Optimization and Dynamical Systems

Uwe Helmke and John B. Moore

Springer

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Boris Miller,Evgeny Rubinovich

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Applied Dynamic Programming for Optimization of Dynamical Systems Rush D. Robinett III,David G. Wilson,G. Richard Eisler,John E. Hurtado,2005-07-01 This book presents a range of dynamic programming DP techniques applied to the optimization of dynamical systems   *Optimization and Control of Dynamic Systems* Henryk Górecki,2017-07-26 This book

offers a comprehensive presentation of optimization and polyoptimization methods The examples included are taken from various domains mechanics electrical engineering economy informatics and automatic control making the book especially attractive With the motto from general abstraction to practical examples it presents the theory and applications of optimization step by step from the function of one variable and functions of many variables with constraints to infinite dimensional problems calculus of variations a continuation of which are optimization methods of dynamical systems that is dynamic programming and the maximum principle and finishing with polyoptimization methods It includes numerous practical examples e g optimization of hierarchical systems optimization of time delay systems rocket stabilization modeled by balancing a stick on a finger a simplified version of the journey to the moon optimization of hybrid systems and of the electrical long transmission line analytical determination of extremal errors in dynamical systems of the rth order multicriteria optimization with safety margins the skeleton method and ending with a dynamic model of bicycle The book is aimed at readers who wish to study modern optimization methods from problem formulation and proofs to practical applications illustrated by inspiring concrete examples   Optimization of Dynamic Systems S. K. Agrawal,B.C. Fabien,2013-03-09 This textbook deals with optimization of dynamic systems The motivation for undertaking this task is as follows There is an ever increasing need to produce more efficient accurate and lightweight mechanical and electromechanical de vices Thus the typical graduating B S and M S candidate is required to have some familiarity with techniques for improving the performance of dynamic systems Unfortunately existing texts dealing with system improvement via optimization remain inaccessible to many of these students and practicing en gineers It is our goal to alleviate this difficulty by presenting to seniors and beginning graduate students practical efficient techniques for solving engineer ing system optimization problems The text has been used in optimal control and dynamic system optimization courses at the University of Deleware the University of Washington and Ohio University over the past four years The text covers the following material in a straightforward detailed manner Static Optimization The problem of optimizing a function that depends on static variables i e parameters is considered Problems with equality and inequality constraints are addressed Numerical Methods Static Optimization Numerical algorithms for the solution of static optimization problems are presented here The methods presented can accommodate both the unconstrained and constrained static optimization problems Calculus of Variation The necessary and sufficient conditions for the ex tremum of functionals are presented Both the fixed final time and free final time problems are considered   **Dynamical Search** Luc Pronzato,Henry P. Wynn,Anatoly A Zhigljavsky,1999-08-27 Certain algorithms that are known to converge can be renormalized or blown up at each iteration so that their local behavior can be seen This creates dynamical systems that we can study with modern tools such as ergodic theory chaos special attractors and Lyapounov exponents Furthermore we can translate the rates of convergence into less studied exponents known as Renyi entropies This all feeds back to suggest new algorithms with faster rates of convergence

For example in line search we can improve upon the Golden Section algorithm with new classes of algorithms that have their own special and sometimes chaotic dynamical systems The ellipsoidal algorithms of linear and convex programming have fast deep cut versions whose dynamical systems contain cyclic attractors And ordinary steepest descent has buried within a beautiful fractal that controls the gateway to a special two point attractor Faster relaxed versions exhibit classical period doubling Dynamical Search presents a stimulating introduction to a brand new field the union of dynamical systems and optimization It will prove fascinating and open doors to new areas of investigation for researchers in both fields plus those in statistics and computer science **Optimization of Dynamical Systems with Impulse Controls and Shocks** Boris Miller,Evgeny Rubinovich,2024-09-19 This text explores the state of the art in the rapidly developing theory of impulse control and introduces the theory of singular space time transformations a new method for studying shock mechanical systems Two approaches in the theory of impulse control are presented The first more traditional approach defines the impulsive action as a discontinuity of phase coordinates depending on the current time the state preceding the action and its magnitude The second requires the use of modern methods for describing dynamical systems differential equations with measures The impulse is treated as an idealization of a very short action of high magnitude which produces an almost abrupt change of phase coordinates The relation between these two approaches is also discussed and several applications both traditional and emerging are considered This text is intended for graduate students and researchers in control engineering and optimal control theory for dynamical systems Readers are assumed to be familiar with the theory of ODEs optimal control and functional analysis though an appendix is included that covers many of the necessary mathematical concepts **Dynamical search applications of dynamical systems in search and optimization** Luc Pronzato,2000 **Linear, Time-varying Approximations to Nonlinear Dynamical Systems** Maria Tomas-Rodriguez,Stephen P. Banks,2010-02-04 Linear Time varying Approximations to Nonlinear Dynamical Systems introduces a new technique for analysing and controlling nonlinear systems This method is general and requires only very mild conditions on the system nonlinearities setting it apart from other techniques such as those well known based on differential geometry The authors cover many aspects of nonlinear systems including stability theory control design and extensions to distributed parameter systems Many of the classical and modern control design methods which can be applied to linear time varying systems can be extended to nonlinear systems by this technique The implementation of the control is therefore simple and can be done with well established classical methods Many aspects of nonlinear systems such as spectral theory which is important for the generalisation of frequency domain methods can be approached by this method Topics in Optimization George Leitmann,1979-07-24 Topics in Optimization **Advances in Dynamics, Optimization and Computation** Oliver Junge,Oliver Schütze,Gary Froyland,Sina Ober-Blöbaum,Kathrin Padberg-Gehle,2020-07-20 This book presents a collection of papers on recent advances in problems concerning dynamics optimal control and optimization In many chapters

computational techniques play a central role Set oriented techniques feature prominently throughout the book yielding state of the art algorithms for computing general invariant sets constructing globally optimal controllers and solving multi objective optimization problems   Analysis, Controllability and Optimization of Time-Discrete Systems and Dynamical Games Werner Krabs,2012-12-06 J P La Salle has developed in 20 a stability theory for systems of difference equations see also 8 which we introduce in the first chapter within the framework of metric spaces The stability theory for such systems can also be found in 13 in a slightly modified form We start with autonomous systems in the first section of chapter 1 After theoretical preparations we examine the localization of limit sets with the aid of Lyapunov Functions Applying these Lyapunov Functions we can develop a stability theory for autonomous systems If we linearize a non linear system at a fixed point we are able to develop a stability theory for fixed points which makes use of the Frechet derivative at the fixed point The next subsection deals with general linear systems for which we intro duce a new concept of stability and asymptotic stability that we adopt from 18 Applications to various fields illustrate these results We start with the classical predator prey model as being developed and investigated by Volterra which is based on a 2 x 2 system of first order differential equations for the densities of the prey and predator population respectively This model has also been investigated in 13 with respect to stability of its equilibrium via a Lyapunov function Here we consider the discrete version of the model   Optimization and Control of Bilinear Systems Panos M. Pardalos,Vitaliy A. Yatsenko,2010-03-14 The present book is based on results of scienti c investigations and on the materials of special courses o ered 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 di er tial 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 elds 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 identi cation in systems with chaotic dynamics Finally Chapter 8 examines the c trolled processes running in biomolecular systems This book is directed to students postgraduate students and speci ists engaged in the elds of control of physical processes quantum and molecular computing biophysics and physical information science   Algorithms for Multi-objective Optimization of Dynamical Systems ,2016 Multi Objective Optimization Problems MOPs deal with optimizing several objectives simultaneously and have diverse applications in engineering economics logistics etc The methods for solving MOPs can generally be classified into stochastic and deterministic approaches Deterministic approaches are capable of finding the global solution even though they are computationally burdensome Stochastic methods

on the other hand can save on computations significantly although they do not guarantee to find the global solution In engineering applications MOPs can become nonlinear multi modal high dimensional and have complex structured solutions that makes them more challenging This theses follows two major goals Firstly it presents new methods and algorithms for solving engineering MOPs by hybridizing the existing methods and comparing their effectiveness by using benchmark problems The hybrid method combines an evolutionary algorithm with a cell mapping method in order to reduce the computational time while maintaining the quality of the solution Implementation details on parallel CPU GPU programming of such methods are discussed as well The second goal of this thesis is to introduce new applications of MOPs in different areas of engineering such as control design path planning fractional systems and airfoil design **Matrix, Numerical, and Optimization Methods in Science and Engineering** Kevin W. Cassel,2021-03-04 Address vector and matrix methods necessary in numerical methods and optimization of linear systems in engineering with this unified text Treats the mathematical models that describe and predict the evolution of our processes and systems and the numerical methods required to obtain approximate solutions Explores the dynamical systems theory used to describe and characterize system behaviour alongside the techniques used to optimize their performance Integrates and unifies matrix and eigenfunction methods with their applications in numerical and optimization methods Consolidating generalizing and unifying these topics into a single coherent subject this practical resource is suitable for advanced undergraduate students and graduate students in engineering physical sciences and applied mathematics **Optimization and Chaos** Mukul Majumdar,Tapan Mitra,Kazuo Nishimura,2013-06-29 This collection of essays brings together some articles on dynamic optimization models that exhibit chaotic behavior Chapters 3 4 5 6 7 and 9 appeared in a Symposium on Chaotic Dynamical Systems in Economic Theory Volume 4 Number 5 1994 Also Chapters 10 11 and 12 appeared in the Journal of Economic The ory We would like to thank the authors and Academic Press for permission to reprint We are grateful to Professor C D Aliprantis for suggesting the idea of a book structured around the Economic Theory Symposium and without the support and patience of Dr Mueller this project could not have been completed We would like to thank Ms Amy Gowan who cheerfully per formed the arduous task of typing the manuscript Thanks are also due to Xiao Qing Yu Tridip Ray and Malabika Majumdar for their help at various stages in the preparation of the manuscript For a course on dynamic optimization addressed to students with a good background in economic theory and real analysis one can assign Chapter 2 as a partial introduction to the basic tech niques Chapters 3 and 4 can be assigned to provide examples of simple optmization models generating complicated behavior *Discrete and Continuous Dynamical Systems* ,2007 **On Some Optimization Problems in Discrete Dynamical Systems** D. Tr Dotchev,B. L. Mandjarov,Z. V. Milushev,1983 Dynamical Systems: Modeling, Optimization, and Control ,2006 Numerical Data Fitting in Dynamical Systems Klaus Schittkowski,2002-12-31 Real life phenomena in engineering natural or medical sciences are often described by a mathematical model with the goal to analyze numerically the behaviour

of the system Advantages of mathematical models are their cheap availability the possibility of studying extreme situations that cannot be handled by experiments or of simulating real systems during the design phase before constructing a first prototype Moreover they serve to verify decisions to avoid expensive and time consuming experimental tests to analyze understand and explain the behaviour of systems or to optimize design and production As soon as a mathematical model contains differential dependencies from an additional parameter typically the time we call it a dynamical model There are two key questions always arising in a practical environment 1 Is the mathematical model correct 2 How can I quantify model parameters that cannot be measured directly In principle both questions are easily answered as soon as some experimental data are available The idea is to compare measured data with predicted model function values and to minimize the differences over the whole parameter space We have to reject a model if we are unable to find a reasonably accurate fit To summarize parameter estimation or data fitting respectively is extremely important in all practical situations where a mathematical model and corresponding experimental data are available to describe the behaviour of a dynamical system

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