

Nonlinear And Mixed Integer Optimization Fundamentals And Applications Topics In Chemical Engineering

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Nonlinear and Mixed-Integer Optimization - Christodoulos A. Floudas 1995-10-05

1. Introduction. PART 1. FUNDAMENTALS OF CONVEX ANALYSIS AND NONLINEAR OPTIMIZATION. 2. Convex Analysis. 3. Fundamentals of Nonlinear Optimization. 4. Duality Theory. PART 2. FUNDAMENTALS OF MIXED-INTEGER OPTIMIZATION. 5. Mixed-Integer Linear Optimization. 6. Mixed-Integer Nonlinear Optimization. PART 3. APPLICATIONS IN PROCESS SYNTHESIS. 7. Process Synthesis. 8. Heat Exchanger Network Synthesis. 9. Distillation-based Separation Systems Synthesis. 10. Synthesis of Reactor Networks and Reactor-Separator-Recycle Systems. Bibliography. Index. *Exergy, Energy System Analysis and Optimization - Volume II* - Christos A. Frangopoulos 2009-05-13

Exergy, Energy System Analysis, and Optimization theme is a component of the Encyclopedia of Energy Sciences, Engineering and Technology Resources which is part of the global Encyclopedia of Life Support Systems (EOLSS), an integrated compendium of twenty one Encyclopedias. These three volumes are organized into five different topics which represent the main scientific areas of the theme: 1. Exergy and Thermodynamic Analysis; 2. Thermoeconomic Analysis; 3. Modeling,

Simulation and Optimization in Energy Systems; 4. Artificial Intelligence and Expert Systems in Energy Systems Analysis; 5. Sustainability Considerations in the Modeling of Energy Systems. Fundamentals and applications of characteristic methods are presented in these volumes. These three volumes are aimed at the following five major target audiences: University and College Students, Educators, Professional Practitioners, Research Personnel and Policy Analysts, Managers, and Decision Makers and NGOs.

Chemical Production Scheduling - Christos T. Maravelias 2021-05-06

Understand common scheduling as well as other advanced operational problems with this valuable reference from a recognized leader in the field. Beginning with basic principles and an overview of linear and mixed-integer programming, this unified treatment introduces the fundamental ideas underpinning most modeling approaches, and will allow you to easily develop your own models. With more than 150 figures, the basic concepts and ideas behind the development of different approaches are clearly illustrated. Addresses a wide range of problems arising in diverse industrial sectors, from oil and gas to fine chemicals, and from commodity chemicals to food manufacturing. A

perfect resource for engineering and computer science students, researchers working in the area, and industrial practitioners.

Multi-level Mixed-Integer Optimization -

Styliani Avraamidou 2022-06-06

This book provides the fundamental underlying mathematical theory, numerical algorithms and efficient computational tools for the solution of multi-level mixed integer optimization problems. It can enable a vast array of decision makers and engineers (e.g. process engineers, bioengineers, chemical and civil engineers, and economists) to model, formulate and solve hierarchical decision making problems. The book gives detailed insights on multi-level optimization by comprehensive explanations, step-by-step numerical examples and case studies, plots, and diagrams.

Optimal Reliability Design -

Way Kuo 2001
Optimal Reliability Design provides a detailed introduction to systems reliability and reliability optimization. State-of-the-art techniques for maximizing system reliability are described, focusing on component reliability enhancement and redundancy arrangement. The authors present several case studies and show how optimization techniques are applied in practice. They also pay particular attention to finding methods that give the optimal trade-off between reliability and cost. The book is suitable for use on graduate-level courses in reliability engineering and operations research. It will also be a valuable reference for practising engineers.

Mathematical Aspects of Computer and Information Sciences -

Ilias S. Kotsireas 2016-04-16

This book constitutes the thoroughly refereed post-conference proceedings of the 6th International Conference on Mathematical Aspects of Computer and Information Sciences, MACIS 2015, held in Berlin, Germany, in November 2015. The 48 revised papers presented together with 7 invited papers were carefully reviewed and selected from numerous submissions. The papers are grouped in topical sections on curves and surfaces, applied algebraic geometry, cryptography, verified numerical computation, polynomial system solving, managing massive data, computational theory of differential and difference equations, data and knowledge exploration, algorithm

engineering in geometric computing, real complexity: theory and practice, global optimization, and general session.

Optimization for Chemical and Biochemical Engineering -

Vassilios S. Vassiliadis 2020-10-31
Discover the subject of optimization in a new light with this modern and unique treatment.

Includes a thorough exposition of applications and algorithms in sufficient detail for practical use, while providing you with all the necessary background in a self-contained manner.

Features a deeper consideration of optimal control, global optimization, optimization under uncertainty, multiobjective optimization, mixed-integer programming and model predictive control. Presents a complete coverage of formulations and instances in modelling where optimization can be applied for quantitative decision-making. As a thorough grounding to the subject, covering everything from basic to advanced concepts and addressing real-life problems faced by modern industry, this is a perfect tool for advanced undergraduate and graduate courses in chemical and biochemical engineering.

Relaxation and Decomposition Methods for Mixed Integer Nonlinear Programming -

Ivo Nowak 2006-03-28

Nonlinear optimization problems containing both continuous and discrete variables are called mixed integer nonlinear programs (MINLP). Such problems arise in many fields, such as process industry, engineering design, communications, and finance. There is currently a huge gap between MINLP and mixed integer linear programming (MIP) solver technology. With a modern state-of-the-art MIP solver it is possible to solve models with millions of variables and constraints, whereas the dimension of solvable MINLP is often limited by a number that is smaller by three or four orders of magnitude. It is theoretically possible to approximate a general MINLP by a MIP with arbitrary precision. However, good MIP approximations are usually much larger than the original problem. Moreover, the approximation of nonlinear functions by piecewise linear functions can be difficult and time-consuming. In this book relaxation and decomposition methods for solving nonconvex structured MINLPs are proposed. In particular, a generic branch-cut-

and-price (BCP) framework for MINLP is presented. BCP is the underlying concept in almost all modern MIP solvers. Providing a powerful decomposition framework for both sequential and parallel solvers, it made the success of the current MIP technology possible. So far generic BCP frameworks have been developed only for MIP, for example, COIN/BCP (IBM, 2003) and ABACUS (OREAS GmbH, 1999). In order to generalize MIP-BCP to MINLP-BCP, the following points have to be taken into account:

- A given (sparse) MINLP is reformulated as a block-separable program with linear coupling constraints. The block structure makes it possible to generate Lagrangian cuts and to apply Lagrangian heuristics.
- In order to facilitate the generation of polyhedral relaxations, nonlinear convex relaxations are constructed.
- The MINLP separation and pricing subproblems for generating cuts and columns are solved with specialized MINLP solvers.

Advanced Optimization for Process Systems Engineering - Ignacio E. Grossmann 2021-03-25
A unique text covering basic and advanced concepts of optimization theory and methods for process systems engineers. With examples illustrating key concepts and algorithms, and exercises involving theoretical derivations, numerical problems and modeling systems, it is ideal for single-semester, graduate courses in process systems engineering.

Encyclopedia of Optimization - Christodoulos A. Floudas 2008-09-04

The goal of the Encyclopedia of Optimization is to introduce the reader to a complete set of topics that show the spectrum of research, the richness of ideas, and the breadth of applications that has come from this field. The second edition builds on the success of the former edition with more than 150 completely new entries, designed to ensure that the reference addresses recent areas where optimization theories and techniques have advanced. Particularly heavy attention resulted in health science and transportation, with entries such as "Algorithms for Genomics", "Optimization and Radiotherapy Treatment Design", and "Crew Scheduling".

Optimization in Science and Engineering - Themistocles M. Rassias 2014-05-29

Optimization in Science and Engineering is dedicated in honor of the 60th birthday of Distinguished Professor Panos M. Pardalos. Pardalos's past and ongoing work has made a significant impact on several theoretical and applied areas in modern optimization. As tribute to the diversity of Dr. Pardalos's work in Optimization, this book comprises a collection of contributions from experts in various fields of this rich and diverse area of science. Topics highlight recent developments and include: Deterministic global optimization Variational inequalities and equilibrium problems Approximation and complexity in numerical optimization Non-smooth optimization Statistical models and data mining Applications of optimization in medicine, energy systems, and complex network analysis This volume will be of great interest to graduate students, researchers, and practitioners, in the fields of optimization and engineering.

Handbook of Combinatorial Optimization - Ding-Zhu Du 2013-12-01

Combinatorial (or discrete) optimization is one of the most active fields in the interface of operations research, computer science, and applied mathematics. Combinatorial optimization problems arise in various applications, including communications network design, VLSI design, machine vision, air line crew scheduling, corporate planning, computer-aided design and manufacturing, database query design, cellular telephone frequency assignment, constraint directed reasoning, and computational biology. Furthermore, combinatorial optimization problems occur in many diverse areas such as linear and integer programming, graph theory, artificial intelligence, and number theory. All these problems, when formulated mathematically as the minimization or maximization of a certain function defined on some domain, have a commonality of discreteness. Historically, combinatorial optimization starts with linear programming. Linear programming has an entire range of important applications including production planning and distribution, personnel assignment, finance, allocation of economic resources, circuit simulation, and control systems. Leonid Kantorovich and Tjalling Koopmans received the Nobel Prize (1975) for

their work on the optimal allocation of resources. Two important discoveries, the ellipsoid method (1979) and interior point approaches (1984) both provide polynomial time algorithms for linear programming. These algorithms have had a profound effect in combinatorial optimization. Many polynomial-time solvable combinatorial optimization problems are special cases of linear programming (e.g. matching and maximum flow). In addition, linear programming relaxations are often the basis for many approximation algorithms for solving NP-hard problems (e.g. dual heuristics).

Curves and Surfaces - Jean-Daniel Boissonnat
2012-01-06

This volume constitutes the thoroughly refereed post-conference proceedings of the 7th International Conference on Curves and Surfaces, held in Avignon, in June 2010. The conference had the overall theme:

"Representation and Approximation of Curves and Surfaces and Applications". The 39 revised full papers presented together with 9 invited talks were carefully reviewed and selected from 114 talks presented at the conference. The topics addressed by the papers range from mathematical foundations to practical implementation on modern graphics processing units and address a wide area of topics such as computer-aided geometric design, computer graphics and visualisation, computational geometry and topology, geometry processing, image and signal processing, interpolation and smoothing, scattered data processing and learning theory and subdivision, wavelets and multi-resolution methods.

Practical Chemical Process Optimization - Ioannis K. Kookos
2022-10-28

This text provides the undergraduate chemical engineering student with the necessary tools for problem solving in chemical or bio-engineering processes. In a friendly, simple, and unified framework, the exposition aptly balances theory and practice. It uses minimal mathematical concepts, terms, algorithms, and describes the main aspects of chemical process optimization using MATLAB and GAMS. Numerous examples and case studies are designed for students to understand basic principles of each optimization method and elicit the immediate discovery of

practical applications. Problem sets are directly tied to real-world situations most commonly encountered in chemical engineering applications. Chapters are structured with handy learning summaries, terms and concepts, and problem sets, and individually reinforce the basics of particular optimization methods. Additionally, the wide breadth of topics that may be encountered in courses such as Chemical Process Optimization, Chemical Process Engineering, Optimization of Chemical Processes, are covered in this accessible text. The book provides formal introductions to MATLAB, GAMS, and a revisit to pertinent aspects of undergraduate calculus. While created for coursework, this text is also suitable for independent study. A full solutions manual is available to instructors who adopt the text for their course.

Deterministic Global Optimization - Christodoulos A. Floudas
2000

This book provides a unified and insightful treatment of deterministic global optimization. It introduces theoretical and algorithmic advances that address the computation and characterization of global optima, determine valid lower and upper bounds on the global minima and maxima, and enclose all solutions of nonlinear constrained systems of equations. Among its special features, the book: Introduces the fundamentals of deterministic global optimization; Provides a thorough treatment of decomposition-based global optimization approaches for biconvex and bilinear problems; Covers global optimization methods for generalized geometric programming problems Presents in-depth global optimization algorithms for general twice continuously differentiable nonlinear problems; Provides a detailed treatment of global optimization methods for mixed-integer nonlinear problems; Develops global optimization approaches for the enclosure of all solutions of nonlinear constrained systems of equations; Includes many important applications from process design, synthesis, control, and operations, phase equilibrium, design under uncertainty, parameter estimation, azeotrope prediction, structure prediction in clusters and molecules, protein folding, and peptide docking. Audience: This book can be used as a textbook in graduate-level courses and

as a desk reference for researchers in all branches of engineering and applied science, applied mathematics, industrial engineering, operations research, computer science, economics, computational chemistry and molecular biology.

Optimization Techniques and Applications with Examples - Xin-She Yang 2018-09-19

A guide to modern optimization applications and techniques in newly emerging areas spanning optimization, data science, machine intelligence, engineering, and computer sciences

Optimization Techniques and Applications with Examples introduces the fundamentals of all the commonly used techniques in optimization that encompass the broadness and diversity of the methods (traditional and new) and algorithms. The author—a noted expert in the field—covers a wide range of topics including mathematical foundations, optimization formulation, optimality conditions, algorithmic complexity, linear programming, convex optimization, and integer programming. In addition, the book discusses artificial neural network, clustering and classifications, constraint-handling, queueing theory, support vector machine and multi-objective optimization, evolutionary computation, nature-inspired algorithms and many other topics. Designed as a practical resource, all topics are explained in detail with step-by-step examples to show how each method works. The book's exercises test the acquired knowledge that can be potentially applied to real problem solving. By taking an informal approach to the subject, the author helps readers to rapidly acquire the basic knowledge in optimization, operational research, and applied data mining. This important resource: Offers an accessible and state-of-the-art introduction to the main optimization techniques Contains both traditional optimization techniques and the most current algorithms and swarm intelligence-based techniques Presents a balance of theory, algorithms, and implementation Includes more than 100 worked examples with step-by-step explanations Written for upper undergraduates and graduates in a standard course on optimization, operations research and data mining, *Optimization Techniques and Applications with Examples* is a highly accessible guide to understanding the

fundamentals of all the commonly used techniques in optimization.

Optimization Methods in Metabolic Networks - Costas D. Maranas 2016-01-05

Provides a tutorial on the computational tools that use mathematical optimization concepts and representations for the curation, analysis and redesign of metabolic networks Organizes, for the first time, the fundamentals of mathematical optimization in the context of metabolic network analysis Reviews the fundamentals of different classes of optimization problems including LP, MILP, MLP and MINLP Explains the most efficient ways of formulating a biological problem using mathematical optimization Reviews a variety of relevant problems in metabolic network curation, analysis and redesign with an emphasis on details of optimization formulations Provides a detailed treatment of bilevel optimization techniques for computational strain design and other relevant problems

Optimization Techniques and Applications with Examples - Xin-She Yang 2018-08-30

A guide to modern optimization applications and techniques in newly emerging areas spanning optimization, data science, machine intelligence, engineering, and computer sciences

Optimization Techniques and Applications with Examples introduces the fundamentals of all the commonly used techniques in optimization that encompass the broadness and diversity of the methods (traditional and new) and algorithms. The author—a noted expert in the field—covers a wide range of topics including mathematical foundations, optimization formulation, optimality conditions, algorithmic complexity, linear programming, convex optimization, and integer programming. In addition, the book discusses artificial neural network, clustering and classifications, constraint-handling, queueing theory, support vector machine and multi-objective optimization, evolutionary computation, nature-inspired algorithms and many other topics. Designed as a practical resource, all topics are explained in detail with step-by-step examples to show how each method works. The book's exercises test the acquired knowledge that can be potentially applied to real problem solving. By taking an informal approach to the subject, the author helps readers to

rapidly acquire the basic knowledge in optimization, operational research, and applied data mining. This important resource: Offers an accessible and state-of-the-art introduction to the main optimization techniques Contains both traditional optimization techniques and the most current algorithms and swarm intelligence-based techniques Presents a balance of theory, algorithms, and implementation Includes more than 100 worked examples with step-by-step explanations Written for upper undergraduates and graduates in a standard course on optimization, operations research and data mining, *Optimization Techniques and Applications with Examples* is a highly accessible guide to understanding the fundamentals of all the commonly used techniques in optimization.

Frontiers in Global Optimization - Christodoulos A. Floudas 2013-12-01

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 conference 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 Optimization", "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 deterministic methods for global optimization, stochastic methods for global optimization, distributed computing methods in global optimization, and

applications of global optimization in several branches of applied science and engineering, computer science, computational chemistry, structural biology, and bio-informatics.

Advances and Trends in Optimization with Engineering Applications - Tamas 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.

Optimization in Engineering - Ramteen Sioshansi 2017-06-24

This textbook covers the fundamentals of optimization, including linear, mixed-integer linear, nonlinear, and dynamic optimization techniques, with a clear engineering focus. It carefully describes classical optimization models and algorithms using an engineering problem-solving perspective, and emphasizes modeling issues using many real-world examples related to a variety of application areas. Providing an appropriate blend of practical applications and

optimization theory makes the text useful to both practitioners and students, and gives the reader a good sense of the power of optimization and the potential difficulties in applying optimization to modeling real-world systems. The book is intended for undergraduate and graduate-level teaching in industrial engineering and other engineering specialties. It is also of use to industry practitioners, due to the inclusion of real-world applications, opening the door to advanced courses on both modeling and algorithm development within the industrial engineering and operations research fields.

Multi-parametric Optimization and Control - Efstratios N. Pistikopoulos 2020-11-24

Recent developments in multi-parametric optimization and control Multi-Parametric Optimization and Control provides comprehensive coverage of recent methodological developments for optimal model-based control through parametric optimization. It also shares real-world research applications to support deeper understanding of the material. Researchers and practitioners can use the book as reference. It is also suitable as a primary or a supplementary textbook. Each chapter looks at the theories related to a topic along with a relevant case study. Topic complexity increases gradually as readers progress through the chapters. The first part of the book presents an overview of the state-of-the-art multi-parametric optimization theory and algorithms in multi-parametric programming. The second examines the connection between multi-parametric programming and model-predictive control—from the linear quadratic regulator over hybrid systems to periodic systems and robust control. The third part of the book addresses multi-parametric optimization in process systems engineering. A step-by-step procedure is introduced for embedding the programming within the system engineering, which leads the reader into the topic of the PAROC framework and software platform. PAROC is an integrated framework and platform for the optimization and advanced model-based control of process systems. Uses case studies to illustrate real-world applications for a better understanding of the concepts presented Covers the fundamentals of optimization and model predictive control Provides information on key topics, such as the

basic sensitivity theorem, linear programming, quadratic programming, mixed-integer linear programming, optimal control of continuous systems, and multi-parametric optimal control An appendix summarizes the history of multi-parametric optimization algorithms. It also covers the use of the parametric optimization toolbox (POP), which is comprehensive software for efficiently solving multi-parametric programming problems.

Disjunctive Programming - Egon Balas 2018-11-27

Disjunctive Programming is a technique and a discipline initiated by the author in the early 1970's, which has become a central tool for solving nonconvex optimization problems like pure or mixed integer programs, through convexification (cutting plane) procedures combined with enumeration. It has played a major role in the revolution in the state of the art of Integer Programming that took place roughly during the period 1990-2010. The main benefit that the reader may acquire from reading this book is a deeper understanding of the theoretical underpinnings and of the applications potential of disjunctive programming, which range from more efficient problem formulation to enhanced modeling capability and improved solution methods for integer and combinatorial optimization. Egon Balas is University Professor and Lord Professor of Operations Research at Carnegie Mellon University's Tepper School of Business.

Business Optimization Using Mathematical Programming - Josef Kallrath 2021

This book presents a structured approach to formulate, model, and solve mathematical optimization problems for a wide range of real world situations. Among the problems covered are production, distribution and supply chain planning, scheduling, vehicle routing, as well as cutting stock, packing, and nesting. The optimization techniques used to solve the problems are primarily linear, mixed-integer linear, nonlinear, and mixed integer nonlinear programming. The book also covers important considerations for solving real-world optimization problems, such as dealing with valid inequalities and symmetry during the modeling phase, but also data interfacing and visualization of results in a more and more

digitized world. The broad range of ideas and approaches presented helps the reader to learn how to model a variety of problems from process industry, paper and metals industry, the energy sector, and logistics using mathematical optimization techniques.

Operations Research Proceedings 1996 - Uwe Zimmermann 2012-12-06

The volume contains a selection of manuscripts of lectures presented at the International Symposium on Operations Research (SOR 96). The Symposium took place at the Technical University of Braunschweig, September 3-6, 1996. SOR 96 was organized under the auspices of the two German societies of Operations Research, Deutsche Gesellschaft für Operations Research (DGOR) and Gesellschaft für Mathematik, Ökonomie und Operations Research (GMOOR) in cooperation with the Working Group Discrete Optimization of the IFIP (WG7.4). Since 1995, DGOR and GMOOR jointly prepare the Symposium as a common annual conference. In particular, the annual general meetings of the DGOR, the GMOOR and the WG7.4 took place during the conference. The Symposium had 527 participants from 32 countries around the world, including 92 participants from Eastern Europe. The Symposium obviously attracts an international audience of workers fully covering the broad spectrum of Operations Research and related areas in economics, mathematics and computer science. The importance of a highly interdisciplinary field as Operations Research is increasing owing to the growth in applications in related disciplines. Technological advances in computer science and algorithmic mathematics are crucial for attacking the great challenges waiting in the areas of applications of Operations Research effectively. As a participant of SOR 96 one could well observe the current pace of achievements. Many of these results are in these proceedings. The program consisted of two plenary, 17 semiplenary, and 335 contributed lectures in 18 sections.

Convex Optimization - Stephen Boyd
2004-03-08

A comprehensive introduction to the tools, techniques and applications of convex optimization.

Optimization Methods in Metabolic Networks -

Costas D. Maranas 2016-02-23

Provides a tutorial on the computational tools that use mathematical optimization concepts and representations for the curation, analysis and redesign of metabolic networks Organizes, for the first time, the fundamentals of mathematical optimization in the context of metabolic network analysis Reviews the fundamentals of different classes of optimization problems including LP, MILP, MLP and MINLP Explains the most efficient ways of formulating a biological problem using mathematical optimization Reviews a variety of relevant problems in metabolic network curation, analysis and redesign with an emphasis on details of optimization formulations Provides a detailed treatment of bilevel optimization techniques for computational strain design and other relevant problems

Handbook of Combinatorial Optimization - Ding-Zhu Du 2006-08-18

This is a supplementary volume to the major three-volume Handbook of Combinatorial Optimization set. It can also be regarded as a stand-alone volume presenting chapters dealing with various aspects of the subject in a self-contained way.

Nonlinear Programming - Dimitri Bertsekas
2016-09-01

This book provides a comprehensive and accessible presentation of algorithms for solving continuous optimization problems. It relies on rigorous mathematical analysis, but also aims at an intuitive exposition that makes use of visualization where possible. It places particular emphasis on modern developments, and their widespread applications in fields such as large-scale resource allocation problems, signal processing, and machine learning. The 3rd edition brings the book in closer harmony with the companion works Convex Optimization Theory (Athena Scientific, 2009), Convex Optimization Algorithms (Athena Scientific, 2015), Convex Analysis and Optimization (Athena Scientific, 2003), and Network Optimization (Athena Scientific, 1998). These works are complementary in that they deal primarily with convex, possibly nondifferentiable, optimization problems and rely on convex analysis. By contrast the nonlinear programming book focuses primarily

on analytical and computational methods for possibly nonconvex differentiable problems. It relies primarily on calculus and variational analysis, yet it still contains a detailed presentation of duality theory and its uses for both convex and nonconvex problems. This on-line edition contains detailed solutions to all the theoretical book exercises. Among its special features, the book: Provides extensive coverage of iterative optimization methods within a unifying framework Covers in depth duality theory from both a variational and a geometric point of view Provides a detailed treatment of interior point methods for linear programming Includes much new material on a number of topics, such as proximal algorithms, alternating direction methods of multipliers, and conic programming Focuses on large-scale optimization topics of much current interest, such as first order methods, incremental methods, and distributed asynchronous computation, and their applications in machine learning, signal processing, neural network training, and big data applications Includes a large number of examples and exercises Was developed through extensive classroom use in first-year graduate courses

21st European Symposium on Computer Aided Process Engineering - E. N. Pistikopoulos
2011-07-21

The European Symposium on Computer Aided Process Engineering (ESCAPE) series presents the latest innovations and achievements of leading professionals from the industrial and academic communities. The ESCAPE series serves as a forum for engineers, scientists, researchers, managers and students to present and discuss progress being made in the area of computer aided process engineering (CAPE). European industries large and small are bringing innovations into our lives, whether in the form of new technologies to address environmental problems, new products to make our homes more comfortable and energy efficient or new therapies to improve the health and well being of European citizens. Moreover, the European Industry needs to undertake research and technological initiatives in response to humanity's "Grand Challenges," described in the declaration of Lund, namely, Global Warming, Tightening Supplies of Energy,

Water and Food, Ageing Societies, Public Health, Pandemics and Security. Thus, the Technical Theme of ESCAPE 21 will be "Process Systems Approaches for Addressing Grand Challenges in Energy, Environment, Health, Bioprocessing & Nanotechnologies."

Optimization Methods in Finance - Gerard Cornuejols 2006-12-21

Optimization models play an increasingly important role in financial decisions. This is the first textbook devoted to explaining how recent advances in optimization models, methods and software can be applied to solve problems in computational finance more efficiently and accurately. Chapters discussing the theory and efficient solution methods for all major classes of optimization problems alternate with chapters illustrating their use in modeling problems of mathematical finance. The reader is guided through topics such as volatility estimation, portfolio optimization problems and constructing an index fund, using techniques such as nonlinear optimization models, quadratic programming formulations and integer programming models respectively. The book is based on Master's courses in financial engineering and comes with worked examples, exercises and case studies. It will be welcomed by applied mathematicians, operational researchers and others who work in mathematical and computational finance and who are seeking a text for self-learning or for use with courses.

Nonlinear and Mixed-Integer Optimization - Christodoulos A. Floudas 1995-10-05

Filling a void in chemical engineering and optimization literature, this book presents the theory and methods for nonlinear and mixed-integer optimization, and their applications in the important area of process synthesis. Other topics include modeling issues in process synthesis, and optimization-based approaches in the synthesis of heat recovery systems, distillation-based systems, and reactor-based systems. The basics of convex analysis and nonlinear optimization are also covered and the elementary concepts of mixed-integer linear optimization are introduced. All chapters have several illustrations and geometrical interpretations of the material as well as suggested problems. Nonlinear and Mixed-

Integer Optimization will prove to be an invaluable source--either as a textbook or a reference--for researchers and graduate students interested in continuous and discrete nonlinear optimization issues in engineering design, process synthesis, process operations, applied mathematics, operations research, industrial management, and systems engineering.

Acta Numerica 2004: Volume 13 - Arieh Iserles
2004-06-03

An annual volume presenting substantive survey articles in numerical mathematics and scientific computing.

Gas Network Optimization by MINLP - Jesco Humpola
2017-07-25

This thesis is about mathematical optimization for an efficient operation of gas transmission networks. The challenging question is how to expand and operate the network in order to facilitate the transportation of specified gas quantities at minimum cost. This problem is a major challenge for gas network operators. It is extremely hard to solve due to the combinatorial complexity of the active network elements such as compressors, the nonlinear physical characteristic of pipelines, and the immense sizes of the problem instances. Mathematical models and optimization techniques can result in huge gains for the network operators in terms of cost reductions and automated computations. We tackle this challenge by developing novel mathematical theory and associated innovative optimization algorithms for large scale instances. This allows us to produce solutions for a real-world instance, i.e., the largest gas network in Germany.

Handbook of Model Predictive Control - Saša V. Raković
2018-09-01

Recent developments in model-predictive control promise remarkable opportunities for designing multi-input, multi-output control systems and improving the control of single-input, single-output systems. This volume provides a definitive survey of the latest model-predictive control methods available to engineers and scientists today. The initial set of chapters present various methods for managing uncertainty in systems, including stochastic model-predictive control. With the advent of affordable and fast computation, control

engineers now need to think about using "computationally intensive controls," so the second part of this book addresses the solution of optimization problems in "real" time for model-predictive control. The theory and applications of control theory often influence each other, so the last section of Handbook of Model Predictive Control rounds out the book with representative applications to automobiles, healthcare, robotics, and finance. The chapters in this volume will be useful to working engineers, scientists, and mathematicians, as well as students and faculty interested in the progression of control theory. Future developments in MPC will no doubt build from concepts demonstrated in this book and anyone with an interest in MPC will find fruitful information and suggestions for additional reading.

Theory of Linear and Integer Programming - Alexander Schrijver
1998-06-11

Theory of Linear and Integer Programming
Alexander Schrijver Centrum voor Wiskunde en Informatica, Amsterdam, The Netherlands
This book describes the theory of linear and integer programming and surveys the algorithms for linear and integer programming problems, focusing on complexity analysis. It aims at complementing the more practically oriented books in this field. A special feature is the author's coverage of important recent developments in linear and integer programming. Applications to combinatorial optimization are given, and the author also includes extensive historical surveys and bibliographies. The book is intended for graduate students and researchers in operations research, mathematics and computer science. It will also be of interest to mathematical historians. Contents 1 Introduction and preliminaries; 2 Problems, algorithms, and complexity; 3 Linear algebra and complexity; 4 Theory of lattices and linear diophantine equations; 5 Algorithms for linear diophantine equations; 6 Diophantine approximation and basis reduction; 7 Fundamental concepts and results on polyhedra, linear inequalities, and linear programming; 8 The structure of polyhedra; 9 Polarity, and blocking and anti-blocking polyhedra; 10 Sizes and the theoretical complexity of linear inequalities and linear

programming; 11 The simplex method; 12 Primal-dual, elimination, and relaxation methods; 13 Khachiyan's method for linear programming; 14 The ellipsoid method for polyhedra more generally; 15 Further polynomiality results in linear programming; 16 Introduction to integer linear programming; 17 Estimates in integer linear programming; 18 The complexity of integer linear programming; 19 Totally unimodular matrices: fundamental properties and examples; 20 Recognizing total unimodularity; 21 Further theory related to total unimodularity; 22 Integral polyhedra and total dual integrality; 23 Cutting planes; 24 Further methods in integer linear programming; Historical and further notes on integer linear programming; References; Notation index; Author index; Subject index

Nonlinear Programming - Lorenz T. Biegler 2010

This book addresses modern nonlinear programming (NLP) concepts and algorithms, especially as they apply to challenging applications in chemical process engineering. The author provides a firm grounding in fundamental NLP properties and algorithms, and relates them to real-world problem classes in process optimization, thus making the material understandable and useful to chemical engineers and experts in mathematical optimization.

Mixed Integer Nonlinear Programming - Jon Lee 2011-12-02

Many engineering, operations, and scientific applications include a mixture of discrete and continuous decision variables and nonlinear relationships involving the decision variables that have a pronounced effect on the set of feasible and optimal solutions. Mixed-integer nonlinear programming (MINLP) problems combine the numerical difficulties of handling nonlinear functions with the challenge of optimizing in the context of nonconvex functions and discrete variables. MINLP is one of the most flexible modeling paradigms available for optimization; but because its scope is so broad, in the most general cases it is hopelessly intractable. Nonetheless, an expanding body of researchers and practitioners — including chemical engineers, operations researchers, industrial engineers, mechanical engineers, economists, statisticians, computer scientists, operations managers, and mathematical

programmers — are interested in solving large-scale MINLP instances.

Applied Integer Programming - Der-San Chen 2011-09-20

An accessible treatment of the modeling and solution of integer programming problems, featuring modern applications and software. In order to fully comprehend the algorithms associated with integer programming, it is important to understand not only how algorithms work, but also why they work. Applied Integer Programming features a unique emphasis on this point, focusing on problem modeling and solution using commercial software. Taking an application-oriented approach, this book addresses the art and science of mathematical modeling related to the mixed integer programming (MIP) framework and discusses the algorithms and associated practices that enable those models to be solved most efficiently. The book begins with coverage of successful applications, systematic modeling procedures, typical model types, transformation of non-MIP models, combinatorial optimization problem models, and automatic preprocessing to obtain a better formulation. Subsequent chapters present algebraic and geometric basic concepts of linear programming theory and network flows needed for understanding integer programming. Finally, the book concludes with classical and modern solution approaches as well as the key components for building an integrated software system capable of solving large-scale integer programming and combinatorial optimization problems. Throughout the book, the authors demonstrate essential concepts through numerous examples and figures. Each new concept or algorithm is accompanied by a numerical example, and, where applicable, graphics are used to draw together diverse problems or approaches into a unified whole. In addition, features of solution approaches found in today's commercial software are identified throughout the book. Thoroughly classroom-tested, Applied Integer Programming is an excellent book for integer programming courses at the upper-undergraduate and graduate levels. It also serves as a well-organized reference for professionals, software developers, and analysts who work in the fields of applied mathematics,

computer science, operations research, management science, and engineering and use integer-programming techniques to model and solve real-world optimization problems.

Fundamentals of Optimization Techniques with Algorithms - Sukanta Nayak 2020-08-25

Optimization is a key concept in mathematics, computer science, and operations research, and is essential to the modeling of any system, playing an integral role in computer-aided design. Fundamentals of Optimization

Techniques with Algorithms presents a complete package of various traditional and advanced optimization techniques along with a variety of example problems, algorithms and MATLAB® code optimization techniques, for linear and nonlinear single variable and multivariable models, as well as multi-objective and advanced optimization techniques. It presents both theoretical and numerical perspectives in a clear and approachable way. In order to help the reader apply optimization techniques in practice, the book details program codes and computer-

aided designs in relation to real-world problems. Ten chapters cover, an introduction to optimization; linear programming; single variable nonlinear optimization; multivariable unconstrained nonlinear optimization; multivariable constrained nonlinear optimization; geometric programming; dynamic programming; integer programming; multi-objective optimization; and nature-inspired optimization. This book provides accessible coverage of optimization techniques, and helps the reader to apply them in practice. Presents optimization techniques clearly, including worked-out examples, from traditional to advanced Maps out the relations between optimization and other mathematical topics and disciplines Provides systematic coverage of algorithms to facilitate computer coding Gives MATLAB® codes in relation to optimization techniques and their use in computer-aided design Presents nature-inspired optimization techniques including genetic algorithms and artificial neural networks