

Reduction of Nonlinear Control Systems

Reduction Of Nonlinear Control Systems A Differential Geometric Approach Mathematics And Its Appli

Francesco Bullo, Andrew D. Lewis



Reduction Of Nonlinear Control Systems A Differential Geometric Approach Mathematics And Its Appli:

Reduction of Nonlinear Control Systems V.I. Elkin, 1999-02-28 Advances in science and technology necessitate the use of increasingly complicated dynamic control processes Undoubtedly sophisticated mathematical models are also concurrently elaborated for these processes In particular linear dynamic control systems $\dot{y} = Ay + Bu$ where A and B are constants are often abandoned in favor of nonlinear dynamic control systems which in addition contain a large number of equations The solution of problems for multidimensional nonlinear control systems encounters serious difficulties which are both mathematical and technical in nature Therefore it is imperative to develop methods of reduction of nonlinear systems to a simpler form for example decomposition into systems of lesser dimension Approaches to reduction are diverse in particular techniques based on approximation methods In this monograph we elaborate the most natural and obvious in our opinion approach which is essentially inherent in any theory of mathematical entities for instance in the theory of linear spaces theory of groups etc Reduction in our interpretation is based on assigning to the initial object an isomorphic object a quotient object and a subobject In the theory of linear spaces for instance reduction consists in reducing to an isomorphic linear space quotient space and subspace Strictly speaking the exposition of any mathematical theory essentially begins with the introduction of these reduced objects and determination of their basic properties in relation to the initial object

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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

Optimization and Control of Bilinear Systems Panos M. Pardalos, Vitaliy A. Yatsenko, 2010-03-14

The present book is based on results of scientific investigations and on the materials of special courses offered for graduate and undergraduate students The purpose of this book is to acquaint the reader with the developments in bilinear systems theory and its applications Particular attention is paid to control of open physical processes functioning in a nonequilibrium mode The text consists of eight chapters Chapter 1 is concerned with the problems of systems analysis of bilinear processes Chapter 2 solves the problem of optimal control of bilinear systems on the basis of differential geometry methods Chapter 3 deals with the progress made in an adaptive estimation technique Chapter 4 is devoted to the application of the Yang Mills fields to investigation of nonlinear control problems Chapter 5 considers intelligent sensors used to examine weak signals This chapter also describes and analyzes bilinear models of intelligent sensing elements Chapter 6 illustrates control problems of a quantum system Chapter 7 discusses the problems of control and identification in systems with chaotic dynamics Finally Chapter 8 examines the controlled processes running in biomolecular systems This book is directed to students postgraduate students and specialists engaged in the fields of control of physical processes quantum and molecular computing biophysics and physical information science

Geometric Control of Mechanical Systems Francesco Bullo, Andrew D. Lewis, 2019-06-12

The primary emphasis of this book is the modeling analysis and control of mechanical systems The methods and results presented can be applied to a large class of mechanical control systems including applications in robotics autonomous vehicle control and multi body systems The book is unique in that it presents a unified rather than an inclusive treatment of control theory for mechanical systems A distinctive feature of the presentation is its reliance on techniques from differential and Riemannian geometry The book contains extensive examples and exercises and will be suitable for a growing number of courses in this area It begins with the detailed mathematical background proceeding through innovative approaches to physical modeling analysis and design techniques Numerous examples illustrate the proposed methods and results while the many exercises test basic knowledge and introduce topics not covered in the main body of the text The audience of this book consists of two groups The first group is comprised of graduate students in engineering or mathematical sciences who wish to learn the basics of geometric mechanics nonlinear control theory and control theory for mechanical systems Readers will be able to immediately begin exploring the research literature on these subjects The second group consists of researchers in mechanics and control theory Nonlinear control theoreticians will find

explicit links between concepts in geometric mechanics and nonlinear control theory Researchers in mechanics will find an overview of topics in control theory that have relevance to mechanics *Geometrical Methods in Variational Problems* N.A. Bobylov, S.V. Emel'yanov, S. Korovin, 2012-12-06 This self contained monograph presents methods for the investigation of nonlinear variational problems These methods are based on geometric and topological ideas such as topological index degree of a mapping Morse Conley index Euler characteristics deformation invariant homotopic invariant and the Lusternik Shnirelman category Attention is also given to applications in optimisation mathematical physics control and numerical methods Audience This volume will be of interest to specialists in functional analysis and its applications and can also be recommended as a text for graduate and postgraduate level courses in these fields **Nonlinear Systems** Nathan van de Wouw, Erjen Lefeber, Ines Lopez Arteaga, 2016-07-07 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 **Applied Differential Geometry: A Modern Introduction** Vladimir G Ivancevic, Tijana T Ivancevic, 2007-05-21 This graduate level monographic textbook treats applied differential geometry from a modern scientific perspective Co authored by the originator of the world's leading human motion simulator Human Biodynamics Engine a complex 264 DOF bio mechanical system modeled by differential geometric tools this is the first book that combines modern differential geometry with a wide spectrum of applications from modern mechanics and physics via nonlinear control to biology and human sciences The book is designed for a two semester course which gives mathematicians a variety of applications for their theory and physicists as well as other scientists and engineers a strong theory underlying their models **Contemporary Trends In Nonlinear Geometric Control Theory And Its Applications** Alfonso Anzaldo-meneses, Bernard Bonnard, Jean Paul Gauthier, Felipe Monroy Perez, 2002-01-30 Mathematical control theory has evolved from the study of practical problems in engineering and sciences to the elaboration of deep important concepts in mathematics and applied sciences This volume concerns contemporary trends in nonlinear geometric control theory and its applications It is a fine collection of papers presenting new results relevant open problems and important applications regarding academic and real world problems The book is dedicated to Velimir Jurdjevic whose

scientific activity has been influential in the research of many of the authors. It contains a number of articles specially written by colleagues and friends of Veljko Jurdjević, all of them leading applied mathematicians and control theorists. There is also place for surveys on topics of current research which present the state of the art of modern geometric control theory. Finally, the volume contains several new mathematical ideas generated by geometric control theory techniques which may initiate new directions of research beyond control theory.

Algebraic Methods for Nonlinear Control Systems Giuseppe Conte, Claude H. Moog, Anna Maria Perdon, 2007-01-19. A self-contained introduction to algebraic control for nonlinear systems suitable for researchers and graduate students. *Algebraic Methods for Nonlinear Control Systems* develops a linear algebraic alternative to the usual differential geometric approach to nonlinear control using vector spaces over suitable fields of nonlinear functions. It describes a range of results, some of which can be derived using differential geometry but many of which cannot. They include classical and generalized realization in the nonlinear context, accessibility and observability recast for the linear algebraic setting, discussion and solution of basic feedback problems, results for dynamic and static state and output feedback. Dynamic feedback and realization are shown to be dealt with and solved much more easily in the algebraic framework. The second edition has been completely revised with new text, examples and exercises; it is divided into two parts: necessary methodology and applications to control problems.

Reviewing **Reduction Of Nonlinear Control Systems A Differential Geometric Approach Mathematics And Its Appli:** Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is really astonishing. Within the pages of "**Reduction Of Nonlinear Control Systems A Differential Geometric Approach Mathematics And Its Appli**," an enthralling opus penned by a very acclaimed wordsmith, readers attempt an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve in to the book is central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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