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Mesoscale Modeling in Chemical Engineering

2015-11-26 Focusing Mesoscales of Multiscale Problems in Chemical Engineering, a volume in the Advances in Chemical Engineering series provides readers with the personal views of recognized authorities who present assessments of the state-of-the-art in the field and help readers develop an understanding of its further evolution. Subjects covered in the book are not limited to the classical chemical engineering disciplines. Contributions connecting chemical engineering to related scientific fields, either providing a fundamental basis or introducing new concepts and tools, are encouraged. This volume aims to create a balance between well developed areas such as process industry, transformation of materials, energy, and environmental issues, and areas where applications of chemical engineering are more recent or emerging. Contains reviews by leading authorities in their respective areas Provides up-to-date reviews of the latest techniques in the modeling of catalytic processes Includes a broad mix of US and European authors, as well as academic/industrial/research institute perspectives Provides discussions on the connections between computation and experimental methods

Domain Decomposition Methods in Science and Engineering XXIV Petter E. Bjørstad 2019-01-05 These are the proceedings of the 24th International Conference on Domain Decomposition Methods in Science and Engineering, which was held in Svalbard, Norway in February 2017. Domain decomposition methods are iterative methods for solving the often very large systems of equations that arise when

engineering problems are discretized, frequently using finite elements or other modern techniques. These methods are specifically designed to make effective use of massively parallel, high-performance computing systems. The book presents both theoretical and computational advances in this domain, reflecting the state of art in 2017.

Geometric Science of Information Frank Nielsen 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.

Reduced Basis Methods for Partial Differential Equations Alfio Quarteroni 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

Real-Time PDE-Constrained Optimization

O. Ghattas 2007-07-12 “…a timely contribution to a field of growing importance. This carefully edited book presents a rich collection of chapters ranging from mathematical methodology to emerging applications. I recommend it to students as a rigorous and comprehensive presentation of simulation-based optimization and to researchers as an overview of recent advances and challenges in the field.” —

Jorge Nocedal, Professor, Northwestern University.Many engineering and scientific problems in design, control, and parameter estimation can be formulated as optimization problems that are governed by partial differential equations (PDEs). The complexities of the PDEs—and the requirement for rapid solution—pose significant difficulties. A particularly challenging class of PDE-constrained optimization problems is characterized by the need for real-time solution, i.e., in time scales that are sufficiently rapid to support simulation-based decision making. Real-Time PDE-Constrained Optimization, the first book devoted to real-time optimization for systems governed by PDEs, focuses on new formulations, methods, and algorithms needed to facilitate real-time, PDE-constrained optimization. In addition to presenting state-of-the-art algorithms and formulations, the text illustrates these algorithms with a diverse set of applications that includes problems in the areas of aerodynamics, biology, fluid dynamics, medicine, chemical processes, homeland security, and structural dynamics. Despite difficulties, there is a pressing need to capitalize on continuing advances in computing power to develop optimization methods that will replace simple rule-based decision making with optimized decisions based on complex PDE simulations. Audience The book is aimed at readers who have expertise in simulation and are interested in incorporating optimization into their simulations, who have expertise in numerical optimization and are interested in adapting optimization methods to the class of infinite-dimensional simulation problems, or who have worked in “offline” optimization contexts and are interested in moving to

"online" optimization.Contents Preface; Part I: Concepts and Properties of Real-Time, Online Strategies. Chapter 1: Constrained Optimal Feedback Control of Systems Governed by Large Differential Algebraic Equations; Chapter 2: A Stabilizing Real-Time Implementation of Nonlinear Model Predictive Control; Chapter 3: Numerical Feedback Controller Design for PDE Systems Using Model Reduction: Techniques and Case Studies; Chapter 4: Least-Squares Finite Element Method for Optimization and Control Problems; Part II: Fast PDE-Constrained Optimization Solvers. Chapter 5: Space-Time Multigrid Methods for Solving Unsteady Optimal Control Problems; Chapter 6: A Time-Parallel Implicit Methodology for the Near-Real-Time Solution of Systems of Linear Oscillators; Chapter 7: Generalized SQP Methods with "Parareal" Time-Domain Decomposition for Time-Dependent PDE-Constrained Optimization; Chapter 8: Simultaneous Pseudo-Timestepping for State-Constrained Optimization Problems in Aerodynamics; Chapter 9: Digital Filter Stepsize Control in DASPK and Its Effect on Control Optimization Performance; Part III: Reduced Order Modeling. Chapter 10: Certified Rapid Solution of Partial Differential Equations for Real-Time Parameter Estimation and Optimization; Chapter 11: Model Reduction for Large-Scale Applications in Computational Fluid Dynamics; Chapter 12: Suboptimal Feedback Control of Flow Separation by POD Model Reduction; Part IV: Applications. Chapter 13: A Combined Shape-Newton and Topology Optimization Technique in Real-Time Image Segmentation; Chapter 14: COFIR: Coarse and Fine

Image Registration; Chapter 15: Real-Time, Large Scale Optimization of Water Network Systems Using a Sub-domain Approach; Index.

Advances and Trends in Optimization with Engineering Applications

TamØs Terlaky 2017-04-26

Optimization is of critical importance in engineering. Engineers constantly strive for the best possible solutions, the most economical use of limited resources, and the greatest efficiency. As system complexity increases, these goals mandate the use of state-of-the-art optimization techniques. In recent years, the theory and methodology of optimization have seen revolutionary improvements. Moreover, the exponential growth in computational power, along with the availability of multicore computing with virtually unlimited memory and storage capacity, has fundamentally changed what engineers can do to optimize their designs. This is a two-way process: engineers benefit from developments in optimization methodology, and challenging new classes of optimization problems arise from novel engineering applications. Advances and Trends in Optimization with Engineering Applications reviews 10 major areas of optimization and related engineering applications, providing a broad summary of state-of-the-art optimization techniques most important to engineering practice. Each part provides a clear overview of a specific area and discusses a range of real-world problems. The book provides a solid foundation for engineers and mathematical optimizers alike who want to understand the importance of optimization methods to engineering and the capabilities of these methods.

Recent Advances in Numerical Methods for

Partial Differential Equations and Applications Xiaobing Feng 2002 An emerging field over the past 15 years, computational mathematics is a vast area which has experienced major developments in both algorithmic advances and applications to other fields. These developments have had profound implications in mathematics, science, engineering and industry. Compiled here are six of nine in-depth survey papers with an expository discussion on computational mathematics that were presented at the 2001 John H. Barrett Memorial Lectures at the University of Tennessee, Knoxville. They focus on parallel numerical algorithms for partial differential equations, their implementation and applications in fluid mechanics and material science. Each of the lecturers is a leading researcher in the field of computational mathematics and its applications. This book will be a useful reference for graduate students as well as the many groups of researchers working in advanced computations, including engineering and computer scientists. Prior knowledge of partial differential equations and their numerical methods is helpful.

Transport Processes at Fluidic Interfaces Dieter Bothe 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.”

Non-Smooth and Complementarity-Based Distributed Parameter Systems Michael Hintermüller

Iterative Methods and Preconditioning for Large and Sparse Linear Systems with Applications Daniele Bertaccini 2018-02-19 This book describes, in a basic way, the most useful and effective iterative solvers and appropriate preconditioning techniques for some of the most important classes of large and sparse linear systems. The solution of large and sparse linear systems is the most time-consuming part for most of the scientific computing simulations. Indeed, mathematical models become more and more accurate by including a greater volume of data, but this requires the solution of larger and harder algebraic systems. In recent years, research has focused on the efficient solution of

large sparse and/or structured systems generated by the discretization of numerical models by using iterative solvers.

Current Trends and Open Problems in Computational Mechanics Fadi Aldakheel

Dissertation Abstracts International 2008

Basic Theory Anatoly Kochubei 2019-02-19 This multi-volume handbook is the most up-to-date and comprehensive reference work in the field of fractional calculus and its numerous applications. This first volume collects authoritative chapters covering the mathematical theory of fractional calculus, including fractional-order operators, integral transforms and equations, special functions, calculus of variations, and probabilistic and other aspects.

Realization and Model Reduction of Dynamical Systems Christopher Beattie 2022-06-09 This book celebrates Professor Thanos Antoulas's 70th birthday, marking his fundamental contributions to systems and control theory, especially model reduction and, more recently, data-driven modeling and system identification. Model reduction is a prominent research topic with wide ranging scientific and engineering applications.

Solving Computationally Expensive Engineering Problems Slawomir Koziel 2014-10-01 Computational complexity is a serious bottleneck for the design process in virtually any engineering area. While migration from prototyping and experimental-based design validation to verification using computer simulation models is inevitable and has a number of advantages, high computational costs of accurate, high-fidelity simulations can be a major issue that slows down the development of computer-

aided design methodologies, particularly those exploiting automated design improvement procedures, e.g., numerical optimization. The continuous increase of available computational resources does not always translate into shortening of the design cycle because of the growing demand for higher accuracy and necessity to simulate larger and more complex systems. Accurate simulation of a single design of a given system may be as long as several hours, days or even weeks, which often makes design automation using conventional methods impractical or even prohibitive. Additional problems include numerical noise often present in the simulation data, possible presence of multiple locally optimum designs, as well as multiple conflicting objectives. In this edited book, various techniques that can alleviate solving computationally expensive engineering design problems are presented. One of the most promising approaches is the use of fast replacement models, so-called surrogates, that reliably represent the expensive, simulation-based model of the system/device of interest but they are much cheaper and analytically tractable. Here, a group of international experts summarize recent developments in the area and demonstrate applications in various disciplines of engineering and science. The main purpose of the work is to provide the basic concepts and formulations of the surrogate-based modeling and optimization paradigm, as well as discuss relevant modeling techniques, optimization algorithms and design procedures. Therefore, this book should be useful to researchers and engineers from any discipline where computationally heavy simulations are used on daily basis in the design

process.

High Performance Computing for Computational Science - VECPAR 2004 Michel Daydé 2005-04-28 This book constitutes the thoroughly refereed post-proceedings of the 6th International Conference on High Performance Computing for Computational Science, VECPAR 2004, held in Valencia, Spain, in June 2004. The 48 revised full papers presented together with 5 invited papers were carefully selected during two rounds of reviewing and improvement from initially 130 contributions. The papers are organized in topical sections on large-scale computations, data management and data mining, GRID computing infrastructure, cluster computing, parallel and distributed computing, and computational linear and non-linear algebra.

Trends in Control Theory and Partial Differential Equations Fatiha Alabau-Boussouira 2019-07-04 This book presents cutting-edge contributions in the areas of control theory and partial differential equations. Over the decades, control theory has had deep and fruitful interactions with the theory of partial differential equations (PDEs). Well-known examples are the study of the generalized solutions of Hamilton-Jacobi-Bellman equations arising in deterministic and stochastic optimal control and the development of modern analytical tools to study the controllability of infinite dimensional systems governed by PDEs. In the present volume, leading experts provide an up-to-date overview of the connections between these two vast fields of mathematics. Topics addressed include regularity of the value function associated to finite dimensional control systems, controllability and observability for PDEs, and asymptotic analysis of

multiagent systems. The book will be of interest for both researchers and graduate students working in these areas.

Advanced Finite Element Methods with Applications Thomas Apel 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.

2017 MATRIX Annals Jan de Gier 2019-03-13 MATRIX is Australia's international and residential mathematical research institute. It facilitates new collaborations and mathematical advances through intensive residential research programs, each 1-4 weeks in duration. This book is a scientific record of the eight programs held at MATRIX in its second year, 2017: - Hypergeometric Motives and Calabi–Yau Differential Equations - Computational Inverse Problems - Integrability in Low-Dimensional Quantum Systems - Elliptic Partial Differential Equations of Second Order: Celebrating

40 Years of Gilbarg and Trudinger's Book - Combinatorics, Statistical Mechanics, and Conformal Field Theory - Mathematics of Risk - Tutte Centenary Retreat - Geometric R-Matrices: from Geometry to Probability The articles are grouped into peer-reviewed contributions and other contributions. The peer-reviewed articles present original results or reviews on a topic related to the MATRIX program; the remaining contributions are predominantly lecture notes or short articles based on talks or activities at MATRIX.

Cancer, Complexity, Computation Igor Balaz 2022-09-17 This book presents unique compendium of groundbreaking ideas where scientists from many different backgrounds are united in their interest in interdisciplinary approaches towards origins and development of cancers, innovative ways of searching for cancer treatment and the role of cancer in the evolution. Chapters give an unequivocal slice of all areas that relate to a quest for understanding cancer and its origin as many-fold nonlinear system, complexity of the cancer developments, a search for cancer treatment using artificial intelligence and evolutionary optimisation, novel modelling techniques, molecular origin of cancer, the role of cancer in evolution of species, interpretation of cancer in terms of artificial life and artificial immune systems, swarm intelligence, cellular automata, computational systems biology, genetic networks, cellular computing, validation through in vitro/vivo tumour models and tumour on chip devices. The book is an inspiring blend of theoretical and experimental results, concepts and paradigms. Distinctive features The book advances widely popular topics of cancer

origin, treatment and understanding of its progress The book is comprised of unique chapters written by world top experts in theoretical and applied oncology, complexity theory, mathematics, computer science. The book illustrates attractive examples of mathematical and computer models and experimental setups.

New Trends in Shape Optimization Aldo Pratelli 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-Nürnberg 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.

Advances in Structural and Multidisciplinary Optimization Axel Schumacher 2017-12-04 The volume includes papers from the WSCMO conference in Braunschweig 2017 presenting research of all aspects of the optimal design of structures as well as multidisciplinary design optimization where the involved disciplines deal with the analysis of solids, fluids or other field

problems. Also presented are practical applications of optimization methods and the corresponding software development in all branches of technology.

Spectral and High Order Methods for Partial Differential Equations ICOSAHOM 2018 Spencer J. Sherwin 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 Biomathematics: Modeling, Optimization and Computational Problems Rubem P. Mondaini 2018-08-16 This book brings together carefully selected, peer-reviewed works on mathematical biology presented at the BIOMAT International Symposium on Mathematical and Computational Biology, which was held at the Institute of Numerical Mathematics, Russian Academy of Sciences, in October 2017, in Moscow. Topics covered include, but are not limited to, the evolution of spatial patterns on metapopulations, problems related to cardiovascular diseases and modeled by boundary control techniques in hemodynamics, algebraic modeling of the genetic code, and multi-step biochemical pathways. Also, new results are presented on topics like pattern recognition of probability distribution of amino acids, somitogenesis through reaction-diffusion models, mathematical modeling of infectious diseases, and many others. Experts, scientific practitioners,

graduate students and professionals working in various interdisciplinary fields will find this book a rich resource for research and applications alike.

Large-Scale PDE-Constrained Optimization

Lorenz T. Biegler

2012-12-06 Optimal design, optimal control, and parameter estimation of systems governed by partial differential equations (PDEs) give rise to a class of problems known as PDE-constrained optimization. The size and complexity of the discretized PDEs often pose significant challenges for contemporary optimization methods. With the maturing of technology for PDE simulation, interest has now increased in PDE-based optimization. The chapters in this volume collectively assess the state of the art in PDE-constrained optimization, identify challenges to optimization presented by modern highly parallel PDE simulation codes, and discuss promising algorithmic and software approaches for addressing them. These contributions represent current research of two strong scientific computing communities, in optimization and PDE simulation. This volume merges perspectives in these two different areas and identifies interesting open questions for further research.

Numerical Control: Part A

2022-03-01 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

High Performance Computing for Computational Science - VECPAR ... 2004

System Modeling and Optimization Christian Pötzsche 2014-11-27 This book is a collection of thoroughly refereed papers presented at the 26th IFIP TC 7 Conference on System Modeling and Optimization, held in Klagenfurt, Austria, in September 2013. The 34 revised papers were carefully selected from numerous submissions. They cover the latest progress in a wide range of topics such as optimal control of ordinary and partial differential equations, modeling and simulation, inverse problems, nonlinear, discrete, and stochastic optimization as well as industrial applications.

Variational Methods Maïtine Bergounioux 2017-01-11 With a focus on the interplay between mathematics and applications of imaging, the first part covers topics from optimization, inverse problems and shape spaces to computer vision and computational anatomy. The second part is geared towards geometric control and related topics, including Riemannian geometry, celestial mechanics and quantum control. Contents: Part I Second-order decomposition model for image processing: numerical

experimentation Optimizing spatial and tonal data for PDE-based inpainting Image registration using phase□amplitude separation Rotation invariance in exemplar-based image inpainting Convective regularization for optical flow A variational method for quantitative photoacoustic tomography with piecewise constant coefficients On optical flow models for variational motion estimation Bilevel approaches for learning of variational imaging models Part II Non-degenerate forms of the generalized Euler□Lagrange condition for state-constrained optimal control problems The Purcell three-link swimmer: some geometric and numerical aspects related to periodic optimal controls Controllability of Keplerian motion with low-thrust control systems Higher variational equation techniques for the integrability of homogeneous potentials Introduction to KAM theory with a view to celestial mechanics Invariants of contact sub-pseudo-Riemannian structures and Einstein□Weyl geometry Time-optimal control for a perturbed Brockett integrator Twist maps and Arnold diffusion for diffeomorphisms A Hamiltonian approach to sufficiency in optimal control with minimal regularity conditions: Part I Index

Industrial Mathematics and Complex Systems Pammy Manchanda 2017-10-18 The book discusses essential topics in industrial and applied mathematics such as image processing with a special focus on medical imaging, biometrics and tomography. Applications of mathematical concepts to areas like national security, homeland security and law enforcement, enterprise and e-government services, personal information and business transactions, and brain-like computers are also highlighted. These

contributions – all prepared by respected academicians, scientists and researchers from across the globe – are based on papers presented at the international conference organized on the occasion of the Silver Jubilee of the Indian Society of Industrial and Applied Mathematics (ISIAM) held from 29 to 31 January 2016 at Sharda University, Greater Noida, India. The book will help young scientists and engineers grasp systematic developments in those areas of mathematics that are essential to properly understand challenging contemporary problems.

Mathematical Reviews 2004

Optimal Boundary Control and Boundary Stabilization of Hyperbolic Systems Martin Gugat 2015-07-15

This brief considers recent results on optimal control and stabilization of systems governed by hyperbolic partial differential equations, specifically those in which the control action takes place at the boundary. The wave equation is used as a typical example of a linear system, through which the author explores initial boundary value problems, concepts of exact controllability, optimal exact control, and boundary stabilization. Nonlinear systems are also covered, with the Korteweg-de Vries and Burgers Equations serving as standard examples. To keep the presentation as accessible as possible, the author uses the case of a system with a state that is defined on a finite space interval, so that there are only two boundary points where the system can be controlled. Graduate and post-graduate students as well as researchers in the field will find this to be an accessible introduction to problems of optimal control and stabilization.

Active Particles, Volume 3 Nicola Bellomo 2022-03-28

This edited volume collects six surveys that present

state-of-the-art results on modeling, qualitative analysis, and simulation of active matter, focusing on specific applications in the natural sciences. Following the previously published Active Particles volumes, these chapters are written by leading experts in the field and reflect the diversity of subject matter in theory and applications within an interdisciplinary framework. Topics covered include: Variability and heterogeneity in natural swarms Multiscale aspects of the dynamics of human crowds Mathematical modeling of cell collective motion triggered by self-generated gradients Clustering dynamics on graphs Random Batch Methods for classical and quantum interacting particle systems The consensus-based global optimization algorithm and its recent variants Mathematicians and other members of the scientific community interested in active matter and its many applications will find this volume to be a timely, authoritative, and valuable resource.

Geometric Partial Differential Equations - Part 2 Andrea Bonito 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

System Modeling and Optimization Lorena Bociu 2017-04-10 This book is a collection of thoroughly refereed papers presented at the 27th IFIP TC 7 Conference on System Modeling and Optimization, held in Sophia Antipolis, France, in June/July 2015. The 48 revised papers were carefully reviewed and selected from numerous submissions. They cover the latest progress in their respective areas and encompass broad aspects of system modeling and optimiza-tion, such as modeling and analysis of systems governed by Partial Differential Equations (PDEs) or Ordinary Differential Equations (ODEs), control of PDEs/ODEs, nonlinear

optimization, stochastic optimization, multi-objective optimization, combinatorial optimization, industrial applications, and numericsof PDEs.

Numerical Analysis and Optimization Mehiddin Al-Baali 2015-07-16 Presenting the latest findings in the field of numerical analysis and optimization, this volume balances pure research with practical applications of the subject. Accompanied by detailed tables, figures, and examinations of useful software tools, this volume will equip the reader to perform detailed and layered analysis of complex datasets. Many real-world complex problems can be formulated as optimization tasks. Such problems can be characterized as large scale, unconstrained, constrained, non-convex, non-differentiable, and discontinuous, and therefore require adequate computational methods, algorithms, and software tools. These same tools are often employed by researchers working in current IT hot topics such as big data, optimization and other complex numerical algorithms on the cloud, devising special techniques for supercomputing systems. The list of topics covered include, but are not limited to: numerical analysis, numerical optimization, numerical linear algebra, numerical differential equations, optimal control, approximation theory, applied mathematics, algorithms and software developments, derivative free optimization methods and programming models. The volume also examines challenging applications to various types of computational optimization methods which usually occur in statistics, econometrics, finance, physics, medicine, biology, engineering and industrial sciences.

Numerical Methods for Optimal Control Problems

Maurizio Falcone 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.

Architectured Materials in Nature and Engineering Yuri Estrin 2019-03-27 This book deals with a group of architectured materials. These are hybrid materials in which the constituents (even strongly dissimilar ones) are combined in a given topology and geometry to provide otherwise conflicting properties. The hybridization presented in the book occurs at various levels - from the molecular to the macroscopic (say, sub-centimeter) ones. This monograph represents a collection of programmatic chapters, defining archimats and summarizing the results

obtained by using the geometry-inspired materials design. The area of architectured or geometry-inspired materials has reached a certain level of maturity and visibility for a comprehensive presentation in book form. It is written by a group of authors who are active researchers working on various aspects of architectured materials. Through its 14 chapters, the book provides definitions and descriptions of the archetypes of architectured materials and addresses the various techniques in which they can be designed, optimized, and manufactured. It covers a broad realm of archimats, from the ones occurring in nature to those that have been engineered, and discusses a range of their possible applications. The book provides inspiring and scientifically profound, yet entertaining, reading for the materials science community and beyond.

Trends in PDE Constrained Optimization Günter Leugering 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.

Reduced-Order Modeling (ROM) for Simulation and Optimization Winfried Keiper 2018-04-11 This edited monograph collects research contributions and addresses the advancement of efficient numerical procedures in the area of model order reduction (MOR) for simulation, optimization and control. The topical scope includes, but is not limited to, new out-of-the-box algorithmic solutions for scientific computing, e.g. reduced basis methods for industrial problems and MOR approaches for electrochemical processes. The target audience comprises research experts and practitioners in the field of simulation, optimization and control, but the book may also be beneficial for graduate students alike.