Viorel Barbu

Mathematical Methods in Optimization of Differential Systems
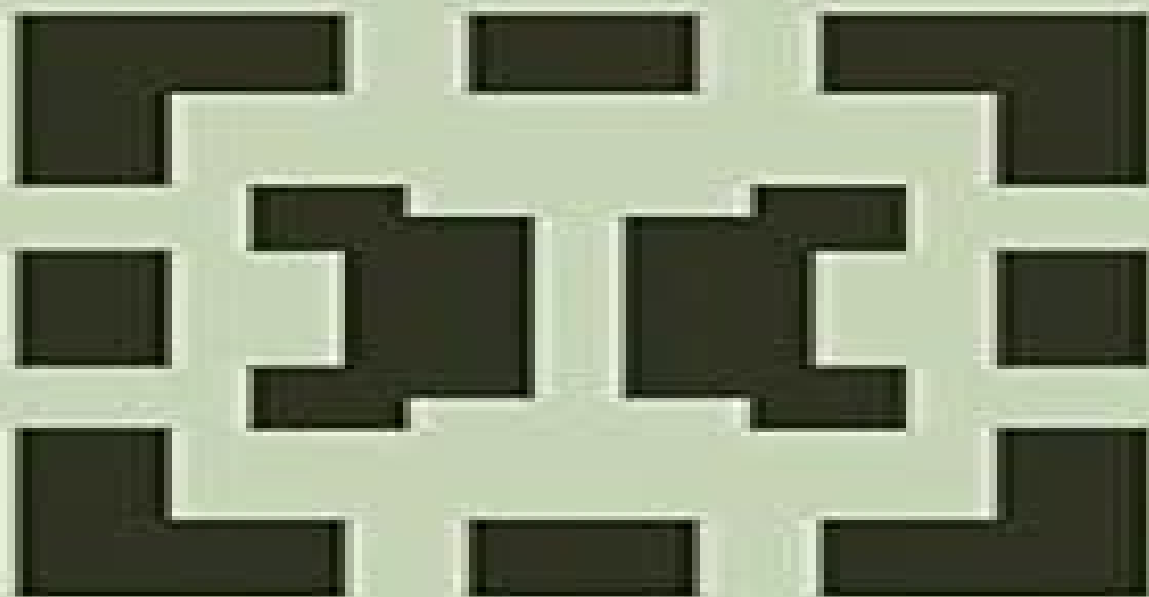
Mathematical Methods In Optimization Of Differential Systems

Roberto Lucchetti,Julian Revalski

Mathematical Methods In Optimization Of Differential Systems:

   Mathematical Methods in Optimization of Differential Systems Viorel Barbu,2012-01-10 This work is a revised and enlarged edition of a book with the same title published in Romanian by the Publishing House of the Romanian Academy in 1989 It grew out of lecture notes for a graduate course given by the author at the University if Ia i and was initially intended for students and readers primarily interested in applications of optimal control of ordinary differential equations In this vision the book had to contain an elementary description of the Pontryagin maximum principle and a large number of examples and applications from various fields of science The evolution of control science in the last decades has shown that its meth ods and tools are drawn from a large spectrum of mathematical results which go beyond the classical theory of ordinary differential equations and real analy ses Mathematical areas such as functional analysis topology partial differential equations and infinite dimensional dynamical systems geometry played and will continue to play an increasing role in the development of the control sciences On the other hand control problems is a rich source of deep mathematical problems Any presentation of control theory which for the sake of accessibility ignores these facts is incomplete and unable to attain its goals This is the reason we considered necessary to widen the initial perspective of the book and to include a rigorous mathematical treatment of optimal control theory of processes governed by ordi nary differential equations and some typical problems from theory of distributed parameter systems   *Mathematical Methods in Optimization of Differential Systems* Viorel Barbu,2012-12-06 This work is a revised and enlarged edition of a book with the same title published in Romanian by the Publishing House of the Romanian Academy in 1989 It grew out of lecture notes for a graduate course given by the author at the University if Ia i and was initially intended for students and readers primarily interested in applications of optimal control of ordinary differential equations In this vision the book had to contain an elementary description of the Pontryagin maximum principle and a large number of examples and applications from various fields of science The evolution of control science in the last decades has shown that its meth ods and tools are drawn from a large spectrum of mathematical results which go beyond the classical theory of ordinary differential equations and real analy ses Mathematical areas such as functional analysis topology partial differential equations and infinite dimensional dynamical systems geometry played and will continue to play an increasing role in the development of the control sciences On the other hand control problems is a rich source of deep mathematical problems Any presentation of control theory which for the sake of accessibility ignores these facts is incomplete and unable to attain its goals This is the reason we considered necessary to widen the initial perspective of the book and to include a rigorous mathematical treatment of optimal control theory of processes governed by ordi nary differential equations and some typical problems from theory of distributed parameter systems   *Mathematical Methods in Robust Control of Linear Stochastic Systems* Vasile Dragan,Toader Morozan,Adrian-Mihail Stoica,2007-02-03 Linear stochastic systems are successfully used to provide mathematical models for real processes in fields such as

aerospace engineering communications manufacturing finance and economy This monograph presents a useful methodology for the control of such stochastic systems with a focus on robust stabilization in the mean square linear quadratic control the disturbance attenuation problem and robust stabilization with respect to dynamic and parametric uncertainty Systems with both multiplicative white noise and Markovian jumping are covered Key Features Covers the necessary pre requisites from probability theory stochastic processes stochastic integrals and stochastic differential equations Includes detailed treatment of the fundamental properties of stochastic systems subjected both to multiplicative white noise and to jump Markovian perturbations Systematic presentation leads the reader in a natural way to the original results New theoretical results accompanied by detailed numerical examples Proposes new numerical algorithms to solve coupled matrix algebraic Riccati equations The unique monograph is geared to researchers and graduate students in advanced control engineering applied mathematics mathematical systems theory and finance It is also accessible to undergraduate students with a fundamental knowledge in the theory of stochastic systems **Optimal Control of Distributed Systems. Theory and Applications** A. V. Fursikov,1999-11-16 This volume presents the analysis of optimal control problems for systems described by partial differential equations The book offers simple and clear exposition of main results in this area The methods proposed by the author cover cases where the controlled system corresponds to well posed or ill posed boundary value problems which can be linear or nonlinear The uniqueness problem for the solution of nonlinear optimal control problems is analyzed in various settings Solutions of several previously unsolved problems are given In addition general methods are applied to the study of two problems connected with optimal control of fluid flows described by the Navier Stokes equations **Stabilization of Navier–Stokes Flows** Viorel Barbu,2010-11-19 Stabilization of Navier Stokes Flows presents recent notable progress in the mathematical theory of stabilization of Newtonian fluid flows Finite dimensional feedback controllers are used to stabilize exponentially the equilibrium solutions of Navier Stokes equations reducing or eliminating turbulence Stochastic stabilization and robustness of stabilizable feedback are also discussed The analysis developed here provides a rigorous pattern for the design of efficient stabilizable feedback controllers to meet the needs of practical problems and the conceptual controllers actually detailed will render the reader s task of application easier still Stabilization of Navier Stokes Flows avoids the tedious and technical details often present in mathematical treatments of control and Navier Stokes equations and will appeal to a sizeable audience of researchers and graduate students interested in the mathematics of flow and turbulence control and in Navier Stokes equations in particular **Operations Research Proceedings 2011** Diethard Klatte,Hans-Jakob Lüthi,Karl Schmedders,2012-06-07 This book contains a selection of refereed papers presented at the International Conference on Operations Research OR 2011 which took place at the University of Zurich from August 30 to September 2 2011 The conference was jointly organized by the German speaking OR societies from Austria GOR Germany GOR and Switzerland SVOR under the patronage of SVOR More than 840 scientists and students from over 50 countries

attended OR 2011 and presented 620 papers in 16 parallel topical streams as well as special award sessions The conference was designed according to the understanding of Operations Research as an interdisciplinary science focusing on modeling complex socio technical systems to gain insight into behavior under interventions by decision makers Dealing with organized complexity lies in the core of OR and designing useful support systems to master the challenge of system management in complex environment is the ultimate goal of our professional societies To this end algorithmic techniques and system modeling are two fundamental competences which are also well balanced in these proceedings   Numerical Control: Part A ,2022-02-15 Numerical Control Part A Volume 23 in the Handbook of Numerical Analysis series highlights new advances in the field with this new volume presenting interesting chapters written by an international board of authors Chapters in this volume include Numerics for finite dimensional control systems Moments and convex optimization for analysis and control of nonlinear PDEs The turnpike property in optimal control Structure Preserving Numerical Schemes for Hamiltonian Dynamics Optimal Control of PDEs and FE Approximation Filtration techniques for the uniform controllability of semi discrete hyperbolic equations Numerical controllability properties of fractional partial differential equations Optimal Control Numerics and Applications of Fractional PDEs and much more Provides the authority and expertise of leading contributors from an international board of authors Presents the latest release in the Handbook of Numerical Analysis series Updated release includes the latest information on Numerical Control   Handbook of Multivalued Analysis Shouchuan Hu,Nikolaos S. Papageorgiou,2013-11-21 In volume I we developed the tools of Multivalued Analysis In this volume we examine the applications After all the initial impetus for the development of the theory of set valued functions came from its applications in areas such as control theory and mathematical economics In fact the needs of control theory in particular the study of systems with a priori feedback led to the systematic investigation of differential equations with a multi valued vector field differential inclusions For this reason we start this volume with three chapters devoted to set valued differential equations However in contrast to the existing books on the subject i e J P Aubin A Cellina Differential Inclusions Springer Verlag 1983 and Deimling Multivalued Differential Equations W De Gruyter 1992 here we focus on Evolution Inclusions which are evolution equations with multi valued terms Evolution equations were raised to prominence with the development of the linear semigroup theory by Hille and Yosida initially with subsequent im portant contributions by Kato Phillips and Lions This theory allowed a successful unified treatment of some apparently different classes of nonstationary linear par tial differential equations and linear functional equations The needs of dealing with applied problems and the natural tendency to extend the linear theory to the nonlinear case led to the development of the nonlinear semigroup theory which became a very effective tool in the analysis of broad classes of nonlinear evolution equations   **Functional Approach to Nonlinear Models of Water Flow in Soils** G. Marinoschi,2006-09-05 a pure mathematician does what he can do as well as he should whilst an applied mathematician does what he should do as well as he can Gr C Moisil Romanian mathematician 1906 1973 Flows in

porous media were initially the starting point for the study which has evolved into this book because the acquirement and improving of kn ledge about the analysis and control of water in ltration and solute spreading arechallenginganddemandingpresentissuesinmanydomains likesoilsci ces hydrology water management water quality management ecology The mathematical modelling required by these processes revealed from the beg ning interesting and di cult mathematical problems so that the attention was redirected to the theoretical mathematical aspects involved Then the qualitative results found were used for the explanation of certain behaviours of the physical processes which had made the object of the initial study and for giving answers to the real problems that arise in the soil science practice In this way the work evidences a perfect topic for an applied mathematical research This book was written in the framework of my research activity within the Institute of Mathematical Statistics and Applied Mathematics of the Ro nianAcademy SomeresultswereobtainedwithintheprojectCNCSIS33045 2004 2006 nanced by the Romanian Ministry of Research and Education In a preliminary form part of the results included here were lecture notes for master and Ph D students during the scienti c stages November December 2003 and May June 2004 of the author at the Center for Optimal Control and Discrete Mathematics belonging to the Central China Normal University in Wuhan   *Geometry, Mechanics, and Dynamics* Paul Newton,Phil Holmes,Alan Weinstein,2006-05-11 Jerry Marsden one of the world s pre eminent mechanicians and applied mathematicians celebrated his 60th birthday in August 2002 The event was marked by a workshop on Geometry Mechanics and Dynamics at the Fields Institute for Research in the Mathematical Sciences of which he wasthefoundingDirector Ratherthanmerelyproduceaconventionalp ceedings with relatively brief accounts of research and technical advances presented at the meeting we wished to acknowledge Jerry s in uence as a teacher a propagator of new ideas and a mentor of young talent Con quently starting in 1999 we sought to collect articles that might be used as entry points by students interested in elds that have been shaped by Jerry s work At the same time we hoped to give experts engrossed in their own technical niches an indication of the wonderful breadth and depth of their subjects as a whole This book is an outcome of the e orts of those who accepted our in tations to contribute It presents both survey and research articles in the several elds that represent the main themes of Jerry s work including elasticity and analysis uid mechanics dynamical systems theory g metric mechanics geometric control theory and relativity and quantum mechanics The common thread running through this broad tapestry is the use of geometric methods that serve to unify diverse disciplines and bring a widevarietyofscientistsandmathematicianstogether speakingalanguage which enhances dialogue and encourages cross fertilization   **Industrial Mathematics and Statistics** J. C. Misra,2003 This comprehensive volume introduces educational units dealing with important topics in Industrial Mathematics and Statistics   **Robust Stabilisation and H_ Problems** Vlad Ionescu,Adrian-Mihail Stoica,2012-12-06 OO It is a matter of general consensus that in the last decade the H _ optimization for robust control has dominated the research effort in control systems theory Much attention has been paid

equally to the mathematical instrumentation and the computational aspects There are several excellent monographs that cover the standard topics in the area Among the recent issues we have to cite here Linear Robust Control authored by Green and Limebeer Prentice Hall 1995 Robust Controller Design Using Normalized Coprime Factor Plant Descriptions by McFarlane and Glover Springer Verlag 1989 Robust and Optimal Control by Zhou Doyle and Glover Prentice Hall 1996 Thus when the authors of the present monograph decided to start the work they were confronted with a very rich literature on the subject However two reasons motivated their initiative The first concerns the theory in which the whole development of the book was embedded As is well known there are several ways of approach oo ing H and robust control theory Here we mention three relevant direc tions chronologically ordered a the first makes use of a generalization of the Beurling Lax theorem to Krein spaces b the second makes use of a generalization of Nevanlinna Pick interpolation theory and commutant lifting theorem c the third and probably the most attractive from an el evate engineering viewpoint is the two Riccati equations based approach which offers a complete solution in state space form   *Large-Scale Scientific Computing* Ivan Lirkov,Svetozar D. Margenov,Jerzy Wasniewski,2009-03-26 Coverage in this proceedings volume includes robust multilevel and hierarchical preconditioning methods applications for large scale computations and optimization of coupled engineering problems and applications of metaheuristics to large scale problems   Minimax Theorems and Qualitative Properties of the Solutions of Hemivariational Inequalities Dumitru Motreanu,Panagiotis D. Panagiotopoulos,2013-12-01 Boundary value problems which have variational expressions in form of inequal ities can be divided into two main classes The class of boundary value prob lems BVPs leading to variational inequalities and the class of BVPs leading to hemivariational inequalities The first class is related to convex energy functions and has being studied over the last forty years and the second class is related to nonconvex energy functions and has a shorter research life beginning with the works of the second author of the present book in the year 1981 Nevertheless a variety of important results have been produced within the framework of the theory of hemivariational inequalities and their numerical treatment both in Mathematics and in Applied Sciences especially in Engineering It is worth noting that inequality problems i e BVPs leading to variational or to hemivariational inequalities have within a very short time had a remarkable and precipitate development in both Pure and Applied Mathematics as well as in Mechanics and the Engineering Sciences largely because of the possibility of applying and further developing new and efficient mathematical methods in this field taken generally from convex and or nonconvex Nonsmooth Analy sis The evolution of these areas of Mathematics has facilitated the solution of many open questions in Applied Sciences generally and also allowed the formu lation and the definitive mathematical and numerical study of new classes of interesting problems   Recent Developments in Well-Posed Variational Problems Roberto Lucchetti,Julian Revalski,2013-03-09 This volume contains several surveys focused on the ideas of approximate solutions well posedness and stability of problems in scalar and vector optimization game theory and calculus of variations These concepts are of

particular interest in many fields of mathematics The idea of stability goes back at least to J Hadamard who introduced it in the setting of differential equations the concept of well posedness for minimum problems is more recent the mid sixties and originates with A N Tykhonov It turns out that there are connections between the two properties in the sense that a well posed problem which at least in principle is easy to solve has a solution set that does not vary too much under perturbation of the data of the problem i e it is stable These themes have been studied in depth for minimum problems and now we have a general picture of the related phenomena in this case But of course the same concepts can be studied in other more complicated situations as e g vector optimization game theory and variational inequalities Let us mention that in several of these new areas there is not even a unique idea of what should be called approximate solution and the latter is at the basis of the definition of well posed problem **The Geometry of Higher-Order Lagrange Spaces** R. Miron,2013-11-11 This monograph is devoted to the problem of the geometrizing of Lagrangians which depend on higher order accelerations It presents a construction of the geometry of the total space of the bundle of the accelerations of order k 1 A geometrical study of the notion of the higher order Lagrange space is conducted and the old problem of prolongation of Riemannian spaces to k osculator manifolds is solved Also the geometrical ground for variational calculus on the integral of actions involving higher order Lagrangians is dealt with Applications to higher order analytical mechanics and theoretical physics are included as well Audience This volume will be of interest to scientists whose work involves differential geometry mechanics of particles and systems calculus of variation and optimal control optimization optics electromagnetic theory and biology *Optimal Control of Viscous Flow* S. S. Sritharan,1998-01-01 **Business Information Systems** Witold Abramowicz,2013-06-14 This book contains the refereed proceedings of the 16th International Conference on Business Information Systems BIS 2013 held in Pozna Poland in June 2013 The theme of this year s conference was Business Applications on the Move reflecting the growing usage of mobile devices in business applications and its repercussions on business processes and information management The 18 revised full papers were carefully reviewed and selected from 52 submissions They are grouped into six sections on modern enterprises and mobile ERP business models and BPM linked data and ontologies recommendations and content analysis knowledge discovery and IT frameworks and systems architecture Connectedness and Necessary Conditions for an Extremum Alexey Abramov,1998-03-31 The present book is the outcome of efforts to introduce topological connectedness as one of the basic tools for the study of necessary conditions for an extremum Apparently this monograph is the first book in the theory of maxima and minima where topological connectedness is used so widely for this purpose Its application permits us to obtain new results in this sphere and to consider the classical results from a nonstandard point of view Regarding the style of the present book it should be remarked that it is comparatively elementary The author has made constant efforts to make the book as self contained as possible Certainly familiarity with the basic facts of topology functional analysis and the theory of optimization is assumed The book is written for applied mathematicians and graduate students

interested in the theory of optimization and its applications We present the synthesis of the well known Dybovitskii Milyutin ap proach for the study of necessary conditions for an extremum based on functional analysis and topological methods This synthesis allows us to show that in some cases we have the following important result if the Euler equation has no non trivial solution at a point of an extremum then some inclusion is valid for the functionals belonging to the dual space This general result is obtained for an optimization problem considered in a lin ear topological space We also show an application of our result to some problems of nonlinear programming and optimal control   Noncommutative Algebraic Geometry and Representations of Quantized Algebras A. Rosenberg,2013-03-09 This book is based on lectures delivered at Harvard in the Spring of 1991 and at the University of Utah during the academic year 1992 93 Formally the book assumes only general algebraic knowledge rings modules groups Lie algebras functors etc It is helpful however to know some basics of algebraic geometry and representation theory Each chapter begins with its own introduction and most sections even have a short overview The purpose of what follows is to explain the spirit of the book and how different parts are linked together without entering into details The point of departure is the notion of the left spectrum of an associative ring and the first natural steps of general theory of noncommutative affine quasi affine and projective schemes This material is presented in Chapter I Further developments originated from the requirements of several important examples I tried to understand to begin with the first Weyl algebra and the quantum plane The book reflects these developments as I worked them out in reallife and in my lectures In Chapter 11 we study the left spectrum and irreducible representations of a whole lot of rings which are of interest for modern mathematical physics The dasses of rings we consider indude as special cases quantum plane algebra of q differential operators quantum Heisenberg and Weyl algebras quantum enveloping algebra ofthe Lie algebra sl 2 coordinate algebra of the quantum group SL 2 the twisted SL 2 of Woronowicz so called dispin algebra and many others

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