Nonlinear Systems And Control Lecture 1 Introduction

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Dynamic Surface Control of Uncertain Nonlinear Systems Springer
This monograph provides insight and fundamental understanding into the feedback control of nonlinear and hybrid process systems. It presents state-of-the-art methods for the synthesis of nonlinear feedback controllers for nonlinear and hybrid systems with uncertainty, constraints and time-delays with numerous applications, especially to chemical processes. It covers both state feedback and output feedback (including state estimator design) controller designs. Control of Nonlinear and Hybrid Process Systems includes numerous comments and remarks providing insight and fundamental understanding into the feedback control of nonlinear and hybrid systems, as well as applications that demonstrate the implementation and effectiveness of the presented control methods. The book includes many detailed examples which can be easily modified by a control engineer to be tailored to a specific application. This book is useful for researchers in control systems theory, graduate students pursuing their degree in control systems and control engineers.
Fault Diagnosis of Nonlinear Systems Using a Hybrid Approach Springer Science & Business Media
In this work, the authors present a global perspective on the methods available for analysis and design of non-linear control systems and detail specific applications. They provide a tutorial exposition of the major non-linear systems analysis techniques followed by a discussion of available non-linear design methods.
Analysis and Control of Nonlinear Systems CRC Press

The purpose of this book is to present a self-contained description of the fun damentals of the theory of nonlinear control systems, with special emphasis on the differential geometric approach. The book is intended as a graduate text as weil as a reference to scientists and engineers involved in the analysis and design of feedback systems. The first version of this book was written in 1983, while I was teach ing at the Department of Systems Science and Mathematics at Washington University in St. Louis. This new edition integrates my subsequent teaching experience gained at the University of Illinois in Urbana-Champaign in 1987, at the Carl-Cranz Gesellschaft in Oberpfaffenhofen in 1987, at the University of California in Berkeley in 1988. In addition to a major rearrangement of the last two Chapters of the first version, this new edition incorporates two additional Chapters at a more elementary level and an exposition of some relevant research findings which have occurred since 1985.

Springer Science & Business Media

This volume deals with controllability and observability properties of nonlinear systems, as well as various ways to obtain input-output representations. The emphasis is on fundamental notions as (controlled) invariant distributions and submanifolds, together with algorithms to compute the required feedbacks.

Advances in the Control of Nonlinear Systems SIAM

This book examines control of nonlinear systems. Coverage ranges from mathematical system theory to practical industrial control applications. The author offers web-based videos illustrating some dynamical aspects and case studies in simulation.

Mathematical Control Theory I Springer Science & Business Media

This book provides a broad overview of state-of-the-art research at the intersection of the Koopman operator theory and control theory. It also reviews novel theoretical results obtained and efficient numerical methods developed within the framework of Koopman operator theory. The contributions discuss the latest findings and techniques in several areas of control theory, including model predictive control, optimal control, observer design, systems identification and structural analysis of controlled systems, addressing both theoretical and numerical aspects and presenting open research directions, as well as detailed numerical schemes and data-driven methods. Each contribution addresses a specific problem. After a brief introduction of the Koopman operator framework, including basic notions and definitions, the book explores numerical methods, such as the dynamic mode decomposition (DMD) algorithm and Arnoldi-based methods, which are used to represent the operator in a finite-dimensional basis and to compute its spectral properties from data. The main body of the book is divided into three parts: theoretical results and numerical techniques for observer design, synthesis analysis, stability analysis, parameter estimation, and identification; data-driven techniques based on DMD, which extract the spectral properties of the Koopman operator from data for the structural analysis of controlled systems; and Koopman operator techniques with specific applications in systems and control, which range from heat transfer analysis to robot control. A useful reference resource on the Koopman operator theory for control theorists and practitioners, the book is also of interest to graduate students,

researchers, and engineers looking for an introduction to a novel and comprehensive approach to systems and control, from pure theory to data-driven methods.

Nonlinear Control in the Year 2000 Springer

There has been great interest in "universal controllers" that mimic the functions of human processes to learn about the systems they are controlling on-line so that performance improves automatically. Neural network controllers are derived for robot manipulators in a variety of applications including position control, force control, link flexibility stabilization and the management of high-frequency joint and motor dynamics. The first chapter provides a background on neural networks and the second on dynamical systems and control. Chapter three introduces the robot control problem and standard techniques such as torque, adaptive and robust control. Subsequent chapters give design techniques and Stability Proofs For NN Controllers For Robot Arms, Practical Robotic systems with high frequency vibratory modes, force control and a general class of non-linear systems. The last chapters are devoted to discrete- time NN controllers. Throughout the text, worked examples are provided.

Reconfigurable Control of Nonlinear Dynamical Systems Springer Science & Business Media

This volume is the proceedings of a conference held May 6 and 7, 1994 at McGill University in Montreal in honour of Professor George on the occasion of his 60th birthday. He has devoted most of his professional life to the subject of feedback control. Invited speakers were internationally prominent researchers from the USA, Canada, UK and the Netherlands. Their papers cover various aspects of linear multivariable feedback control, nonlinear systems and the complexity of systems.

Nonlinear and Optimal Control Theory Springer Science & Business Media

Although the problem of nonlinear controller design is as old as that of linear controller design, the systematic design methods framed in response are more sparse. Given the range and complexity of nonlinear systems, effective new methods of control design are therefore of significant importance. Dynamic Surface Control of Uncertain Nonlinear Systems provides a theoretically rigorous and practical introduction to nonlinear control design. The convex optimization approach applied to good effect in linear systems is extended to the nonlinear case using the new dynamic surface control (DSC) algorithm developed by the authors. A variety of problems – DSC design, output feedback, input saturation and fault-tolerant control among them – are considered. The inclusion of applications material demonstrates the real significance of the DSC algorithm, which is robust and easy to use, for nonlinear systems with uncertainty in automotive and robotics. Written for the researcher and graduate student of nonlinear control theory, this book will provide the applied mathematician and engineer alike with a set of powerful tools for nonlinear control design. It will also be of interest to practitioners working with a mechatronic systems in aerospace, manufacturing and automotive and robotics, milieux.

Lecture Notes on Nonlinear Control Systems Springer Science & Business Media

This book includes selected contributions by lecturers at the third annual Formation d’Automatique de Paris. It provides a well-integrated synthesis of the latest thinking in nonlinear optimal

control, observer design, stability analysis and structural properties of linear systems, without the need for an exhaustive literature review. The internationally known contributors to this volume represent many of the most reputable control centers in Europe.

Theory and Applications Springer

The theory of switched systems is related to the study of hybrid systems, which has gained attention from control theorists, computer scientists, and practicing engineers. This book examines switched systems from a control-theoretic perspective, focusing on stability analysis and control synthesis of systems that combine continuous dynamics with switching events. It includes a vast bibliography and a section of technical and historical notes.

Designs for Uncertainty, Constraints and Time-Delays Springer Science & Business Media

The purpose of this book is twofold: To survey control system design methods based on the system inversion technique and to collect into one place the many recent results in the field. It has been known for some time that inverse systems may be used to solve numerous control problems. Despite the importance and conceptual simplicity of this topic there appears to be no monograph written on it. The purpose of this work is therefore to present and apply a systematic design method which bases itself on the fundamental system property of invertibility. Many different theoretical and practical aspects are considered in this volume working from elementary topics in the first section to current research in the second.

Nonlinear Model Predictive Control Springer

For over a quarter of a century, high-gain observers have been used extensively in the design of output feedback control of nonlinear systems. This book presents a clear, unified treatment of the theory of high-gain observers and their use in feedback control. Also provided is a discussion of the separation principle for nonlinear systems; this differs from other separation results in the literature in that recovery of stability as well as performance of state feedback controllers is given. The author provides a detailed discussion of applications of high-gain observers to adaptive control and regulation problems and recent results on the extended high-gain observers. In addition, the author addresses two challenges that face the implementation of high-gain observers: high dimension and measurement noise. Low-power observers are presented for high-dimensional systems. The effect of measurement noise is characterized and techniques to reduce that effect are presented. The book ends with discussion of digital implementation of the observers. Readers will find comprehensive coverage of the main results on high-gain observers; rigorous, self-contained proofs of all results; and numerous examples that illustrate and provide motivation for the results. The book is intended for engineers and applied mathematicians who design or research feedback control systems.

Emergent Problems in Nonlinear Systems and Control Springer

The lectures gathered in this volume present some of the different aspects of Mathematical Control Theory. Adopting the point of view of Geometric Control Theory and of Nonlinear Control Theory, the lectures focus on some aspects of the

Optimization and Control of nonlinear, not necessarily smooth, dynamical systems. Specifically, three of the five lectures discuss respectively: logic-based switching control, sliding mode control and the input to the state stability paradigm for the control and stability of nonlinear systems. The remaining two lectures are devoted to Optimal Control: one investigates the connections between Optimal Control Theory, Dynamical Systems and Differential Geometry, while the second presents a very general version, in a non-smooth context, of the Pontryagin Maximum Principle. The arguments of the whole volume are self-contained and are directed to everyone working in Control Theory. They offer a sound presentation of the methods employed in the control and optimization of nonlinear dynamical systems.

Analysis, Stability, and Control Prentice Hall

Control of nonlinear systems, one of the most active research areas in control theory, has always been a domain of natural convergence of research interests in applied mathematics and control engineering. The theory has developed from the early phase of its history, when the basic tool was essentially only the Lyapunov second method, to the present day, where the mathematics ranges from differential geometry, calculus of variations, ordinary and partial differential equations, functional analysis, abstract algebra and stochastic processes, while the applications to advanced engineering design span a wide variety of topics, which include nonlinear controllability and observability, optimal control, state estimation, stability and stabilization, feedback equivalence, motion planning, noninteracting control, disturbance attenuation, asymptotic tracking. The reader will find in the book methods and results which cover a wide variety of problems: starting from pure mathematics (like recent fundamental results on (non)analycity of small balls and the distance function), through its applications to all just mentioned topics of nonlinear control, up to industrial applications of nonlinear control algorithms.

Nonlinear Control Systems Springer

The authors present a study of the H-infinity control problem and related topics for descriptor systems, described by a set of nonlinear differential-algebraic equations. They derive necessary and sufficient conditions for the existence of a controller solving the standard nonlinear H-infinity control problem considering both state and output feedback. One such condition for the output feedback control problem to be solvable is obtained in terms of Hamilton–Jacobi inequalities and a weak coupling condition; a parameterization of output feedback controllers solving the problem is also provided. All of these results are then specialized to the linear case. The derivation of state-space formulae for all controllers solving the standard H-infinity control problem for descriptor systems is proposed. Among other important topics covered are balanced realization, reduced-order controller design and mixed H2/H-infinity control. "H-infinity Control for Nonlinear Descriptor Systems" provides a comprehensive introduction and easy access to advanced topics.

Nonlinear Control Systems II Springer Nature

There has been much excitement over the emergence of new mathematical techniques for the analysis and control of nonlinear systems. In addition, great technological advances have bolstered the impact of analytic advances and produced many new problems and applications which are nonlinear in an

essential way. This book lays out in a concise mathematical framework the tools and methods of analysis which underlie this diversity of applications.

Nonlinear Control Systems Springer Science & Business Media

Nonlinear Model Predictive Control (NMPC) has become the accepted methodology to solve complex control problems related to process industries. The main motivation behind explicit NMPC is that an explicit state feedback law avoids the need for executing a numerical optimization algorithm in real time. The benefits of an explicit solution, in addition to the efficient on-line computations, include also verifiability of the implementation and the possibility to design embedded control systems with low software and hardware complexity. This book considers the multi-parametric Nonlinear Programming (mp-NLP) approaches to explicit approximate NMPC of constrained nonlinear systems, developed by the authors, as well as their applications to various NMPC problem formulations and several case studies. The following types of nonlinear systems are considered, resulting in different NMPC problem formulations: Nonlinear systems described by first-principles models and nonlinear systems described by black-box models; - Nonlinear systems with continuous control inputs and nonlinear systems with quantized control inputs; - Nonlinear systems without uncertainty and nonlinear systems with uncertainties (polyhedral description of uncertainty and stochastic description of uncertainty); - Nonlinear systems, consisting of interconnected nonlinear sub-systems. The proposed mp-NLP approaches are illustrated with applications to several case studies, which are taken from diverse areas such as automotive mechatronics, compressor control, combustion plant control, reactor control, pH maintaining system control, cart and spring system control, and diving computers.

Proceedings of the Joint Workshop on Feedback and Synthesis of Linear and Nonlinear Systems, Bielefeld /Rom Springer

The noninteracting control problem with stability consists of rendering a nonlinear system noninteractive while achieving internal stability. With the exception of systems with outputs partitioned into given blocks or when the state of the system is not available for feedback, this problem is well understood. However, this book provides a useful supplement to the standard texts on the nonlinear control theory and collects all the existing results on the nonlinear noninteracting control problem into a self-contained and extensive concept.

Advanced Topics in Control Systems Theory Springer Science & Business Media

This treatment of modern topics related to the control of nonlinear systems is a collection of contributions celebrating the work of Professor Henk Nijmeijer and honoring his 60th birthday. It addresses several topics that have been the core of Professor Nijmeijer’s work, namely: the control of nonlinear systems, geometric control theory, synchronization, coordinated control, convergent systems and the control of underactuated systems. The book presents recent advances in these areas, contributed by leading international researchers in systems and control. In addition to the theoretical questions treated in the text, particular attention is paid to a number of applications including (mobile) robotics, marine vehicles, neural dynamics and mechanical systems generally. This volume provides a broad picture of the analysis and control of nonlinear systems for scientists and

engineers with an interest in the interdisciplinary field of systems and control theory. The reader will benefit from the expert participants' ideas on important open problems with contributions that represent the state of the art in nonlinear control.

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