Deterministic Global Optimization Theory Methods And Applications 1st Edition

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.

This book on canonical duality theory provides a comprehensive review of its philosophical origin, physics foundation, and mathematical statements in both finite- and infinite-dimensional spaces. A ground-breaking methodological theory, canonical duality theory can be used for modeling complex systems within a unified framework and for solving a large class of challenging problems in multidisciplinary fields in engineering, mathematics, and the sciences. This volume places a particular emphasis on canonical duality theory's role in bridging the gap between non-convex analysis/mechanics and global optimization. With 18 total chapters written by experts in their fields, this volume provides a nonconventional theory for unified understanding of the fundamental difficulties in large deformation mechanics, bifurcation/chaos in nonlinear science, and the NP-hard problems in global optimization. Additionally, readers will find a unified methodology and powerful algorithms for solving challenging problems in complex systems with real-world applications in non-convex analysis, non-monotone variational inequalities, integer programming, topology optimization, post-buckling of large deformed structures, etc. Researchers and graduate students will find explanation and potential applications in multidisciplinary fields.

Theformulationofmanypracticalproblemsnaturallyinvolvesconstraintsonthe variables entering the mathematical model of a real-life situation to be analyzed. It is of great interest to ?nd the possible scenarios satisfying all constraints, and, iftherearemanyofthem,eitherto?ndthebestsolution,ortoobtainacompact, explicit representation of the whole feasible set. The 2nd Workshop on Global Constrained Optimization and Constraint S- isfaction, COCOS 2003, which took place during November 18–21, 2003 in L- sanne, Switzerland, was dedicated to theoretical, algorithmic, and application oriented advances in answering these questions. Here global optimization refers to ?nding the absolutely best feasible point, while constraint satisfaction refers to?ndingallpossiblefeasiblepoints.AsinCOCOS2002,the?rstsuchworkshop (see the proceeedings [1]), the emphasis was on complete solving techniques for problems involving continuous variables that provide all solutions with full rigor, and on applications which, however, were allowed to have relaxed standards of rigor. The participants used the opportunity to meet experts from global optimi- tion, mathematical programming, constraint programming, and applications, and to present and discuss ongoing work and new directions in the ?eld. Four invited lectures and 20 contributed talks were presented at the workshop. The invited lectures were given by John Hooker (Logic-Based Methods for Global Optimization), Jean-Pierre Merlet (Usual and Unusual

Applications of Interval Analysis), Hermann Schichl (The COCONUT Optimization Environment), and Jorge Mor ? e (Global Optimization Computational Servers). This volume contains the text of Hooker's invited lecture and of 12 c- tributed talks. Copies of the slides for most presentations can be found at [2].
Constraintsatisfactionproblems.Threepapersfocusonalgorithmicaspects of constraint satisfaction problems.
Solving nonsmooth optimization (NSO) problems is critical in many practical applications and real-world modeling systems. The aim of this book is to survey various numerical methods for solving NSO problems and to provide an overview of the latest developments in the field. Experts from around the world share their perspectives on specific aspects of numerical NSO. The book is divided into four parts, the first of which considers general methods including subgradient, bundle and gradient sampling methods. In turn, the second focuses on methods that exploit the problem's special structure, e.g. algorithms for nonsmooth DC programming, VU decomposition techniques, and algorithms for minimax and piecewise differentiable problems. The third part considers methods for special problems like multiobjective and mixed integer NSO, and problems involving inexact data, while the last part highlights the latest advancements in derivative-free NSO. Given its scope, the book is ideal for students attending courses on numerical nonsmooth optimization, for lecturers who teach optimization courses, and for practitioners who apply nonsmooth optimization methods in engineering, artificial intelligence, machine learning, and business. Furthermore, it can serve as a reference text for experts dealing with nonsmooth optimization.
Deterministic Global OptimizationTheory, Methods and ApplicationsSpringer Science & Business Media
This proceedings volume addresses advances in global optimization—a multidisciplinary research field that deals with the analysis, characterization and computation of global minima and/or maxima of nonlinear, non-convex and nonsmooth functions in continuous or discrete forms. The volume contains selected papers from the third biannual World Congress on Global Optimization in Engineering & Science (WCGO), held in the Yellow Mountains, Anhui, China on July 8-12, 2013. The papers fall into eight topical sections: mathematical programming; combinatorial optimization; duality theory; topology optimization; variational inequalities and complementarity problems; numerical optimization; stochastic models and simulation and complex simulation and supply chain analysis.
Interest in constrained optimization originated with the simple linear pro gramming model since it was practical and perhaps the only computationally tractable model at the time. Constrained linear optimization models were soon adopted in numerous application areas and are perhaps the most widely used mathematical models in operations research and management science at the time of this writing. Modelers have, however, found the assumption of linearity to be overly restrictive in expressing the real-world phenomena and problems in economics, finance, business, communication, engineering design, computational biology, and other areas that frequently demand the use of nonlinear expressions and discrete variables in optimization models. Both of these extensions of the linear programming model are NP-hard, thus representing very challenging problems. On the brighter side, recent advances in algorithmic and computing technology make it possible to re visit these

problems with the hope of solving practically relevant problems in reasonable amounts of computational time. Initial attempts at solving nonlinear programs concentrated on the de velopment of local optimization methods guaranteeing globality under the assumption of convexity. On the other hand, the integer programming liter ature has concentrated on the development of methods that ensure global optima. The aim of this book is to marry the advancements in solving nonlinear and integer programming models and to develop new results in the more general framework of mixed-integer nonlinear programs (MINLPs) with the goal of devising practically efficient global optimization algorithms for MINLPs.

This book reflects a significant part of authors' research activity dur ing the last ten years. The present monograph is constructed on the results obtained by the authors through their direct cooperation or due to the authors separately or in cooperation with other mathematicians. All these results fit in a unitary scheme giving the structure of this work. The book is mainly addressed to researchers and scholars in Pure and Applied Mathematics, Mechanics, Physics and Engineering. We are greatly indebted to Viorica Venera Motreanu for the careful reading of the manuscript and helpful comments on important issues. We are also grateful to our Editors of Kluwer Academic Publishers for their professional assistance. Our deepest thanks go to our numerous scientific collaborators and friends, whose work was so important for us. D. Motreanu and V. Radulescu IX Introduction The present monograph is based on original results obtained by the authors in the last decade. This book provides a comprehensive expo sition of some modern topics in nonlinear analysis with applications to the study of several classes of boundary value problems. Our framework includes multivalued elliptic problems with discontinuities, variational inequalities, hemivariational inequalities and evolution problems. The treatment relies on variational methods, monotonicity principles, topo logical arguments and optimization techniques. Excepting Sections 1 and 3 in Chapter 1 and Sections 1 and 3 in Chapter 2, the material is new in comparison with any other book, representing research topics where the authors contributed. The outline of our work is the following.

This volume contains the edited texts of the lectures presented at the Workshop on High Performance Algorithms and Software for Nonlinear Optimization held in Erice, Sicily, at the "G. Stampacchia" School of Mathematics of the "E. Majorana" Centre for Scientific Culture, June 30 - July 8, 2001. In the first year of the new century, the aim of the Workshop was to assess the past and to discuss the future of Nonlinear Optimization, and to highlight recent achieve ments and promising research trends in this field. An emphasis was requested on algorithmic and high performance software developments and on new computational experiences, as well as on theoretical advances. We believe that such goal was basically achieved. The Workshop was attended by 71 people from 22 countries. Although not all topics were covered, the presentations gave indeed a wide overview of the field, from different and complementary stand points. Besides the lectures, several formal and informal discussions took place. We wish to express our appreciation for the active contribution of all the participants in the meeting. The 18 papers included in this volume represent a significant selection of the most recent developments in nonlinear programming

theory and practice. They show that there is plenty of exciting ideas, implementation issues and new applications which produce a very fast evolution in the field.

There has been much recent progress in approximation algorithms for nonconvex continuous and discrete problems from both a theoretical and a practical perspective. In discrete (or combinatorial) optimization many approaches have been developed recently that link the discrete universe to the continuous universe through geomet ric, analytic, and algebraic techniques. Such techniques include global optimization formulations, semidefinite programming, and spectral theory. As a result new ap proximate algorithms have been discovered and many new computational approaches have been developed. Similarly, for many continuous nonconvex optimization prob lems, new approximate algorithms have been developed based on semidefinite pro gramming and new randomization techniques. On the other hand, computational complexity, originating from the interactions between computer science and numeri cal optimization, is one of the major theories that have revolutionized the approach to solving optimization problems and to analyzing their intrinsic difficulty. The main focus of complexity is the study of whether existing algorithms are efficient for the solution of problems, and which problems are likely to be tractable. The quest for developing efficient algorithms leads also to elegant general approaches for solving optimization problems, and reveals surprising connections among problems and their solutions. A conference on Approximation and Complexity in Numerical Optimization: Con tinuous and Discrete Problems was held during February 28 to March 2, 1999 at the Center for Applied Optimization of the University of Florida.

This book begins with a concentrated introduction into deterministic global optimization and moves forward to present new original results from the authors who are well known experts in the field. Multiextremal continuous problems that have an unknown structure with Lipschitz objective functions and functions having the first Lipschitz derivatives defined over hyperintervals are examined. A class of algorithms using several Lipschitz constants is introduced which has its origins in the DIRECT (DIviding RECTangles) method. This new class is based on an efficient strategy that is applied for the search domain partitioning. In addition a survey on derivative free methods and methods using the first derivatives is given for both one-dimensional and multi-dimensional cases. Non-smooth and smooth minorants and acceleration techniques that can speed up several classes of global optimization methods with examples of applications and problems arising in numerical testing of global optimization algorithms are discussed. Theoretical considerations are illustrated through engineering applications. Extensive numerical testing of algorithms described in this book stretches the likelihood of establishing a link between mathematicians and practitioners. The authors conclude by describing applications and a generator of random classes of test functions with known local and global minima that is used in more than 40 countries of the world. This title serves as a starting point for

students, researchers, engineers, and other professionals in operations research, management science, computer science, engineering, economics, environmental sciences, industrial and applied mathematics to obtain an overview of deterministic global optimization.

The research of Antanas Zilinskas has focused on developing models for global optimization, implementing and investigating the corresponding algorithms, and applying those algorithms to practical problems. This volume, dedicated to Professor Zilinskas on the occasion of his 60th birthday, contains new survey papers in which leading researchers from the field present various models and algorithms for solving global optimization problems.

Introduction to Global Optimization Exploiting Space-Filling Curves provides an overview of classical and new results pertaining to the usage of space-filling curves in global optimization. The authors look at a family of derivative-free numerical algorithms applying space-filling curves to reduce the dimensionality of the global optimization problem; along with a number of unconventional ideas, such as adaptive strategies for estimating Lipschitz constant, balancing global and local information to accelerate the search. Convergence conditions of the described algorithms are studied in depth and theoretical considerations are illustrated through numerical examples. This work also contains a code for implementing space-filling curves that can be used for constructing new global optimization algorithms. Basic ideas from this text can be applied to a number of problems including problems with multiextremal and partially defined constraints and non-redundant parallel computations can be organized. Professors, students, researchers, engineers, and other professionals in the fields of pure mathematics, nonlinear sciences studying fractals, operations research, management science, industrial and applied mathematics, computer science, engineering, economics, and the environmental sciences will find this title useful . ?

This monograph deals with a general class of solution approaches in deterministic global optimization, namely the geometric branch-and-bound methods which are popular algorithms, for instance, in Lipschitzian optimization, d.c. programming, and interval analysis.It also introduces a new concept for the rate of convergence and analyzes several bounding operations reported in the literature, from the theoretical as well as from the empirical point of view. Furthermore, extensions of the prototype algorithm for multicriteria global optimization problems as well as mixed combinatorial optimization problems are considered. Numerical examples based on facility location problems support the theory. Applications of geometric branch-and-bound methods, namely the circle detection problem in image processing, the integrated scheduling and location makespan problem, and the median line location problem in the three-dimensional space are also presented. The book is intended for both researchers and students in the areas of mathematics, operations research, engineering, and computer science.

At the heart of the topology of global optimization lies Morse Theory: The study of the behaviour of lower level sets of functions as the level varies. Roughly speaking, the topology of lower level sets only may change when passing a level which corresponds to a stationary point (or Karush-Kuhn Tucker point). We study elements of Morse Theory, both in the unconstrained and constrained case. Special attention is paid to the degree of differentiabil ity of the functions under consideration. The reader will become motivated to discuss the possible shapes and forms of functions that may possibly arise within a given problem framework. In a separate chapter we show how certain ideas may be carried over to nonsmooth items, such as problems of Chebyshev approximation type. We made this choice in order to show that a good under standing of regular smooth problems may lead to a straightforward treatment of "just" continuous problems by means of suitable perturbation techniques, taking a priori nonsmoothness into account. Moreover, we make a focal point analysis in order to emphasize the difference between inner product norms and, for example, the maximum norm. Then, specific tools from algebraic topol ogy, in particular homology theory, are treated in some detail. However, this development is carried out only as far as it is needed to understand the relation between critical points of a function on a manifold with structured boundary. Then, we pay attention to three important subjects in nonlinear optimization.

Global optimization aims at solving the most general problems of deterministic mathematical programming: to find the global optimum of a nonlinear, nonconvex, multivariate function of continuous and/or integer variables subject to constraints which may be themselves nonlinear and nonconvex. In addition, once the solutions are found, proof of its optimality is also expected from this methodology. Therefore, with these difficulties in mind, global optimization is becoming an increasingly powerful and important methodology. Essays and Surveys in Global Optimization is the most recent examination of its mathematical capability, power, and wide ranging solutions to many fields in the applied sciences.

Access the Latest Advances in Food Quality Optimization and Safety Assurance Thermal processing has undergone a remarkable amount of research throughout the past decade, indicating that the process not only remains viable, but that it is also expanding around the world. An organized exploration of new developments in academic and current food industry practices, Engineering Aspects of Thermal Food Processing presents groundbreaking advances in the physical and engineering aspects of thermal food processing, paying particular attention to modeling, simulation, optimization, online control, and automation. Divided into Four Cohesive Sections Under the editorial guidance of a leading thermal processing authority, the book first covers the fundamentals and new processes in the thermal processing industry, including new packaging materials like retortable pouches. The second section moves on to mathematical modeling and simulation, which also addresses emerging preservation technology such as ohmic heating. The third section of the book is devoted to optimization, recognizing that mathematical optimization is the key

ingredient for computing optimal operating policies and building advanced decision support systems. This section discusses processes like thermal sterilization, microwave processing, and in-line aseptic processing as well as an analysis of plant production productivity. The final section examines online control and automation describing a practical and efficient strategy for on-line correction of thermal process deviations during retort sterilization of canned foods. Concluding with expert analysis and discussion of the manufacturers' businesses in today's competitive marketplace, Engineering Aspects of Thermal Food Processing explores the entire processing line from modeling through optimization. It effectively assists manufacturers in maintaining a seamless workflow while lowering their bottom lines.

Simplicial Global Optimization is centered on deterministic covering methods partitioning feasible region by simplices. This book looks into the advantages of simplicial partitioning in global optimization through applications where the search space may be significantly reduced while taking into account symmetries of the objective function by setting linear inequality constraints that are managed by initial partitioning. The authors provide an extensive experimental investigation and illustrates the impact of various bounds, types of subdivision, strategies of candidate selection on the performance of algorithms. A comparison of various Lipschitz bounds over simplices and an extension of Lipschitz global optimization with-out the Lipschitz constant to the case of simplicial partitioning is also depicted in this text. Applications benefiting from simplicial partitioning are examined in detail such as nonlinear least squares regression and pile placement optimization in grillage-type foundations. Researchers and engineers will benefit from simplicial partitioning algorithms such as Lipschitz branch and bound, Lipschitz optimization without the Lipschitz constant, heuristic partitioning presented. This book will leave readers inspired to develop simplicial versions of other algorithms for global optimization and even use other non-rectangular partitions for special applications.

The aim of the book is to cover the three fundamental aspects of research in equilibrium problems: the statement problem and its formulation using mainly variational methods, its theoretical solution by means of classical and new variational tools, the calculus of solutions and applications in concrete cases. The book shows how many equilibrium problems follow a general law (the so-called user equilibrium condition). Such law allows us to express the problem in terms of variational inequalities. Variational inequalities provide a powerful methodology, by which existence and calculation of the solution can be obtained.

This book presents a new approach to global non-convex constrained optimization. Problem dimensionality is reduced via space-filling curves. To economize the search, constraint is accounted separately (penalties are not employed). The multicriteria case is also considered. All techniques are generalized for (non-redundant) execution on multiprocessor systems. Audience: Researchers and students working in optimization, applied mathematics, and computer science.

This proceedings volume highlights a selection of papers presented at the Sixth International Conference on High Performance Scientific Computing, which took place in Hanoi, Vietnam on March 16-20, 2015. The conference was jointly organized by the Heidelberg Institute of Theoretical Studies (HITS), the Institute of Mathematics of the Vietnam Academy of Science and Technology (VAST), the Interdisciplinary Center for

Scientific Computing (IWR) at Heidelberg University, and the Vietnam Institute for Advanced Study in Mathematics, Ministry of Education The contributions cover a broad, interdisciplinary spectrum of scientific computing and showcase recent advances in theory, methods, and practical applications. Subjects covered numerical simulation, methods for optimization and control, parallel computing, and software development, as well as the applications of scientific computing in physics, mechanics, biomechanics and robotics, material science, hydrology, biotechnology, medicine, transport, scheduling, and industry.

Global optimization is concerned with the computation and characterization of global optima of nonlinear functions. During the past three decades the field of global optimization has been growing at a rapid pace, and the number of publications on all aspects of global optimization has been increasing steadily. Many applications, as well as new theoretical, algorithmic, and computational contributions have resulted. The Handbook of Global Optimization is the first comprehensive book to cover recent developments in global optimization. Each contribution in the Handbook is essentially expository in nature, but scholarly in its treatment. The chapters cover optimality conditions, complexity results, concave minimization, DC programming, general quadratic programming, nonlinear complementarity, minimax problems, multiplicative programming, Lipschitz optimization, fractional programming, network problems, trajectory methods, homotopy methods, interval methods, and stochastic approaches. The Handbook of Global Optimization is addressed to researchers in mathematical programming, as well as all scientists who use optimization methods to model and solve problems.

Global Optimization has emerged as one of the most exciting new areas of mathematical programming. Global optimization has received a wide attraction from many fields in the past few years, due to the success of new algorithms for addressing previously intractable problems from diverse areas such as computational chemistry and biology, biomedicine, structural optimization, computer sciences, operations research, economics, and engineering design and control. This book contains refereed invited papers submitted at the 4th international confer ence on Frontiers in Global Optimization held at Santorini, Greece during June 8-12, 2003. Santorini is one of the few sites of Greece, with wild beauty created by the explosion of a volcano which is in the middle of the gulf of the island. The mystic landscape with its numerous mult-extrema, was an inspiring location particularly for researchers working on global optimization. The three previous conferences on "Recent Advances in Global Opti mization", "State-of-the-Art in Global Optimization", and "Optimization in Computational Chemistry and Molecular Biology: Local and Global approaches" took place at Princeton University in 1991, 1995, and 1999, respectively. The papers in this volume focus on de terministic methods for global optimization, stochastic methods for global optimization, distributed computing methods in global optimization, and applications of global optimiza tion in several branches of applied science and engineering, computer science, computational chemistry, structural biology, and bio-informatics.

This book consists of two parts. Firstly, the main notions of abstract convexity and their applications in the study of some classes of functions and sets are presented. Secondly, both theoretical and numerical aspects of global optimization based on abstract convexity are examined. Most of the book does not require knowledge of

advanced mathematics. Classical methods of nonconvex mathematical programming, being based on a local approximation, cannot be used to examine and solve many problems of global optimization, and so there is a clear need to develop special global tools for solving these problems. Some of these tools are based on abstract convexity, that is, on the representation of a function of a rather complicated nature as the upper envelope of a set of fairly simple functions. Audience: The book will be of interest to specialists in global optimization, mathematical programming, and convex analysis, as well as engineers using mathematical tools and optimization techniques and specialists in mathematical modelling.

Continuous optimization is the study of problems in which we wish to opti mize (either maximize or minimize) a continuous function (usually of several variables) often subject to a collection of restrictions on these variables. It has its foundation in the development of calculus by Newton and Leibniz in the 17*^ century. Nowadys, continuous optimization problems are widespread in the mathematical modelling of real world systems for a very broad range of applications. Solution methods for large multivariable constrained continuous optimiza tion problems using computers began with the work of Dantzig in the late 1940s on the simplex method for linear programming problems. Recent re search in continuous optimization has produced a variety of theoretical devel opments, solution methods and new areas of applications. It is impossible to give a full account of the current trends and modern applications of contin uous optimization. It is our intention to present a number of topics in order to show the spectrum of current research activities and the development of numerical methods and applications.

The book presents a treatment of topological and differential properties of multivalued mappings and marginal functions. In addition, applications to sensitivity analysis of nonlinear programming problems under perturbations are studied. Properties of marginal functions associated with optimization problems are analyzed under quite general constraints defined by means of multivalued mappings. A unified approach to directional differentiability of functions and multifunctions forms the base of the volume. Nonlinear programming problems involving quasidifferentiable functions are considered as well. A significant part of the results are based on theories and concepts of two former Soviet Union researchers, Demyanov and Rubinov, and have never been published in English before. It contains all the necessary information from multivalued analysis and does not require special knowledge, but assumes basic knowledge of calculus at an undergraduate level.

Optimization in Computational Chemistry and Molecular Biology: Local and Global Approaches covers recent developments in optimization techniques for addressing several computational chemistry and biology problems. A tantalizing problem that cuts across the fields of computational chemistry, biology, medicine, engineering and applied mathematics is how proteins fold. Global and local optimization provide a systematic framework of conformational searches for the prediction of three-dimensional protein structures that represent the global

minimum free energy, as well as low-energy biomolecular conformations. Each contribution in the book is essentially expository in nature, but of scholarly treatment. The topics covered include advances in local and global optimization approaches for molecular dynamics and modeling, distance geometry, protein folding, molecular structure refinement, protein and drug design, and molecular and peptide docking. Audience: The book is addressed not only to researchers in mathematical programming, but to all scientists in various disciplines who use optimization methods in solving problems in computational chemistry and biology.

The book consists of three parts. The first part introduces concepts and algorithms in optimization theory, which have been used in neural network research. The second part covers main neural network models and their theoretical analysis. The third part of the book introduces various neural network models for solving nonlinear programming problems and combinatorial optimization problems. Audience: Graduate students and researchers who are interested in the intersection of optimization theory and artificial neural networks. The book is appropriate for graduate courses.

In the paper we propose a model of tax incentives optimization for inve- ment projects with a help of the mechanism of accelerated depreciation. Unlike the tax holidays which influence on effective income tax rate, accelerated - preciation affects on taxable income. In modern economic practice the state actively use for an attraction of - vestment into the creation of new enterprises such mechanisms as accelerated depreciation and tax holidays. The problem under our consideration is the following. Assume that the state (region) is interested in realization of a certain investment project, for ex- ple, the creation of a new enterprise. In order to attract a potential investor the state decides to use a mechanism of accelerated tax depreciation. The foll- ing question arise. What is a reasonable principle for choosing depreciation rate? From the state’s point of view the future investor’s behavior will be rat- nal. It means that while looking at economic environment the investor choose such a moment for investment which maximizes his expected net present value (NPV) from the given project. For this case both criteria and “investment rule” depend on proposed (by the state) depreciation policy. For the simplicity we will suppose that the purpose of the state for a given project is a maximi- tion of a discounted tax payments into the budget from the enterprise after its creation. Of course, these payments depend on the moment of investor’s entry and, therefore, on the depreciation policy established by the state.

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 ad vances 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 con strained 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 prob lems 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.

A textbook for an undergraduate course in mathematical programming for students with a knowledge of elementary real analysis, linear algebra, and classical linear programming (simple techniques). Focuses on the computation and characterization of global optima of nonlinear functions, rather than the locally optimal solutions addressed by most books on optimization. Incorporates the theoretical, algorithmic, and computational advances of the past three decades that help solve globally multi-extreme problems in the mathematical modeling of real world systems. Annotation copyright by Book News, Inc., Portland, OR

Since the first attempts to model proteins on a computer began almost thirty years ago, our understanding of protein structure and dynamics has dramatically increased. Spectroscopic measurement techniques continue to improve in resolution and sensitivity, allowing a wealth of information to be obtained with regard to the kinetics of protein folding and unfolding, and complementing the detailed structural picture of the folded state. Concurrently, algorithms, software, and computational hardware have progressed to the point where both structural and kinetic problems may be studied with a fair degree of realism. Despite these advances, many major challenges remain in understanding protein folding at both the conceptual and practical levels. Computational Methods for Protein Folding seeks to illuminate recent advances in computational modeling of protein folding in a way that will be useful to physicists, chemists, and chemical physicists. Covering a broad spectrum of computational methods and practices culled from a variety of research fields, the editors present a full range of models that, together, provide a thorough and current description of all aspects of protein folding. A valuable resource for both students and professionals in the field, the book will be of value both as a cutting-edge overview of existing information and as a catalyst for inspiring new studies. Computational Methods for Protein Folding is the 120th volume in the acclaimed series Advances in Chemical Physics, a compilation of scholarly works dedicated to the dissemination of contemporary advances in chemical physics, edited by Nobel Prize-winner Ilya Prigogine.

There has been much recent progress in global optimization algo rithms for nonconvex continuous and discrete problems from both a theoretical and a

practical perspective. Convex analysis plays a fun damental role in the analysis and development of global optimization algorithms. This is due essentially to the fact that virtually all noncon vex optimization problems can be described using differences of convex functions and differences of convex sets. A conference on Convex Analysis and Global Optimization was held during June 5 -9, 2000 at Pythagorion, Samos, Greece. The conference was honoring the memory of C. Caratheodory (1873-1950) and was en dorsed by the Mathematical Programming Society (MPS) and by the Society for Industrial and Applied Mathematics (SIAM) Activity Group in Optimization. The conference was sponsored by the European Union (through the EPEAEK program), the Department of Mathematics of the Aegean University and the Center for Applied Optimization of the University of Florida, by the General Secretariat of Research and Tech nology of Greece, by the Ministry of Education of Greece, and several local Greek government agencies and companies. This volume contains a selective collection of refereed papers based on invited and contribut ing talks presented at this conference. The two themes of convexity and global optimization pervade this book. The conference provided a forum for researchers working on different aspects of convexity and global opti mization to present their recent discoveries, and to interact with people working on complementary aspects of mathematical programming.

This book contains papers presented at the 14th European Symposium on Computer Aided Process Engineering (ESCAPE-14). The ESCAPE symposia bring together scientists, students and engineers from academia and industry, who are active in the research and application of Computer Aided Process Engineering. The objective of ESCAPE-14 is to highlight the use of computers and information technology tools on five specific themes: 1. Product and Process Design, 2. Synthesis and Process Integration, 3. Process Control and Analysis, 4. Manufacturing & Process Operations, 5. New Challenges in CAPE. - Provides this year's comprehensive overview of the current state of affairs in the CAPE community - Contains reports from the frontiers of science by the field's most respected scientists - Special Keynote by Professor Roger Sargent, Long Term Achievement CAPE Award winner

This book presents state-of-the-art results and methodologies in modern global optimization, and has been a staple reference for researchers, engineers, advanced students (also in applied mathematics), and practitioners in various fields of engineering. The second edition has been brought up to date and continues to develop a coherent and rigorous theory of deterministic global optimization, highlighting the essential role of convex analysis. The text has been revised and expanded to meet the needs of research, education, and applications for many years to come. Updates for this new edition include: · Discussion of modern approaches to minimax, fixed point, and equilibrium theorems, and to nonconvex optimization; · Increased focus on dealing more efficiently with ill-posed problems of global optimization, particularly those with

hard constraints; · Important discussions of decomposition methods for specially structured problems; · A complete revision of the chapter on nonconvex quadratic programming, in order to encompass the advances made in quadratic optimization since publication of the first edition. · Additionally, this new edition contains entirely new chapters devoted to monotonic optimization, polynomial optimization and optimization under equilibrium constraints, including bilevel programming, multiobjective programming, and optimization with variational inequality constraint. From the reviews of the first edition: The book gives a good review of the topic. ...The text is carefully constructed and well written, the exposition is clear. It leaves a remarkable impression of the concepts, tools and techniques in global optimization. It might also be used as a basis and guideline for lectures on this subject. Students as well as professionals will profitably read and use it.—Mathematical Methods of Operations Research, 49:3 (1999)

This book contains 112 papers selected from about 250 submissions to the 6th World Congress on Global Optimization (WCGO 2019) which takes place on July 8–10, 2019 at University of Lorraine, Metz, France. The book covers both theoretical and algorithmic aspects of Nonconvex Optimization, as well as its applications to modeling and solving decision problems in various domains. It is composed of 10 parts, each of them deals with either the theory and/or methods in a branch of optimization such as Continuous optimization, DC Programming and DCA, Discrete optimization & Network optimization, Multiobjective programming, Optimization under uncertainty, or models and optimization methods in a specific application area including Data science, Economics & Finance, Energy & Water management, Engineering systems, Transportation, Logistics, Resource allocation & Production management. The researchers and practitioners working in Nonconvex Optimization and several application areas can find here many inspiring ideas and useful tools & techniques for their works.

This volume presents a selection of advanced case studies that address a substantial range of issues and challenges arising in space engineering. The contributing authors are well-recognized researchers and practitioners in space engineering and in applied optimization. The key mathematical modeling and numerical solution aspects of each application case study are presented in sufficient detail. Classic and more recent space engineering problems – including cargo accommodation and object placement, flight control of satellites, integrated design and trajectory optimization, interplanetary transfers with deep space manoeuvres, low energy transfers, magnetic cleanliness modeling, propulsion system design, sensor system placement, systems engineering, space traffic logistics, and trajectory optimization – are discussed. Novel points of view related to computational global optimization and optimal control, and to multidisciplinary design optimization are also given proper emphasis. A particular attention is paid also to scenarios expected in the context of future interplanetary explorations. Modeling and Optimization in Space Engineering will benefit researchers and practitioners working on space engineering applications. Academics, graduate

and post-graduate students in the fields of aerospace and other engineering, applied mathematics, operations research and optimal control will also find the book useful, since it discusses a range of advanced model development and solution techniques and tools in the context of real-world applications and new challenges.

The advent of genome sequencing and associated technologies has transformed biologists' ability to measure important classes of molecules and their interactions. This expanded cellular view has opened the field to thousands of interactions that previously were outside the researchers' reach. The processing and interpretation of these new vast quantities of interconnected data call for sophisticated mathematical models and computational methods. Systems biology meets this need by combining genomic knowledge with theoretical, experimental and computational approaches from a number of traditional scientific disciplines to create a mechanistic explanation of cellular systems and processes.Systems Biology I: Genomics and Systems Biology II: Networks, Models, and Applications offer a much-needed study of genomic principles and their associated networks and models. Written for a wide audience, each volume presents a timely compendium of essential information that is necessary for a comprehensive study of the subject. The chapters in the two volumes reflect the hierarchical nature of systems biology. Chapter authors-world-recognized experts in their fields-provide authoritative discussions on a wide range of topics along this hierarchy. Volume I explores issues pertaining to genomics that range from prebiotic chemistry to noncoding RNAs. Volume II covers an equally wide spectrum, from mass spectrometry to embryonic stem cells. The two volumes are meant to provide a reliable reference for students and researchers alike.

Nonsmooth and nonconvex models arise in several important applications of mechanics and engineering. The interest in this field is growing from both mathematicians and engineers. The study of numerous industrial applications, including contact phenomena in statics and dynamics or delamination effects in composites, require the consideration of nonsmoothness and nonconvexity. The mathematical topics discussed in this book include variational and hemivariational inequalities, duality, complementarity, variational principles, sensitivity analysis, eigenvalue and resonance problems, and minimax problems. Applications are considered in the following areas among others: nonsmooth statics and dynamics, stability of quasi- static evolution processes, friction problems, adhesive contact and debonding, inverse problems, pseudoelastic modeling of phase transitions, chaotic behavior in nonlinear beams, and nonholonomic mechanical systems. This volume contains 22 chapters written by various leading researchers and presents a cohesive and authoritative overview of recent results and applications in the area of nonsmooth and nonconvex mechanics. Audience: Faculty, graduate students, and researchers in applied mathematics, optimization, control and engineering.

Significant research activity has occurred in the area of global optimization in

recent years. Many new theoretical, algorithmic, and computational contributions have resulted. Despite the major importance of test problems for researchers, there has been a lack of representative nonconvex test problems for constrained global optimization algorithms. This book is motivated by the scarcity of global optimization test problems and represents the first systematic collection of test problems for evaluating and testing constrained global optimization algorithms. This collection includes problems arising in a variety of engineering applications, and test problems from published computational reports.