Stability Of Finite And Infinite Dimensional Systems

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Stability of Finite and Infinite Dimensional Nonlinear Delay Systems, Independent of the Delay S. P. Banks 1996
Stability of Dynamical Systems Anthony N. Michel 2008 Filling a gap in the literature, this volume offers the first comprehensive analysis of all the major types of system models. Throughout the text, there are many examples and applications to important classes of systems in areas such as power and energy, feedback control, artificial neural networks, digital signal processing and control, manufacturing, computer networks, and socio-economics. Replete with exercises and requiring basic knowledge of linear algebra, analysis, and differential equations, the work may be used as a textbook for graduate courses in stability theory of dynamical systems. The book may also serve as a self-study reference for graduate students, researchers, and practitioners in a huge variety of fields.
Stabilization of Infinite Dimensional Systems El Hassan Zerrik 2021-03-29 This book deals with the stabilization issue of infinite dimensional dynamical systems both at the theoretical and applications levels. Systems theory is a branch of applied mathematics, which is interdisciplinary and develops activities in fundamental research which are at the frontier of mathematics, automation and engineering sciences. It is everywhere, innumerable and daily, and moreover is there something which is not system: it is present in medicine, commerce, economy, psychology, biological sciences, finance, architecture (construction of towers, bridges, etc.), weather forecast, robotics, automobile, aeronautics, localization systems and so on. These are the few fields of application that are useful and even essential to our society. It is a question of studying the behavior of systems and acting on their evolution. Among the most important notions in system theory, which has attracted the most attention, is stability. The existing literature on systems stability is quite important, but disparate, and the purpose of this book is to bring together in one document the essential results on the stability of infinite dimensional dynamical systems. In addition, as such systems evolve in time and space, explorations and research on their stability have been mainly focused on the whole domain in which the system evolved. The authors have strongly felt that, in this sense, important considerations are missing: those which consist in considering that the system of interest may be unstable on the whole domain, but stable in a certain region of the whole domain. This is the case in many applications ranging from engineering sciences to living science. For this reason, the authors have dedicated this book to extension of classical results on stability to the regional case. This book considers a very important issue, which is that it should be accessible to mathematicians and to graduate engineering with a minimal background in functional analysis. Moreover, for the majority of the students, this would be their only acquaintance with infinite dimensional system. Accordingly, it is organized by following increasing difficulty order. The two first chapters deal with stability and stabilization of infinite dimensional linear systems described by partial differential equations. The following chapters concern original and innovative aspects of stability and stabilization of certain classes of systems motivated by real applications, that is to say bilinear and semi-linear systems. The stability of these systems has been considered from a global and regional point of view. A particular aspect concerning the stability of the gradient has also been considered for various classes of systems. This book is aimed at students of doctoral and master’s degrees, engineering students and researchers interested in the stability of infinite dimensional dynamical systems, in various aspects.
Stability and Stabilization of Infinite Dimensional Systems with Applications Zheng-Hua Luo 2012-12-06 This book reports on recent achievements in stability and feedback stabilization of infinite systems. In particular emphasis is placed on second order partial differential equations, such as Euler-Bernoulli beam equations, which arise from vibration control of flexible robots arms and large space structures. Various control methods such as sensor feedback control and dynamic boundary control are applied to stabilize the equations. Many new theorems and methods are included in the book. Proof procedures of existing theorems are simplified, and detailed proofs have been given to most theorems. New results on semigroups and their stability are presented, and readers can learn several useful techniques for solving practical engineering problems. Until now, the recently obtained research results included in this book were unavailable in one volume. This self-contained book is an invaluable source of information for all those who are familiar with some basic theorems of functional analysis.
Ergodicity of the Finite and Infinite Dimensional Alpha-stable Systems L. Xu 2008
Attractors for infinite-dimensional non-autonomous dynamical systems Alexandre Carvalho 2012-09-26 The book treats the theory of attractors for non-autonomous dynamical systems. The aim of the book is to give a coherent account of the current state of the theory, using the framework of processes to impose the minimum of restrictions on the nature of the non-autonomous dependence. The book is intended as an up-to-date summary of the field, but much of it will be accessible to beginning graduate students. Clear indications will be given as to which material is fundamental and which is more advanced, so that those new to the area can quickly obtain an overview, while those already involved can pursue the topics we cover more deeply.
Representation and Control of Infinite Dimensional Systems Alain Bensoussan 1993-01-01 The quadratic cost optimal control problem for systems described by linear ordinary differential equations occupies a central role in the study of control systems both from the theoretical and design points of view. The study of this problem over an infinite time horizon shows the beautiful interplay between optimality and the qualitative properties of systems such as controllability, observability and stability. This theory is far more difficult for infinite-dimensional systems such as systems with time delay and distributed parameter systems. In the first place, the difficulty stems from the essential unboundedness of the system operator. Secondly, when control and observation are exercised through the boundary of the domain, the operator representing the sensor and actuator are also often unbounded. The present book, in two volumes, is in some sense a self-contained account of this theory of quadratic cost optimal control for a large class of infinite-dimensional systems. Volume I deals with the theory of time evolution of controlled infinite-dimensional systems. It contains a reasonably complete account of the necessary semigroup theory and the theory of delay-differential and partial differential equations. Volume II deals with the optimal control of such systems when performance is measured via a quadratic cost. It covers recent work on the boundary control of hyperbolic systems and exact controllability. Some of the material covered here appears for the first time in book form. The book should be useful for mathematicians and theoretical engineers interested in the field of control.
Lagrangian and Hamiltonian Methods for Nonlinear Control 2003 A Astolfi 2003-10-07 This is the

second of a series of IFAC Workshops initiated in 2000. The first one chaired and organized by Profs. N. Leonard and R. Ortega, was held in Princeton in March 2000. This proceedings volume looks at the role-played by Lagrangian and Hamiltonian methods in disciplines such as classical mechanics, quantum mechanics, fluid dynamics, electrodynamics, celestial mechanics and how such methods can be practically applied in the control community. *Presents and illustrates new approaches to nonlinear control that exploit the Lagrangian and Hamiltonian structure of the system to be controlled *Highlights the important role of Lagrangian and Hamiltonian Structures as design methods

Hankel Norm Approximation for Infinite-Dimensional Systems A. Sasane 2002-05-14 Model reduction is an important engineering problem in which one aims to replace an elaborate model by a simpler model without undue loss of accuracy. The accuracy can be mathematically measured in several possible norms and the Hankel norm is one such. The Hankel norm gives a meaningful notion of distance between two linear systems: roughly speaking, it is the induced norm of the operator that maps past inputs to future outputs. It turns out that the engineering problem of model reduction in the Hankel norm is closely related to the mathematical problem of finding solutions to the sub-optimal Nehari-Takagi problem, which is called "the sub-optimal Hankel norm approximation problem" in this book. Although the existence of a solution to the sub-optimal Hankel norm approximation problem has been known since the 1970's, this book presents explicit solutions and, in particular, new formulae for several large classes of infinite-dimensional systems for the first time.

Input-to-State Stability Andrii Mironchenko 2023-03-30 Input-to-State Stability presents the dominating stability paradigm in nonlinear control theory that revolutionized our view on stabilization of nonlinear systems, design of robust nonlinear observers, and stability of nonlinear interconnected control systems. The applications of input-to-state stability (ISS) are manifold and include mechatronics, aerospace engineering, and systems biology. Although the book concentrates on the ISS theory of finite-dimensional systems, it emphasizes the importance of a more general view of infinite-dimensional ISS theory. This permits the analysis of more general system classes and provides new perspectives on and a better understanding of the classical ISS theory for ordinary differential equations (ODEs). Features of the book include: • a comprehensive overview of the theoretical basis of ISS; • a description of the central applications of ISS in nonlinear control theory; • a detailed discussion of the role of small-gain methods in the stability of nonlinear networks; and • an in-depth comparison of ISS for finite- and infinite-dimensional systems. The book also provides a short overview of the ISS theory for other systems classes (partial differential equations, hybrid, impulsive, and time-delay systems) and surveys the available results for the important stability properties that are related to ISS. The reader should have a basic knowledge of analysis, Lebesgue integration theory, linear algebra, and the theory of ODEs but requires no prior knowledge of dynamical systems or stability theory. The author introduces all the necessary ideas within the book. Input-to-State Stability will interest researchers and graduate students studying nonlinear control from either a mathematical or engineering background. It is intended for active readers and contains numerous exercises of varying difficulty, which are integral to the text, complementing and widening the material developed in the monograph.

Stability of Dynamical Systems Anthony N. Michel 2015-03-30 The second edition of this textbook provides a single source for the analysis of system models represented by continuous-time and discrete-time, finite-dimensional and infinite-dimensional, and continuous and discontinuous dynamical systems. For these system models, it presents results which comprise the classical Lyapunov stability theory involving monotonic Lyapunov functions, as well as corresponding contemporary stability results involving non-monotonic Lyapunov functions. Specific examples from several diverse areas are given to demonstrate the applicability of the developed theory to many important classes of systems, including digital control systems, nonlinear regulator systems, pulse-width-modulated feedback control systems, and artificial neural networks. The authors cover the following four general topics: - Representation and modeling of dynamical systems of the types described above - Presentation of Lyapunov and Lagrange stability theory for dynamical systems defined on general metric spaces involving monotonic and non-monotonic Lyapunov functions - Specialization of this stability theory to finite-dimensional dynamical systems - Specialization of this stability theory to infinite-dimensional dynamical systems Replete with examples and requiring only a basic knowledge of linear algebra, analysis, and differential equations, this book can be used as a textbook for graduate courses in stability theory of dynamical systems. It may also serve as a self-study reference for graduate students, researchers, and practitioners in applied mathematics, engineering, computer science, economics, and the physical and life sciences. Review of the First Edition: “The authors have done an excellent job maintaining the rigor of the presentation, and in providing standalone statements for diverse types of systems. [This] is a very interesting book which complements the existing literature. [It] is clearly written, and difficult concepts are illustrated by means of good examples.” - Alessandro Astolfi, IEEE Control Systems Magazine, February 2009

Polyhedral Systems in Finite and Infinite Dimensions with Applications to Robust Stability of Variational Inequalities René Henrion 2009

Convergence of Controllers Designed Using State Space Methods Institute for Computer Applications in Science and Engineering 1991 In this paper convergence of finite-dimensional controllers for infinite-dimensional systems designed using approximations is examined. Stable coprime factorization theory is used to show that under the standard assumptions of uniform stabilizability/detectability, the controllers stabilize the original system for large enough model order. The controllers converge uniformly to an infinite-dimensional controller, as does the closed loop response.

Stability of Infinite Dimensional Stochastic Differential Equations with Applications Kai Liu 2005-08-23 Stochastic differential equations in infinite dimensional spaces are motivated by the theory and analysis of stochastic processes and by applications such as stochastic control, population biology, and turbulence, where the analysis and control of such systems involves investigating their stability. While the theory of such equations is well establ

Robust Control of Linear Systems and Nonlinear Control M. A. Kaashoek 2013-03-07 This volume is the second of the three volume publication containing the proceedings of the 1989 International Symposium on the Mathemat ical Theory of Networks and Systems (MTNS-89), which was held in Amsterdam, The Netherlands, June 19-23, 1989 The International Symposia MTNS focus attention on problems from system and control theory, circuit theory and signal processing, which, in general, require application of sophisticated mathematical tools, such as from function and operator theory, linear algebra and matrix theory, differential and algebraic geometry. The interaction between advanced mathematical methods and practical engineering problems of circuits, systems and control, which is typical for MTNS, turns out to be most effective and is, as these proceedings show, a continuing source of exciting advances. The second volume contains invited papers and a large selection of other symposium presentations in the vast area of robust and nonlinear control. Modern developments in robust control and H-infinity theory, for finite as well as for infinite dimensional systems, are presented. A large part of the volume is devoted to nonlinear control. Special atten tion is paid to problems in robotics. Also the general theory of nonlinear and infinite dimensional systems is discussed. A couple of papers deal with problems of stochastic control and filterina. vi Preface The titles of the two other volumes are: Realization and Modelling in System Theory (volume 1) and Signal Processing, Scattering and Operator Theory, and Numerical Methods (volume 3).

Discontinuous Systems Yury V. Orlov 2008-10-28 Discontinuous Systems develops nonsmooth stability analysis and discontinuous control synthesis based on novel modeling of discontinuous dynamic systems, operating under uncertain conditions. While being primarily a research monograph devoted to the theory of discontinuous dynamic systems, no background in discontinuous systems is required; such systems are introduced in the book at the appropriate conceptual level. Being developed for discontinuous systems, the theory is successfully applied to their subclasses – variable-structure and impulsive systems – as well as to finite- and infinite-dimensional systems such as distributed-parameter and time-delay systems. The presentation concentrates on algorithms rather than on technical implementation although theoretical results are illustrated by electromechanical applications. These specific applications complete the book and, together with the introductory theoretical constituents bring some elements of the tutorial to the text.

Control and Observer Design for Nonlinear Finite and Infinite Dimensional Systems Thomas Meurer 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.

Ergodicity of the Finite and Infinite Dimensional [alpha]-stable Systems Lihu Xu 2008

Realization and Modelling in System Theory A.C. Ran 2013-03-07 This volume is the first of the three volume publication containing the proceedings of the 1989 International Symposium on the Mathematical Theory of Networks and Systems (MTNS-89), which was held in Amsterdam, The Netherlands, June 19-23, 1989. The International Symposia MTNS focus attention on problems from system and control theory, circuit theory and signal processing, which, in general, require application of sophisticated mathematical tools, such as from function and operator theory, linear algebra and matrix theory, differential and algebraic geometry. The interaction between advanced mathematical methods and practical engineering problems of circuits, systems and control, which is typical for MTNS, turns out to be most effective and is, as these proceedings show, a continuing source of exciting advances. The first volume contains invited papers and a large selection of other symposium presentations on the general theory of deterministic and stochastic systems with an emphasis on realization and modelling. A wide variety of recent results on approximate realization and system identification, stochastic dynamical systems, discrete event systems,- o systems, singular systems and nonstandard models IS presented. Preface vi Also a few papers on applications in hydrology and hydraulics are included. The titles of the two other volumes are: Robust Control of Linear Sys tems and Nonlinear Control (volume 2) and Signal Processing. Scatter ing and Operator Theory. and Numerical Methods (volume 3). The Editors are most grateful to the about 300 reviewers for their help in the refereeing process. The Editors thank Ms. G. Bijleveld and Ms.

From Finite to Infinite Dimensional Dynamical Systems James Robinson 2001-05-31 This volume contains six papers originally presented at a NATO Advanced Study Institute held in Cambridge, U.K. in 1995 on the fundamental properties of partial differential equations and modeling processes involving spatial dynamics. The contributors, from academic institutions in Europe and the U.S., discuss such topics as lattice dynamical systems, low-dimensional models of turbulence, and nonlinear dynamics of extended systems. The volume is not indexed. c. Book News Inc.

Synchronization in Infinite-Dimensional Deterministic and Stochastic Systems Igor Chueshov 2020-07-29 The main goal of this book is to systematically address the mathematical methods that are applied in the study of synchronization of infinite-dimensional evolutionary dissipative or partially dissipative systems. It bases its unique monograph presentation on both general and abstract models and covers several important classes of coupled nonlinear deterministic and stochastic PDEs which generate infinite-dimensional dissipative systems. This text, which adapts readily to advanced graduate coursework in dissipative dynamics, requires some background knowledge in evolutionary equations and introductory functional analysis as well as a basic understanding of PDEs and the theory of random processes. Suitable for researchers in synchronization theory, the book is also relevant to physicists and engineers interested in both the mathematical background and the methods for the asymptotic analysis of coupled infinite-dimensional dissipative systems that arise in continuum mechanics.

Infinite-Dimensional Systems F. Kappel 2006-11-14

Control Theory of Infinite-Dimensional Systems Joachim Kerner 2020-06-25 This book presents novel results by participants of the conference “Control theory of infinite-dimensional systems” that took place in January 2018 at the FernUniversität in Hagen. Topics include well-posedness, controllability, optimal control problems as well as stability of linear and nonlinear systems, and are covered by world-leading experts in these areas. A distinguishing feature of the contributions in this volume is the particular combination of researchers from different fields in mathematics working in an interdisciplinary fashion on joint projects in mathematical system theory. More explicitly, the fields of partial differential equations, semigroup theory, mathematical physics, graph and network theory as well as numerical analysis are all well-represented.

Infinite Dimensional Optimization and Control Theory Hector O. Fattorini 1999-03-28 Treats optimal problems for systems described by ODEs and PDEs, using an approach that unifies finite and infinite dimensional nonlinear programming.

Dynamics of Infinite Dimensional Systems Shui-Nee Chow 2013-06-29 The 1986 NATO Advanced Study Insti tute on Dynamics of Infini te Dimensional Systems was held at the Instituto Superior Tecnico. Lisbon. Portugal. In recent years. there have been several research workers who have been considering partial differential equations and functional differential equations as dynamical systems on function spaces. Such approaches have led to the formulation of more theoretical problems that need to be investigated. In the applications. the theoretical ideas have contributed significantly to a better understanding of phenomena that have been experimentally and computationally observed. The investigators of this development come wi th several different backgrounds - some from classical partial differential equations. some from classical ordinary differential equations and some interested in specific applications. Each group has special ideas and often these ideas have not been transmitted from one group to another. The purpose of this NATO Workshop was to bring together research workers from these various areas. It provided asoundboard for the impact of the ideas of each respective discipline. We believe that goal was accomplished. but time will be a better judge. We have included the list of participants at the workshop. with most of these giving a presentation. Although the proceedings do not include all of the presentations. it is a good representative sampie. We wish to express our gratitude to NATO. and.to Dr. M. di Lullo of NATO. who unfortunately did not live to see the completion of this project.

The Stability and Stabilizability of Infinite Dimensional Linear Systems Via Liapunov's Direct Method Alan Paul Ross 1979 This dissertation attempts to extend to infinite dimensional linear systems in a Hilbert space some of the stability and stabilizability results that have been obtained for finite dimensional systems using the direct method of Liapunov. The familiar finite dimensional applications of Liapunov's direct method to the stability and stabilizability of linear systems involve the existence of certain positive matrices which satisfy some form of algebraic Riccati equation. Former extensions of these results to infinite dimensional systems in Hilbert space apply exclusively to exponential (uniform asymptotic) stability. Recently, recognizing that exponential stability is a very strong property to expect of some physical systems, some attention has been paid to weaker forms of stability. This thesis generalizes the results of Liapunov's direct method to infinite dimensional systems in a manner that addresses these weaker forms of stability. This is accomplished by developing the distinct concepts of nonnegative, positive, and strictly positive operators. The resulting stability and stabilizability theorems are stated in terms of weak stability, but they are shown to be applicable, in many cases, to strong and exponential stability as well.

Dynamic Feedback in Finite- and Infinite-dimensional Linear Systems Johannes Maria Schumacher 1981

Stability of Dynamical Systems Anthony N Michel 2007-11-12 Filling a gap in the literature, this volume offers the first comprehensive analysis of all the major types of system models. Throughout the text, there are many examples and applications to important classes of systems in areas such as power and energy, feedback control, artificial neural networks, digital signal processing and control, manufacturing, computer networks, and socio-economics. Replete with exercises and requiring basic knowledge of linear algebra, analysis, and differential equations, the work may be used as a textbook for graduate courses in stability theory of dynamical systems. The book may also serve as a self-study reference for graduate students, researchers, and practitioners in a huge variety of fields.

Stability Analysis of Linear ODE-PDE Interconnected Systems Mathieu Bajodek 2022 Infinite dimensional systems allow to model a large panel of physical phenomena for which the state variables evolve both temporally and spatially. This manuscript deals with the evaluation of the stability of their equilibrium point. Two case studies are treated in particular: the stability analysis of ODE-transport, and ODE-reaction-diffusion interconnected systems. Theoretical tools exist for the stability analysis of these infinite-dimensional linear systems and are based on an operator algebra rather than a matrix algebra. However, these existence results raise a problem of numerical constructibility. During implementation, an approximation is performed and the results are conservative. The design of numerical tools leading to

stability guarantees for which the degree of conservatism is evaluated and controlled is then a major issue. How can we develop reliable numerical criteria to rule on the stability or instability of infinite-dimensional linear systems? In order to answer this question, one proposes here a new generic method, which is decomposed in two steps. First, from the perspective of Legendre polynomials approximation, augmented models are built and split the original system into two blocks: on the one hand, a finite-dimensional approximated system is isolated, on the other hand, the infinite-dimensional truncation error is preserved and modeled. Then, frequency and time tools of finite dimension are deployed in order to propose stability criteria that have high or low numerical load depending on the approximated order. In frequencies, with the aid of the small gain theorem, sufficient stability conditions are obtained. In temporal, with the aid of the Lyapunov theorem, an under estimate of the stability regions is proposed as a linear matrix inequality and an over estimate as a positivity test. Our two case studies have been treated with this general methodology. The main result concerns the case of ODE-transport interconnected systems, for which the approximation and stability analysis using Legendre polynomials leads to exponentially fast converging estimates of stability regions. The method developed in this manuscript can be adapted to other types of approximations and exported to other infinite-dimensional linear systems. Thus, this work opens the way to obtain necessary and sufficient finite-dimensional conditions of stability for infinite-dimensional systems.
Introduction to Infinite-Dimensional Systems Theory Ruth Curtain 2020-04-05 Infinite-dimensional systems is a well established area of research with an ever increasing number of applications. Given this trend, there is a need for an introductory text treating system and control theory for this class of systems in detail. This textbook is suitable for courses focusing on the various aspects of infinite-dimensional state space theory. This book is made accessible for mathematicians and post-graduate engineers with a minimal background in infinite-dimensional system theory. To this end, all the system theoretic concepts introduced throughout the text are illustrated by the same types of examples, namely, diffusion equations, wave and beam equations, delay equations and the new class of platoon-type systems. Other commonly met distributed and delay systems can be found in the exercise sections. Every chapter ends with such a section, containing about 30 exercises testing the theoretical concepts as well. An extensive account of the mathematical background assumed is contained in the appendix.
The Control Systems Handbook William S. Levine 2018-10-03 At publication, The Control Handbook immediately became the definitive resource that engineers working with modern control systems required. Among its many accolades, that first edition was cited by the AAP as the Best Engineering Handbook of 1996. Now, 15 years later, William Levine has once again compiled the most comprehensive and authoritative resource on control engineering. He has fully reorganized the text to reflect the technical advances achieved since the last edition and has expanded its contents to include the multidisciplinary perspective that is making control engineering a critical component in so many fields. Now expanded from one to three volumes, The Control Handbook, Second Edition organizes cutting-edge contributions from more than 200 leading experts. The third volume, Control System Advanced Methods, includes design and analysis methods for MIMO linear and LTI systems, Kalman filters and observers, hybrid systems, and nonlinear systems. It also covers advanced considerations regarding — Stability Adaptive controls System identification Stochastic control Control of distributed parameter systems Networks and networked controls As with the first edition, the new edition not only stands as a record of accomplishment in control engineering but provides researchers with the means to make further advances. Progressively organized, the first two volumes in the set include: Control System Fundamentals Control System Applications
Control and Estimation in Distributed Parameter Systems H. T. Banks 1992-01-01 Research in control and estimation of distributed parameter systems encompasses a wide range of applications including both fundamental science and emerging technologies. The latter include smart materials (piezoceramics, shape memory alloys, magnetostrictives, electrorheological fluids) fabrication and testing, design of high-pressure chemical vapor deposition (CVD) reactors for production of microelectronic surfaces (e.g., semiconductors), while the former include groundwater contamination cleanup and other environmental modeling questions, climatology, flow control, and fluid-structure interactions as well as more traditional topics in biology, mechanics, and acoustics. These expository papers provide substantial stimulus to both young researchers and experienced investigators in control theory. Includes a comprehensive and lucid presentation that relates frequency domain techniques to state-space or time domain approaches for infinite-dimensional systems including design of robust stabilizing and finite-dimensional controllers for infinite-dimensional systems. It focuses on these two approaches to control design in an integrated system theoretic framework. This is excellent reading for researchers in both the frequency domain and time domain control communities. In other articles, topics considered include pointwise control of distributed parameter systems, bounded and unbounded sensors and actuators, stabilization issues for large flexible structures, and an overview discussion of damping models for flexible structures.
Linear Port-Hamiltonian Systems on Infinite-dimensional Spaces Birgit Jacob 2012-06-13 This book provides a self-contained introduction to the theory of infinite-dimensional systems theory and its applications to port-Hamiltonian systems. The textbook starts with elementary known results, then progresses smoothly to advanced topics in current research. Many physical systems can be formulated using a Hamiltonian framework, leading to models described by ordinary or partial differential equations. For the purpose of control and for the interconnection of two or more Hamiltonian systems it is essential to take into account this interaction with the environment. This book is the first textbook on infinite-dimensional port-Hamiltonian systems. An abstract functional analytical approach is combined with the physical approach to Hamiltonian systems. This combined approach leads to easily verifiable conditions for well-posedness and stability. The book is accessible to graduate engineers and mathematicians with a minimal background in functional analysis. Moreover, the theory is illustrated by many worked-out examples.
An Introduction to Infinite Dimensional Dynamical Systems - Geometric Theory J.K. Hale 2013-04-17 Including: An Introduction to the Homotopy Theory in Noncompact Spaces
Nonsmooth Lyapunov Analysis in Finite and Infinite Dimensions Yury Orlov 2020-02-08 Nonsmooth Lyapunov Analysis in Finite and Infinite Dimensions provides helpful tools for the treatment of a broad class of dynamical systems that are governed, not only by ordinary differential equations but also by partial and functional differential equations. Existing Lyapunov constructions are extended to discontinuous systems—those with variable structure and impact—by the involvement of nonsmooth Lyapunov functions. The general theoretical presentation is illustrated by control-related applications; the nonsmooth Lyapunov construction is particularly applied to the tuning of sliding-mode controllers in the presence of mismatched disturbances and to orbital stabilization of the bipedal gate. The nonsmooth construction is readily extendible to the control and identification of distributed-parameter and time-delay systems. The first part of the book outlines the relevant fundamentals of benchmark models and mathematical basics. The second concentrates on the construction of nonsmooth Lyapunov functions. Part III covers design and applications material. This book will benefit the academic research and graduate student interested in the mathematics of Lyapunov equations and variable-structure control, stability analysis and robust feedback design for discontinuous systems. It will also serve the practitioner working with applications of such systems. The reader should have some knowledge of dynamical systems theory, but no background in discontinuous systems is required—they are thoroughly introduced in both finite- and infinite-dimensional settings.
An Introduction to Infinite-Dimensional Linear Systems Theory Ruth F. Curtain 2012-12-06 Infinite dimensional systems is now an established area of research. Given the recent trend in systems theory and in applications towards a synthesis of time- and frequency-domain methods, there is a need for an introductory text which treats both state-space and frequency-domain aspects in an integrated fashion. The authors' primary aim is to write an introductory textbook for a course on infinite dimensional linear systems. An important consideration by the authors is that their book should be accessible to graduate engineers and mathematicians with a minimal background in functional analysis. Consequently, all the mathematical background is summarized in an extensive appendix. For the majority of students, this would be their only acquaintance with infinite dimensional systems.
The Connection Between Infinite Dimensional and Finite Dimensional Dynamical Systems Basil Nicolaenko 1989-12-21 The last few years have seen a number of major developments demonstrating that the long-term behavior of solutions of a very large class of partial differential equations possesses a striking resemblance to the behavior of solutions of finite dimensional dynamical systems, or ordinary differential equations. The first of these advances was the discovery that a dissipative PDE has a compact, global attractor with finite

Hausdorff and fractal dimensions. More recently, it was shown that some of these PDEs possess a finite dimensional inertial manifold-that is, an invariant manifold containing the attractor and exponentially attractive trajectories. With the improved understanding of the exact connection between finite dimensional dynamical systems and various classes of dissipative PDEs, it is now realistic to hope that the wealth of studies of such topics as bifurcations of finite vector fields and ``strange'' fractal attractors can be brought to bear on various mathematical models, including continuum flows. Surprisingly, a number of distributed systems from continuum mechanics have been found to exhibit the same nontrivial dynamic behavior as observed in low-dimensional dynamical systems. As a natural consequence of these observations, a new direction of research has arisen: detection and analysis of finite dimensional dynamical characteristics of infinite-dimensional systems. This book represents the proceedings of an AMS-IMS-SIAM Summer Research Conference, held in July, 1987 at the University of Colorado at Boulder. Bringing together mathematicians and physicists, the conference provided a forum for presentations on the latest developments in the field and fostered lively interactions on open questions and future directions. With contributions from some of the top experts, these proceedings will provide readers with an overview of this vital area of research.
Dissipativity in Control Engineering Alexander Schaum 2021-07-19 Dissipativity, as a natural mechanism of energy interchange is common to many physical systems that form the basis of modern automated control applications. Over the last decades it has turned out as a useful concept that can be generalized and applied in an abstracted form to very different system setups, including ordinary and partial differential equation models. In this monograph, the basic notions of stability, dissipativity and systems theory are connected in order to establish a common basis for designing system monitoring and control schemes. The approach is illustrated with a set of application examples covering finite and infinite-dimensional models, including a ship steering model, the inverted pendulum, chemical and biological reactors, relaxation oscillators, unstable heat equations and first-order hyperbolic integro-differential equations.
Stability of Finite and Infinite Dimensional Systems Michael I. Gil' 2012-12-06 The aim of Stability of Finite and Infinite Dimensional Systems is to provide new tools for specialists in control system theory, stability theory of ordinary and partial differential equations, and differential-delay equations. Stability of Finite and Infinite Dimensional Systems is the first book that gives a systematic exposition of the approach to stability analysis which is based on estimates for matrix-valued and operator-valued functions, allowing us to investigate various classes of finite and infinite dimensional systems from the unified viewpoint. This book contains solutions to the problems connected with the Aizerman and generalized Aizerman conjectures and presents fundamental results by A. Yu. Levin for the stability of nonautonomous systems having variable real characteristic roots. Stability of Finite and Infinite Dimensional Systems is intended not only for specialists in stability theory, but for anyone interested in various applications who has had at least a first-year graduate-level course in analysis.
Representation and Control of Infinite Dimensional Systems Alain Bensoussan 2007-04-05 This unified, revised second edition of a two-volume set is a self-contained account of quadratic cost optimal control for a large class of infinite-dimensional systems. The original editions received outstanding reviews, yet this new edition is more concise and self-contained. New material has been added to reflect the growth in the field over the past decade. There is a unique chapter on semigroup theory of linear operators that brings together advanced concepts and techniques which are usually treated independently. The material on delay systems and structural operators has not yet appeared anywhere in book form.

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