIEUL Michel FLIESS Bronislaw JAKUBCZYCK Hector SUSSMANN Jan WILLEMS We gratefully acknowledge the time and thought they gave to this task We would also like to thank Chris BYRNES for arranging for the publication of these proceedings through the series Progress in Systems and Control Theory BIRKHAUSER Finally we are very grateful to the following institutions who through their financial support contributed essentially to the success of this conference CNRS Special year Systemes Dynamiques DRET MEN DAGIC GRECO AUTOMATIQUE Claude Bernard Lyon I University Entreprise Rhone Alpes International Conseil General du RhOne the cities of LYON and VILLEURBANNE **Mathematical Control**

Theory Eduardo D. Sontag, 2013-11-21 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 of interest in the modern as well as the classical techniques of applied mathematics This renewal of interest both in research and teaching has led to the establishment of the series Texts in Applied Mathematics TAM The development of new courses is a natural consequence of a high level of excitement on the research frontier as newer techniques such as numerical and symbolic computer 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 to 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 Mathematics Sciences AMS series which will focus on advanced textbooks and research level monographs v Preface to the Second Edition The most significant differences between this edition and the first are as follows Additional chapters and sections have been written dealing with nonlinear controllability via Lie algebraic methods variational and numerical approaches to nonlinear control including a brief introduction to the Calculus of Variations and the Minimum Principle time optimal control of linear systems feedback linearization single input case nonlinear optimal feedback controllability of recurrent nets and controllability of linear systems with bounded controls **Topological Obstructions**

to Stability and Stabilization Wouter Jongeneel, Emmanuel Moulay, 2023-05-16 This open access book provides a unified overview of topological obstructions to the stability and stabilization of dynamical systems defined on manifolds and an overview that is self contained and accessible to the control oriented graduate student The authors review the interplay between the topology of an attractor its domain of attraction and the underlying manifold that is supposed to contain these sets They present some proofs of known results in order to highlight assumptions and to develop extensions and they provide new results showcasing the most effective methods to cope with these obstructions to stability and stabilization Moreover the book shows how Borsuk's retraction theory and the index theoretic methodology of Krasnoselskii and Zabreiko underlie a large fraction of currently known results This point of view reveals important open problems and for that reason this book is of interest to any researcher in control dynamical systems topology or related fields *Elliptic and Parabolic Problems*

Catherine Bandle, Henri Berestycki, Bernhard Brighi, Alain Brillard, Michel Chipot, Jean-Michel Coron, Carlo Sbordone, Itai Shafir, Vanda Valente, Giorgio Vergara Caffarelli, 2006-01-17 Haim Brezis has made significant contributions in the fields of partial differential equations and functional analysis and this volume collects contributions by his former students and collaborators in honor of his 60th anniversary at a conference in Gaeta. It presents new developments in the theory of partial differential equations with emphasis on elliptic and parabolic problems. Chaos in Automatic Control Wilfrid Perruquetti, Jean-Pierre Barbot, 2018-10-03 Chaotic behavior arises in a variety of control settings. In some cases it is beneficial to remove this behavior; in others, introducing or taking advantage of the existing chaotic components can be useful, for example in cryptography. Chaos in Automatic Control surveys the latest methods for inserting, taking advantage of, or removing chaos in a variety of applications. This book supplies the theoretical and pedagogical basis of chaos in control systems along with new concepts and recent developments in the field. Presented in three parts, the book examines open loop analysis, closed loop control, and applications of chaos in control systems. The first section builds a background in the mathematics of ordinary differential and difference equations on which the remainder of the book is based. It includes an introductory chapter by Christian Mira, a pioneer in chaos research. The next section explores solutions to problems arising in observation and control of closed loop chaotic control systems. These include model independent control methods, strategies such as H_∞ and sliding modes, polytopic observers, normal forms using homogeneous transformations, and observability normal forms. The final section explores applications in wireless transmission, optics, power electronics, and cryptography. Chaos in Automatic Control distills the latest thinking in chaos while relating it to the most recent developments and applications in control. It serves as a platform for developing more robust, autonomous, intelligent, and adaptive systems.

Computation and Control II Kenneth L. Bowers, John Lund, 2013-11-27 This volume contains a collection of papers delivered by the participants at the second Conference on Computation and Control held at Montana State University in Bozeman, Montana, from August 17-19, 1990. The conference, as well as these proceedings, attests to the vitality and cohesion between the control theorist and the numerical analyst that was advertised by the first Conference on Computation and Control in 1988. The proceedings of that initial conference were published by Birkhäuser Boston as the first volume of this same series entitled Computation and Control: Proceedings of the Bozeman Conference, Bozeman, Montana, 1988. Control theory and numerical analysis are both, by their very nature, interdisciplinary subjects, as evidenced by their interaction with other fields of mathematics and engineering. While it is clear that new control or estimation algorithms and new feedback design methodologies will need to be implemented computationally, it is likewise clear that new problems in computational mathematics arise when implementing a new generation of control algorithms. For these reasons, computational mathematics is moving to the forefront in recent developments in modern control theory, and conversely, control theory and its applications continue to be a fertile area for computationalists. This volume contains a representative cross section of the

interdisciplinary blend of analytic and numerical techniques that often occur between advanced control design and practical numerical solution of lumped and distributed parameter systems

Topological Fixed Point Theory of Multivalued Mappings Lech Górniewicz, 2013-11-11 This book is an attempt to give a systematic presentation of results and methods which concern the fixed point theory of multivalued mappings and some of its applications In selecting the material we have restricted ourselves to studying topological methods in the fixed point theory of multivalued mappings and applications mainly to differential inclusions Thus in Chapter III the approximation on the graph method in fixed point theory of multivalued mappings is presented Chapter IV is devoted to the homological methods and contains more general results e.g. the Lefschetz Fixed Point Theorem the fixed point index and the topological degree theory In Chapter V applications to some special problems in fixed point theory are formulated Then in the last chapter a direct application to differential inclusions are presented Note that Chapter I and Chapter II have an auxiliary character and only results connected with the Banach Contraction Principle see Chapter II are strictly related to topological methods in the fixed point theory In the last section of our book see Section 75 we give a bibliographical guide and also signal some further results which are not contained in our monograph The author thanks several colleagues and my wife Maria who read and commented on the manuscript These include J Andres A Buraczewski G Gabor A Gorka M Górniewicz S Park and A Wieczorek The author wishes to express his gratitude to P Konstanty for preparing the electronic version of this monograph

Algebra and Applications 2 Abdenacer Makhlouf, 2021-12-29 This book is part of Algebra and Geometry a subject within the SCIENCES collection published by ISTE and Wiley and the second of three volumes specifically focusing on algebra and its applications Algebra and Applications 2 centers on the increasing role played by combinatorial algebra and Hopf algebras including an overview of the basic theories on non associative algebras operads and combinatorial Hopf algebras The chapters are written by recognized experts in the field providing insight into new trends as well as a comprehensive introduction to the theory The book incorporates self contained surveys with the main results applications and perspectives The chapters in this volume cover a wide variety of algebraic structures and their related topics Alongside the focal topic of combinatorial algebra and Hopf algebras non associative algebraic structures in iterated integrals chronological calculus differential equations numerical methods control theory non commutative symmetric functions Lie series descent algebras Butcher groups chronological algebras Magnus expansions and Rota Baxter algebras are explored Algebra and Applications 2 is of great interest to graduate students and researchers Each chapter combines some of the features of both a graduate level textbook and of research level surveys

Theory Of Difference Equations Numerical Methods And Applications V. Lakshmikantham, V. Trigiante, 2002-06-12 Provides a clear and comprehensive overview of the fundamental theories numerical methods and iterative processes encountered in difference calculus Explores classical problems such as orthological polynomials the Euclidean algorithm roots of polynomials and well conditioning

Mathematics of Complexity and Dynamical Systems Robert A.

Meyers,2011-10-05 Mathematics of Complexity and Dynamical Systems is an authoritative reference to the basic tools and concepts of complexity systems theory and dynamical systems from the perspective of pure and applied mathematics Complex systems are systems that comprise many interacting parts with the ability to generate a new quality of collective behavior through self organization e g the spontaneous formation of temporal spatial or functional structures These systems are often characterized by extreme sensitivity to initial conditions as well as emergent behavior that are not readily predictable or even completely deterministic The more than 100 entries in this wide ranging single source work provide a comprehensive explication of the theory and applications of mathematical complexity covering ergodic theory fractals and multifractals dynamical systems perturbation theory solitons systems and control theory and related topics Mathematics of Complexity and Dynamical Systems is an essential reference for all those interested in mathematical complexity from undergraduate and graduate students up through professional researchers

Mathematical Control Theory Jerzy Zabczyk,2020-06-20 This textbook presents in a mathematically precise manner a unified introduction to deterministic control theory With the exception of a few more advanced concepts required for the final part of the book the presentation requires only a knowledge of basic facts from linear algebra differential equations and calculus In addition to classical concepts and ideas the author covers the stabilization of nonlinear systems using topological methods realization theory for nonlinear systems impulsive control and positive systems the control of rigid bodies the stabilization of infinite dimensional systems and the solution of minimum energy problems This second edition includes new chapters that introduce a variety of topics such as controllability with vanishing energy boundary control systems and delayed systems With additional proofs theorems results and a substantially larger index this new edition will be an invaluable resource for students and researchers of control theory Mathematical Control Theory An Introduction will be ideal for a beginning graduate course in mathematical control theory or for self study by professionals needing a complete picture of the mathematical theory that underlies the applications of control theory From reviews of the first edition At last We did need an introductory textbook on control which can be read understood and enjoyed by anyone Gian Carlo Rota The Bulletin of Mathematics Books It covers a remarkable number of topics The exposition is excellent and the book is a joy to read A novel one semester course covering both linear and nonlinear systems could be given The book is an excellent one for introducing a mathematician to control theory Bulletin of the AMS Indeed for mathematicians who look for the basic ideas or a general picture about the main branches of control theory I believe this book can provide an excellent bridge to this area IEEE Control Systems Magazine

Proceedings of the International Congress of Mathematicians Rajendra Bhatia,Arup Pal,2010 ICM 2010 proceedings comprise a four volume set containing articles based on plenary lectures and invited section lectures the Abel and Noether lectures as well as contributions based on lectures delivered by the recipients of the Fields Medal the Nevanlinna and Chern Prizes The first volume will also contain the speeches at the opening and closing ceremonies and other highlights of the Congress

Control and Nonlinearity Jean-Michel Coron, 2007 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

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