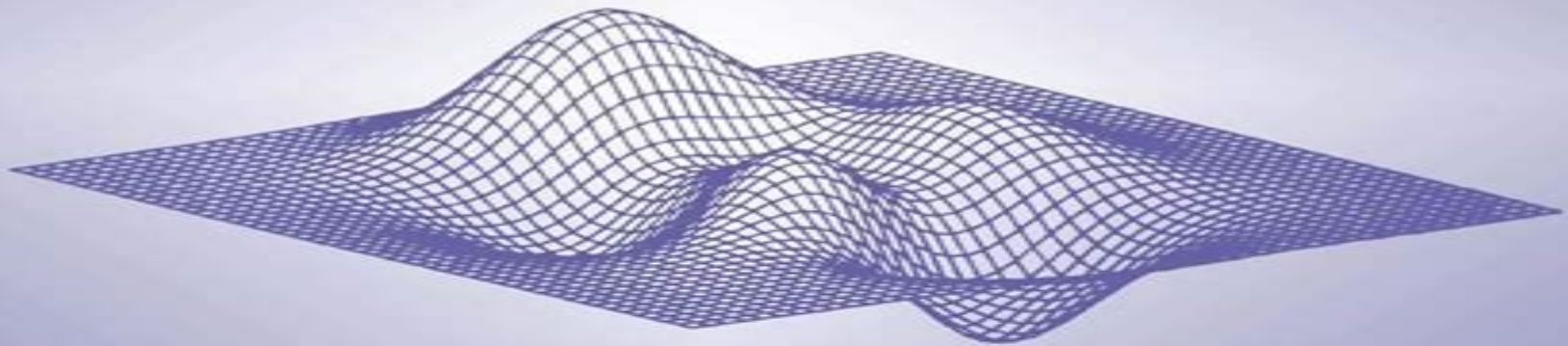


NONCONVEX OPTIMIZATION AND ITS APPLICATIONS

Rigorous Global Search: Continuous Problems

R. Baker Kearfott



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R. Baker Kearfott



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Rigorous Global Search R. Baker Kearfott, 2014-01-15

This book presents a carefully selected group of methods for unconstrained and bound constrained optimization problems and analyzes them in depth both theoretically and algorithmically. It focuses on clarity in algorithmic description and analysis rather than generality and while it provides pointers to the literature for the most general theoretical results and robust software the author thinks it is more important that readers have a complete understanding of special cases that convey essential ideas. A companion to Kelley's book *Iterative Methods for Linear and Nonlinear Equations* SIAM 1995 this book contains many exercises and examples and can be used as a text, a tutorial for self study or a reference. *Iterative Methods for Optimization* does more than cover traditional gradient based optimization it is the first book to treat sampling methods including the Hooke Jeeves implicit filtering MDS and Nelder Mead schemes in a unified way and also the first book to make connections between sampling methods and the traditional gradient methods. Each of the main algorithms in the text is described in pseudocode and a collection of MATLAB codes is available. Thus readers can experiment with the algorithms in an easy way as well as implement them in other languages.

Iterative Methods for Optimization C. T. Kelley, 1999-01-01

Black Box Optimization, Machine Learning, and No-Free Lunch Theorems Panos M. Pardalos, Varvara Rasskazova, Michael N. Vrahatis, 2021-05-27 This edited volume illustrates the connections between machine learning techniques, black box optimization and no free lunch theorems. Each of the thirteen contributions focuses on the commonality and interdisciplinary concepts as well as the fundamentals needed to fully comprehend the impact of individual applications and problems. Current theoretical, algorithmic and practical methods used are provided to stimulate a new effort towards innovative and efficient solutions. The book is intended for beginners who wish to achieve a broad overview of optimization methods and also for more experienced researchers as well as researchers in mathematics, optimization, operations research, quantitative logistics, data analysis and statistics who will benefit from access to a quick reference to key topics and methods. The coverage ranges from mathematically rigorous methods to heuristic and evolutionary approaches in an attempt to equip the reader with different viewpoints of the same problem.

Bayesian Heuristic Approach to Discrete and Global Optimization Jonas Mockus, William Eddy, Gintaras Reklaitis, 2013-03-09

Bayesian decision theory is known to provide an effective framework for the practical solution of discrete and nonconvex optimization problems. This book is the first to demonstrate that this framework is also well suited for the exploitation of heuristic methods in the solution of such problems, especially those of large scale for which exact optimization approaches can be prohibitively costly. The book covers all aspects ranging from the formal presentation of the Bayesian Approach to its extension to the Bayesian Heuristic Strategy and its utilization within the informal interactive Dynamic Visualization strategy. The developed framework is applied in forecasting, in neural network optimization and in a large number of discrete and continuous optimization problems. Specific application areas which are discussed include scheduling and visualization.

problems in chemical engineering manufacturing process control and epidemiology Computational results and comparisons with a broad range of test examples are presented The software required for implementation of the Bayesian Heuristic Approach is included Although some knowledge of mathematical statistics is necessary in order to fathom the theoretical aspects of the development no specialized mathematical knowledge is required to understand the application of the approach or to utilize the software which is provided Audience The book is of interest to both researchers in operations research systems engineering and optimization methods as well as applications specialists concerned with the solution of large scale discrete and or nonconvex optimization problems in a broad range of engineering and technological fields It may be used as supplementary material for graduate level courses

Advances in Applied Mathematics and Global Optimization

David Y. Gao,Hanif D. Sherali,2009-04-09 The articles that comprise this distinguished annual volume for the Advances in Mechanics and Mathematics series have been written in honor of Gilbert Strang a world renowned mathematician and exceptional person Written by leading experts in complementarity duality global optimization and quantum computations this collection reveals the beauty of these mathematical disciplines and investigates recent developments in global optimization nonconvex and nonsmooth analysis nonlinear programming theoretical and engineering mechanics large scale computation quantum algorithms and computation and information theory

Methods for Solving Systems of Nonlinear Equations

Werner C. Rheinboldt,1998-01-01 This volume discusses the ideas behind non linear equations as well as their theoretical foundations and properties

Surveys in Differential-Algebraic Equations III

Achim Ilchmann,Timo Reis,2015-10-29 The present volume comprises survey articles on various fields of Differential Algebraic Equations DAEs which have widespread applications in controlled dynamical systems especially in mechanical and electrical engineering and a strong relation to ordinary differential equations The individual chapters provide reviews presentations of the current state of research and new concepts in Flexibility of DAE formulations Reachability analysis and deterministic global optimization Numerical linear algebra methods Boundary value problems The results are presented in an accessible style making this book suitable not only for active researchers but also for graduate students with a good knowledge of the basic principles of DAEs for self study

Parallel Processing and Applied Mathematics

Roman Wyrzykowski,Jack Dongarra,Ewa Deelman,Konrad Karczewski,2018-03-22 The two volume set LNCS 10777 and 10778 constitutes revised selected papers from the 12th International Conference on Parallel Processing and Applied Mathematics PPAM 2017 held in Lublin Poland in September 2017 The 49 regular papers presented in the proceedings were selected from 98 submissions For the workshops and special sessions that were held as integral parts of the PPAM 2017 conference a total of 51 papers was accepted from 75 submissions The papers were organized in topical sections named as follows Part I numerical algorithms and parallel scientific computing particle methods in simulations task based paradigm of parallel computing GPU computing parallel non numerical algorithms performance evaluation of parallel algorithms and applications environments and frameworks for

parallel distributed cloud computing applications of parallel computing soft computing with applications and special session on parallel matrix factorizations Part II workshop on models algorithms and methodologies for hybrid parallelism in new HPC systems workshop power and energy aspects of computations PEAC 2017 workshop on scheduling for parallel computing SPC 2017 workshop on language based parallel programming models WLPP 2017 workshop on PGAS programming minisymposium on HPC applications in physical sciences minisymposium on high performance computing interval methods workshop on complex collective systems

Numerical Software with Result Verification René Alt, 2004-03-12 This book constitutes the thoroughly refereed post proceedings of the Dagstuhl Seminar 03041 on Numerical Software with Result Verification held at Dagstuhl Castle Germany in January 2003 The 18 revised full papers presented were selected during two rounds of reviewing and improvements The papers are organized in topical sections on languages software systems and tools new verification techniques based on interval arithmetic applications in science and engineering and novel approaches to verification

Stigmergic Optimization Ajith Abraham, Crina Grosan, Vitorino Ramos, 2006-07-18 First studied in social insects like ants indirect self organizing interactions known as stigmergy occur when one individual modifies the environment and another subsequently responds to the new environment The implications of self organizing behavior extend to robotics and beyond This book explores the application of stigmergy for a variety of optimization problems The volume comprises 12 chapters including an introductory chapter conveying the fundamental definitions inspirations and research challenges

Relaxation and Decomposition Methods for Mixed Integer Nonlinear Programming Ivo Nowak, 2006-03-28 Nonlinear optimization problems containing both continuous and discrete variables are called mixed integer nonlinear programs MINLP Such problems arise in many fields such as process industry engineering design communications and finance There is currently a huge gap between MINLP and mixed integer linear programming MIP solver technology With a modern state of the art MIP solver it is possible to solve models with millions of variables and constraints whereas the dimension of solvable MINLP is often limited by a number that is smaller by three or four orders of magnitude It is theoretically possible to approximate a general MINLP by a MIP with arbitrary precision However good MIP approximations are usually much larger than the original problem Moreover the approximation of nonlinear functions by piecewise linear functions can be difficult and time consuming In this book relaxation and decomposition methods for solving nonconvex structured MINLPs are proposed In particular a generic branch cut and price BCP framework for MINLP is presented BCP is the underlying concept in almost all modern MIP solvers Providing a powerful decomposition framework for both sequential and parallel solvers it made the success of the current MIP technology possible So far generic BCP frameworks have been developed only for MIP for example COIN BCP IBM 2003 and ABACUS OREAS GmbH 1999 In order to generalize MIP BCP to MINLP BCP the following points have to be taken into account A given sparse MINLP is reformulated as a block separable program with linear coupling constraints The block structure makes it possible to generate Lagrangian cuts and to apply Lagrangian

heuristics In order to facilitate the generation of polyhedral relaxations nonlinear convex relaxations are constructed The MINLP separation and pricing subproblems for generating cuts and columns are solved with specialized MINLP solvers

Interval Linear Programming and Extensions Milan Hladík, 2025-05-31 This book delves into the intricate world of interval programming offering a comprehensive exploration of mathematical programming problems characterized by interval data Interval data often arising from uncertainties like measurement errors or estimations are also pivotal in analyzing stability sensitivity and managing numerical issues At the heart of this book is the principle of interval analysis ensuring that all possible realizations of interval data are accounted for Readers will uncover a wealth of knowledge as the author meticulously examines how variations in input coefficients affect optimal solutions and values in linear programming The chapters are organized into three parts foundational concepts of interval analysis linear programming with interval data and advanced extensions into multiobjective and nonlinear problems This book invites readers to explore critical questions about stability duality and practical applications across diverse fields With contributions from eminent scholars it provides a unique blend of theoretical insights and practical case studies Designed for both researchers and students with a basic understanding of mathematics this book serves as an essential resource for anyone interested in mathematical programming Whether used as a monograph or a lecture textbook it offers clear explanations and comprehensive proofs to make complex concepts accessible Scholars in operations research applied mathematics and related disciplines will find this volume invaluable for advancing their understanding of interval programming

Handbook of Constraint Programming

Francesca Rossi, Peter van Beek, Toby Walsh, 2006-08-18 Constraint programming is a powerful paradigm for solving combinatorial search problems that draws on a wide range of techniques from artificial intelligence computer science databases programming languages and operations research Constraint programming is currently applied with success to many domains such as scheduling planning vehicle routing configuration networks and bioinformatics The aim of this handbook is to capture the full breadth and depth of the constraint programming field and to be encyclopedic in its scope and coverage While there are several excellent books on constraint programming such books necessarily focus on the main notions and techniques and cannot cover also extensions applications and languages The handbook gives a reasonably complete coverage of all these lines of work based on constraint programming so that a reader can have a rather precise idea of the whole field and its potential Of course each line of work is dealt with in a survey like style where some details may be neglected in favor of coverage However the extensive bibliography of each chapter will help the interested readers to find suitable sources for the missing details Each chapter of the handbook is intended to be a self contained survey of a topic and is written by one or more authors who are leading researchers in the area The intended audience of the handbook is researchers graduate students higher year undergraduates and practitioners who wish to learn about the state of the art in constraint programming No prior knowledge about the field is necessary to be able to read the chapters and gather useful

knowledge Researchers from other fields should find in this handbook an effective way to learn about constraint programming and to possibly use some of the constraint programming concepts and techniques in their work thus providing a means for a fruitful cross fertilization among different research areas The handbook is organized in two parts The first part covers the basic foundations of constraint programming including the history the notion of constraint propagation basic search methods global constraints tractability and computational complexity and important issues in modeling a problem as a constraint problem The second part covers constraint languages and solver several useful extensions to the basic framework such as interval constraints structured domains and distributed CSPs and successful application areas for constraint programming Covers the whole field of constraint programming Survey style chapters Five chapters on applications

Design for Energy and the Environment MAHMOUD M EL-HALWAGI, Andreas A. Linninger, 2009-06-05 An examination of systematic techniques for the design of sustainable processes and products this book covers reducing energy consumption preventing pollution developing new pathways for biofuels and producing environmentally friendly and high quality products It discusses innovative design approaches and technological pathways that impact ene

Perspectives on Enclosure Methods Ulrich Kulisch, Rudolf Lohner, Axel Facius, 2012-12-06 Enclosure methods and their applications have been developed to a high standard during the last decades These methods guarantee the validity of the computed results This means they are of the same standard as the rest of mathematics The book deals with a wide variety of aspects of enclosure methods All contributions follow the common goal to push the limits of enclosure methods forward Topics that are treated include basic questions of arithmetic proving conjectures bounds for Krylow type linear system solvers bounds for eigenvalues the wrapping effect algorithmic differencing differential equations finite element methods application in robotics and nonsmooth global optimization

Modeling, Design, and Simulation of Systems with Uncertainties Andreas Rauh, Ekaterina Auer, 2011-06-06 To describe the true behavior of most real world systems with sufficient accuracy engineers have to overcome difficulties arising from their lack of knowledge about certain parts of a process or from the impossibility of characterizing it with absolute certainty Depending on the application at hand uncertainties in modeling and measurements can be represented in different ways For example bounded uncertainties can be described by intervals affine forms or general polynomial enclosures such as Taylor models whereas stochastic uncertainties can be characterized in the form of a distribution described for example by the mean value the standard deviation and higher order moments The goal of this Special Volume on Modeling Design and Simulation of Systems with Uncertainties is to cover modern methods for dealing with the challenges presented by imprecise or unavailable information All contributions tackle the topic from the point of view of control state and parameter estimation optimization and simulation Thematically this volume can be divided into two parts In the first we present works highlighting the theoretic background and current research on algorithmic approaches in the field of uncertainty handling together with their reliable software implementation The second part is concerned with real

life application scenarios from various areas including but not limited to mechatronics robotics and biomedical engineering

Decision Making Under Uncertainty Via Optimization, Modelling, and Analysis Laxminarayan Sahoo, Tapan Senapati, Madhumangal Pal, Ronald R. Yager, 2025-03-02 This book focuses on cutting edge developments in optimal decision making incorporating modeling and optimization for determining renewable energy sources supply chain management and environmental planning under uncertainty It addresses mathematical models of cost effective management policies This book presents the best decision making practices for solving real world challenges This book provides access to an invaluable collection of various decision making issues that scholars and industry practitioners use as a reference The readers are able to understand how decision making problems are formulated under uncertainty and how to use right optimization strategies to fix problems

Computing Statistics under Interval and Fuzzy Uncertainty Hung T. Nguyen, Vladik Kreinovich, Berlin Wu, Gang Xiang, 2011-11-17 In many practical situations we are interested in statistics characterizing a population of objects e g in the mean height of people from a certain area Most algorithms for estimating such statistics assume that the sample values are exact In practice sample values come from measurements and measurements are never absolutely accurate Sometimes we know the exact probability distribution of the measurement inaccuracy but often we only know the upper bound on this inaccuracy In this case we have interval uncertainty e g if the measured value is 1 0 and inaccuracy is bounded by 0 1 then the actual unknown value of the quantity can be anywhere between 1 0 0 1 0 9 and 1 0 0 1 1 1 In other cases the values are expert estimates and we only have fuzzy information about the estimation inaccuracy This book shows how to compute statistics under such interval and fuzzy uncertainty The resulting methods are applied to computer science optimal scheduling of different processors to information technology maintaining privacy to computer engineering design of computer chips and to data processing in geosciences radar imaging and structural mechanics

Deterministic Global Optimization Christodoulos A. Floudas, 2013-03-09 The vast majority of important applications in science engineering and applied science are characterized by the existence of multiple minima and maxima as well as first second and higher order saddle points The area of Deterministic Global Optimization introduces theoretical algorithmic and computational advances that i address the computation and characterization of global minima and maxima ii determine valid lower and upper bounds on the global minima and maxima and iii address the enclosure of all solutions of nonlinear constrained systems of equations Global optimization applications are widespread in all disciplines and they range from atomistic or molecular level to process and product level representations The primary goal of this book is three fold first to introduce the reader to the basics of deterministic global optimization second to present important theoretical and algorithmic advances for several classes of mathematical problems that include biconvex and bilinear problems signomial problems general twice differentiable nonlinear problems mixed integer nonlinear problems and the enclosure of all solutions of nonlinear constrained systems of equations and third to tie the theory and methods together with a variety of important applications

Vector and Parallel

Processing - VECPAR 2000 Jose M.L.M. Palma, Jack Dongarra, Vicente Hernandez, 2003-06-29 This book is the final outcome of VECPAR 2000 4th International Meeting on Vector and Parallel Processing VECPAR constitutes a series of conferences which have been organized by the Faculty of Engineering of the University of Porto since 1993 with the main objective of disseminating new knowledge on parallel computing Readership of This Book The book is aimed at an audience of researchers and graduate students in a broad range of scientific areas including not only computer science but also applied mathematics and numerical analysis physics and engineering Book Plan From a total of 66 papers selected on the basis of extended abstracts for presentation at the conference a subset of 34 papers were chosen during a second review process leading to their inclusion in the book together with the invited talks The book contains a total of 40 papers organized into 6 chapters where each may appeal to people in different but still related scientific areas All chapters with the exception of Chapter 6 are initiated by a short text providing a quick overview of the organization and papers in the chapter The 13 papers in Chapter 1 cover the aspects related to the use of multiple processors Operating systems languages and software tools for scheduling and code transformation are the topics included in this chapter initiated by the talk on computing over the Internet entitled Grid Computing by Ian Foster

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