

International Series of Numerical Mathematics

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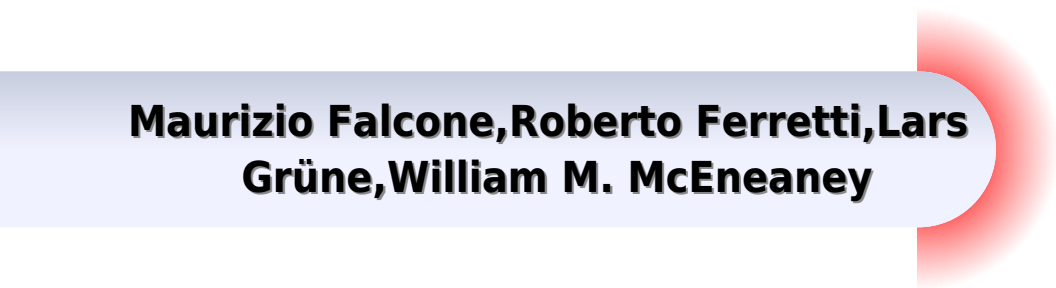
Aldo Pratelli
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Editors

New Trends in Shape Optimization

 Birkhäuser

Trends Optimization International Numerical Mathematics

**Maurizio Falcone, Roberto Ferretti, Lars
Grüne, William M. McEneaney**



Trends Optimization International Numerical Mathematics:

Advances in Optimization Werner Oettli, Diethard Pallaschke, 2013-11-27 This volume contains actual contributions to the current research directions in Optimization Theory as well as applications to economic problems and to problems in industrial engineering Of particular interest are convex and Nonsmooth Analysis Sensitivity Theory Optimization techniques for nonsmooth and Variational problems Control Theory and Vector optimization The volume contains research and survey papers The main benefit is given by a global survey of the state of art of modern Optimization Theory and some typical applications

Computational Mathematics and Variational Analysis Nicholas J. Daras, Themistocles M. Rassias, 2020-06-06 This volume presents a broad discussion of computational methods and theories on various classical and modern research problems from pure and applied mathematics Readers conducting research in mathematics engineering physics and economics will benefit from the diversity of topics covered Contributions from an international community treat the following subjects calculus of variations optimization theory operations research game theory differential equations functional analysis operator theory approximation theory numerical analysis asymptotic analysis and engineering Specific topics include algorithms for difference of monotone operators variational inequalities in semi inner product spaces function variation principles and normed minimizers equilibria of parametrized N player nonlinear games multi symplectic numerical schemes for differential equations time delay multi agent systems computational methods in non linear design of experiments unsupervised stochastic learning asymptotic statistical results global local transformation scattering relations of elastic waves generalized Ostrowski and trapezoid type rules numerical approximation Sz sz Durrmeyer operators and approximation integral inequalities behaviour of the solutions of functional equations functional inequalities in complex Banach spaces functional contractions in metric spaces

Numerical Methods for Optimal Control Problems Maurizio Falcone, Roberto Ferretti, Lars Grüne, William M. McEneaney, 2019-01-26 This work presents recent mathematical methods in the area of optimal control with a particular emphasis on the computational aspects and applications Optimal control theory concerns the determination of control strategies for complex dynamical systems in order to optimize some measure of their performance Started in the 60 s under the pressure of the space race between the US and the former USSR the field now has a far wider scope and embraces a variety of areas ranging from process control to traffic flow optimization renewable resources exploitation and management of financial markets These emerging applications require more and more efficient numerical methods for their solution a very difficult task due the huge number of variables The chapters of this volume give an up to date presentation of several recent methods in this area including fast dynamic programming algorithms model predictive control and max plus techniques This book is addressed to researchers graduate students and applied scientists working in the area of control problems differential games and their applications

Handbook of Mathematical Models and Algorithms in Computer Vision and Imaging Ke Chen, Carola-Bibiane Schönlieb, Xue-Cheng Tai, Laurent Younes, 2023-02-24

This handbook gathers together the state of the art on mathematical models and algorithms for imaging and vision. Its emphasis lies on rigorous mathematical methods which represent the optimal solutions to a class of imaging and vision problems and on effective algorithms which are necessary for the methods to be translated to practical use in various applications. Viewing discrete images as data sampled from functional surfaces enables the use of advanced tools from calculus, functions and calculus of variations and nonlinear optimization and provides the basis of high resolution imaging through geometry and variational models. Besides optimization, naturally connects traditional model driven approaches to the emerging data driven approaches of machine and deep learning. No other framework can provide comparable accuracy and precision to imaging and vision. Written by leading researchers in imaging and vision, the chapters in this handbook all start with gentle introductions which make this work accessible to graduate students. For newcomers to the field, the book provides a comprehensive and fast track introduction to the content to save time and get on with tackling new and emerging challenges. For researchers, exposure to the state of the art of research works leads to an overall view of the entire field so as to guide new research directions and avoid pitfalls in moving the field forward and looking into the next decades of imaging and information services. This work can greatly benefit graduate students, researchers and practitioners in imaging and vision, applied mathematicians, medical imagers, engineers and computer scientists.

Mathematical Analysis and Applications

Themistocles M. Rassias, Panos M. Pardalos, 2019-12-12. An international community of experts/scientists comprise the research and survey contributions in this volume which covers a broad spectrum of areas in which analysis plays a central role. Contributions discuss theory and problems in real and complex analysis, functional analysis, approximation theory, operator theory, analytic inequalities, the Radon transform, nonlinear analysis and various applications of interdisciplinary research. Some are also devoted to specific applications such as the three body problem, finite element analysis in fluid mechanics, algorithms for difference of monotone operators, a vibrational approach to a financial problem and more. This volume is useful to graduate students and researchers working in mathematics, physics, engineering and economics.

Geometric Science of Information Frank Nielsen, Frederic Barbaresco, 2015-10-24. This book constitutes the refereed proceedings of the Second International Conference on Geometric Science of Information GSI 2015 held in Palaiseau, France, in October 2015. The 80 full papers presented were carefully reviewed and selected from 110 submissions and are organized into the following thematic sessions: Dimension reduction on Riemannian manifolds, optimal transport, optimal transport and applications in imagery, statistics, shape space and diffeomorphic mappings, random geometry, homology, Hessian information, geometry, topological forms and Information, information geometry, optimization, information geometry in image analysis, divergence geometry, optimization on manifold, Lie groups and geometric mechanics, thermodynamics, computational information geometry, Lie groups, novel statistical and computational frontiers, geometry of time series and linear dynamical systems and Bayesian and information geometry for inverse problems.

Global Riemannian Geometry: Curvature and

Topology Ana Hurtado, Steen Markvorsen, Maung Min-Oo, Vicente Palmer, 2020-08-19 This book contains a clear exposition of two contemporary topics in modern differential geometry distance geometric analysis on manifolds in particular comparison theory for distance functions in spaces which have well defined bounds on their curvature the application of the Lichnerowicz formula for Dirac operators to the study of Gromov's invariants to measure the K theoretic size of a Riemannian manifold It is intended for both graduate students and researchers Transport Processes at Fluidic Interfaces Dieter Bothe, Arnold Reusken, 2017-07-13 There are several physico chemical processes that determine the behavior of multiphase fluid systems e g the fluid dynamics in the different phases and the dynamics of the interface s mass transport between the fluids adsorption effects at the interface and transport of surfactants on the interface and result in heterogeneous interface properties In general these processes are strongly coupled and local properties of the interface play a crucial role A thorough understanding of the behavior of such complex flow problems must be based on physically sound mathematical models which especially account for the local processes at the interface This book presents recent findings on the rigorous derivation and mathematical analysis of such models and on the development of numerical methods for direct numerical simulations Validation results are based on specifically designed experiments using high resolution experimental techniques A special feature of this book is its focus on an interdisciplinary research approach combining Applied Analysis Numerical Mathematics Interface Physics and Chemistry as well as relevant research areas in the Engineering Sciences The contributions originated from the joint interdisciplinary research projects in the DFG Priority Programme SPP 1506 Transport Processes at Fluidic Interfaces *Numerical Control: Part B* Emmanuel Trélat, Enrique Zuazua, 2023-02-20 *Numerical Control Part B* Volume 24 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 Control problems in the coefficients and the domain for linear elliptic equations Computational approaches for extremal geometric eigenvalue problems Non overlapping domain decomposition in space and time for PDE constrained optimal control problems on networks Feedback Control of Time dependent Nonlinear PDEs with Applications in Fluid Dynamics Stabilization of the Navier Stokes equations Theoretical and numerical aspects Reconstruction algorithms based on Carleman estimates and more Other sections cover Discrete time formulations as time discretization strategies in data assimilation Back and forth iterations Time reversal methods Unbalanced Optimal Transport from Theory to Numerics An ADMM Approach to the Exact and Approximate Controllability of Parabolic Equations Nonlocal balance laws an overview over recent results Numerics and control of conservation laws Numerical approaches for simulation and control of superconducting quantum circuits 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 Foundations of Bilevel Programming Stephan Dempe, 2005-12-19 Bilevel programming

problems are hierarchical optimization problems where the constraints of one problem the so called upper level problem are defined in part by a second parametric optimization problem the lower level problem If the lower level problem has a unique optimal solution for all parameter values this problem is equivalent to a one level optimization problem having an implicitly defined objective function Special emphasize in the book is on problems having non unique lower level optimal solutions the optimistic or weak and the pessimistic or strong approaches are discussed The book starts with the required results in parametric nonlinear optimization This is followed by the main theoretical results including necessary and sufficient optimality conditions and solution algorithms for bilevel problems Stationarity conditions can be applied to the lower level problem to transform the optimistic bilevel programming problem into a one level problem Properties of the resulting problem are highlighted and its relation to the bilevel problem is investigated Stability properties numerical complexity and problems having additional integrality conditions on the variables are also discussed Audience Applied mathematicians and economists working in optimization operations research and economic modelling Students interested in optimization will also find this book useful

Geometric Partial Differential Equations - Part 2 Andrea Bonito,Ricardo Horacio

Nochetto,2021-01-26 Besides their intrinsic mathematical interest geometric partial differential equations PDEs are ubiquitous in many scientific engineering and industrial applications They represent an intellectual challenge and have received a great deal of attention recently The purpose of this volume is to provide a missing reference consisting of self contained and comprehensive presentations It includes basic ideas analysis and applications of state of the art fundamental algorithms for the approximation of geometric PDEs together with their impacts in a variety of fields within mathematics science and engineering About every aspect of computational geometric PDEs is discussed in this and a companion volume Topics in this volume include stationary and time dependent surface PDEs for geometric flows large deformations of nonlinearly geometric plates and rods level set and phase field methods and applications free boundary problems discrete Riemannian calculus and morphing fully nonlinear PDEs including Monge Ampere equations and PDE constrained optimization Each chapter is a complete essay at the research level but accessible to junior researchers and students The intent is to provide a comprehensive description of algorithms and their analysis for a specific geometric PDE class starting from basic concepts and concluding with interesting applications Each chapter is thus useful as an introduction to a research area as well as a teaching resource and provides numerous pointers to the literature for further reading The authors of each chapter are world leaders in their field of expertise and skillful writers This book is thus meant to provide an invaluable readable and enjoyable account of computational geometric PDEs

New Trends in Shape Optimization Aldo Pratelli,Günter Leugering,2015-12-01 This volume reflects New Trends in Shape Optimization and is based on a workshop of the same name organized at the Friedrich Alexander University Erlangen N rnberg in September 2013 During the workshop senior mathematicians and young scientists alike presented their latest findings The format of the meeting allowed fruitful

discussions on challenging open problems and triggered a number of new and spontaneous collaborations As such the idea was born to produce this book each chapter of which was written by a workshop participant often with a collaborator The content of the individual chapters ranges from survey papers to original articles some focus on the topics discussed at the Workshop while others involve arguments outside its scope but which are no less relevant for the field today As such the book offers readers a balanced introduction to the emerging field of shape optimization

Reduced Basis Methods for Partial Differential Equations Alfio Quarteroni, Andrea Manzoni, Federico Negri, 2015-08-19 This book provides a basic introduction to reduced basis RB methods for problems involving the repeated solution of partial differential equations PDEs arising from engineering and applied sciences such as PDEs depending on several parameters and PDE constrained optimization The book presents a general mathematical formulation of RB methods analyzes their fundamental theoretical properties discusses the related algorithmic and implementation aspects and highlights their built in algebraic and geometric structures More specifically the authors discuss alternative strategies for constructing accurate RB spaces using greedy algorithms and proper orthogonal decomposition techniques investigate their approximation properties and analyze offline online decomposition strategies aimed at the reduction of computational complexity Furthermore they carry out both a priori and a posteriori error analysis The whole mathematical presentation is made more stimulating by the use of representative examples of applicative interest in the context of both linear and nonlinear PDEs Moreover the inclusion of many pseudocodes allows the reader to easily implement the algorithms illustrated throughout the text The book will be ideal for upper undergraduate students and more generally people interested in scientific computing All these pseudocodes are in fact implemented in a MATLAB package that is freely available at <https://github.com/redbkit>

Eclipsing Binary Stars: Modeling and Analysis Josef Kallrath, Eugene F. Milone, 2009-08-14 Have you ever stopped at a construction project on the way to your office and the day's astrophysics Remember the other onlookers folks just enjoying the spectacle as we all do in following developments away from our areas of active work We are excited and thrilled when the Hubble Space Telescope discovers an Einstein Cross when the marvelous pulsars enter our lives and when computer scientists put a little box on our desk that outperforms yesterday's giant machines We are free to make use of such achievements and we respect the imagination and discipline needed to bring them about just as onlookers respect the abilities and planning needed to create a building they may later use After all each of us contributes in our own areas as best as we can In addition to the serious onlookers there will be passersby who take only a casual look at the site They may use the building later but have little or no interest in its construction and give no thought to the resources needed to bring it to completion Upon arriving at work those persons write astronomy and astrophysics books at various levels in which they must say something about close binary stars Usually a page or two will do and the emphasis is on the MLR mass luminosity radius data obtained only from binaries

Spectral and High Order Methods for Partial Differential Equations ICOSAHOM 2020+1 Jens M. Melenk, Ilaria

Perugia, Joachim Schöberl, Christoph Schwab, 2023-06-30 The volume features high quality papers based on the presentations at the ICOSAHOM 2020 1 on spectral and high order methods The carefully reviewed articles cover state of the art topics in high order discretizations of partial differential equations The volume presents a wide range of topics including the design and analysis of high order methods the development of fast solvers on modern computer architecture and the application of these methods in fluid and structural mechanics computations Advanced Finite Element Methods with Applications

Thomas Apel, Ulrich Langer, Arnd Meyer, Olaf Steinbach, 2019-06-28 Finite element methods are the most popular methods for solving partial differential equations numerically and despite having a history of more than 50 years there is still active research on their analysis application and extension This book features overview papers and original research articles from participants of the 30th Chemnitz Finite Element Symposium which itself has a 40 year history Covering topics including numerical methods for equations with fractional partial derivatives isogeometric analysis and other novel discretization methods like space time finite elements and boundary elements analysis of a posteriori error estimates and adaptive methods enhancement of efficient solvers of the resulting systems of equations discretization methods for partial differential equations on surfaces and methods adapted to applications in solid and fluid mechanics it offers readers insights into the latest results

Spectral and High Order Methods for Partial Differential Equations ICOSAHOM 2018 Spencer J. Sherwin, David Moxey, Joaquim Peiró, Peter E. Vincent, Christoph Schwab, 2020-08-11 This open access book features a selection of high quality papers from the presentations at the International Conference on Spectral and High Order Methods 2018 offering an overview of the depth and breadth of the activities within this important research area The carefully reviewed papers provide a snapshot of the state of the art while the extensive bibliography helps initiate new research directions **Trends in PDE**

Constrained Optimization Günter Leugering, Peter Benner, Sebastian Engell, Andreas Griewank, Helmut Harbrecht, Michael Hinze, Rolf Rannacher, Stefan Ulbrich, 2014-12-22 Optimization problems subject to constraints governed by partial differential equations PDEs are among the most challenging problems in the context of industrial economical and medical applications Almost the entire range of problems in this field of research was studied and further explored as part of the Deutsche Forschungsgemeinschaft DFG priority program 1253 on Optimization with Partial Differential Equations from 2006 to 2013 The investigations were motivated by the fascinating potential applications and challenging mathematical problems that arise in the field of PDE constrained optimization New analytic and algorithmic paradigms have been developed implemented and validated in the context of real world applications In this special volume contributions from more than fifteen German universities combine the results of this interdisciplinary program with a focus on applied mathematics The book is divided into five sections on Constrained Optimization Identification and Control Shape and Topology Optimization Adaptivity and Model Reduction Discretization Concepts and Analysis and Applications Peer reviewed research articles present the most recent results in the field of PDE constrained optimization and control problems Informative survey articles

give an overview of topics that set sustainable trends for future research This makes this special volume interesting not only for mathematicians but also for engineers and for natural and medical scientists working on processes that can be modeled by PDEs

Anisotropic Isoperimetric Problems and Related Topics Valentina Franceschi, Alessandra Pluda, Giorgio Saracco, 2024-12-18 This book contains contributions from speakers at the Anisotropic Isoperimetric Problems hence it also appears in describing systems of particles where a balance between attractive and repulsive forces appears A prominent example is that of Gamow's liquid drop model for atomic nuclei where protons are subject to the strong nuclear attractive force represented by the perimeter and the electromagnetic repulsive force represented by a nonlocal term Such a model has been shown to be sound as it explains the basic characteristics of the nuclei and it successfully predicts nuclear fission for nuclei with a large atomic number Similar energy functionals model various physical and biological systems showcasing the competition between short range interfacial and long range nonlocal terms leading to pattern formation The authors mention e.g. the Ohta-Kawasaki model for microphase separation of diblock copolymers and the Yukawa potential for colloidal systems Despite diverse systems the emergence of microphases follows similar patterns although rigorously proving this phenomenon remains a challenge The book collects several contributions within these topics shedding light on the current state of the art

Discrete and Fractional Programming Techniques for Location Models A.I. Barros, 2013-11-21 At first sight discrete and fractional programming techniques appear to be two completely unrelated fields in operations research We will show how techniques in both fields can be applied separately and in a combined form to particular models in location analysis Location analysis deals with the problem of deciding where to locate facilities considering the clients to be served in such a way that a certain criterion is optimized The term facilities immediately suggests factories warehouses schools etc while the term clients refers to depots retail units students etc Three basic classes can be identified in location analysis continuous location network location and discrete location The differences between these fields arise from the structure of the set of possible locations for the facilities Hence locating facilities in the plane or in another continuous space corresponds to a continuous location model while finding optimal facility locations on the edges or vertices of a network corresponds to a network location model Finally if the possible set of locations is a finite set of points we have a discrete location model Each of these fields has been actively studied arousing intense discussion on the advantages and disadvantages of each of them The usual requirement that every point in the plane or on the network must be a candidate location point is one of the mostly used arguments against continuous and network location models

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