Recent Advances In Convex Optimization

Here is a book devoted to well-structured and thus efficiently solvable convex optimization problems, with emphasis on conic

quadratic and semidefinite programming. The authors present the basic theory underlying these problems as well as their numerous applications in engineering, including synthesis of filters, Lyapunov stability analysis,

and structural design. The authors also discuss the complexity issues and provide an overview of the basic theory of state-of-the-art polynomial time interior point methods for linear, conic quadratic, and semidefinite

programming. The book's focus on well-structured convex problems in conic form allows for unified theoretical and algorithmical treatment of a wide spectrum of important optimization problems arising in applications.

This book provides a comprehensive introduction to nonlinear programming, featuring a broad range of applications and solution methods in the field of continuous optimization. It begins with a

summary of classical results on unconstrained optimization, followed by a wealth of applications from a diverse mix of fields, e.g. location analysis, traffic planning, and water quality management, to

name but a few. In turn, the book presents a formal description of optimality conditions, followed by an in-depth discussion of the main solution techniques. Each method is formally described, and then fully solved using a

numerical example. Mathematical optimization encompasses both a rich and rapidly evolving body of fundamental theory, and a variety of exciting applications in science and engineering. The present book

contains a careful selection of articles on recent advances in optimization theory, numerical methods, and their applications in engineering. It features in particular new methods and applications in the fields of optimal

control, PDE-constrained optimization, nonlinear optimization, and convex optimization. The authors of this volume took part in the 14th Belgian-French-German Conference on Optimization

(BFG09) organized in Leuven, Belgium, on September 14-18, 2009. The volume contains a selection of reviewed articles contributed by the conference speakers as well as three survey articles by plenary speakers and two

papers authored by the winners of the best talk and best poster prizes awarded at BFG09. Researchers and graduate students in applied mathematics, computer science, and many branches of engineering will find in this book an

interesting and useful collection of recent ideas on the methods and applications of optimization. Non-convex Optimization for Machine Learning takes an in-depth look at the basics of non-convex optimization with

applications to machine learning. It introduces the rich literature in this area, as well as equips the reader with the tools and techniques needed to apply and analyze simple but powerful procedures for non-convex problems.

Non-convex Optimization for Machine Learning is as self-contained as possible while not losing focus of the main topic of non-convex optimization techniques. The monograph initiates the discussion with entire chapters devoted to

presenting a tutorial-like treatment of basic concepts in convex analysis and optimization, as well as their non-convex counterparts. The monograph concludes with a look at four interesting

applications in the areas of machine learning and signal processing, and exploring how the non-convex optimization techniques introduced earlier can be used to solve these problems. The monograph also

contains, for each of the topics discussed, exercises and figures designed to engage the reader, as well as extensive bibliographic notes pointing towards classical works and recent advances. Non-convex Optimization for

Machine Learning can be used for a semester-length course on the basics of non-convex optimization with applications to machine learning. On the other hand, it is also possible to cherry pick individual portions, such the chapter on

sparse recovery, or the EM algorithm, for inclusion in a broader course. Several courses such as those in machine learning, optimization, and signal processing may benefit from the inclusion of such topics. Recent Advances in

Industrial and Applied Mathematics
Recent Advances in Learning and Control
Recent Advances in Robust Control
Recent Advances in Optimization and its Applications in Engineering
4th International

Conference, LOD 2018, Volterra, Italy, September 13-16, 2018, Revised Selected Papers

The three volume set LNAI 9284, 9285, and 9286 constitutes the refereed proceedings of the European

Conference on Machine Learning and Knowledge Discovery in Databases, ECML PKDD 2015, held in Porto, Portugal, in September 2015. The 131 papers presented in these proceedings were carefully reviewed and selected from a

total of 483 submissions. These include 89 research papers, 11 industrial papers, 14 nectar papers, 17 demo papers. They were organized in topical sections named: classification, regression and supervised learning; clustering and

unsupervised learning; data preprocessing; data streams and online learning; deep learning; distance and metric learning; large scale learning and big data; matrix and tensor analysis; pattern and sequence mining; preference learning

and label ranking; probabilistic, statistical, and graphical approaches; rich data; and social and graphs. Part III is structured in industrial track, nectar track, and demo track. Developments in deep learning in the

past decade have led to phenomenal growth in AI-based automated medical diagnosis, opening a door to a new era of both medical research and medical industry. It is a golden age for researchers involved in the development and

application of advanced machine learning techniques for medical and clinical problems. This book captures the most recent important advances in this cross-disciplinary topic and brings the latest advances to a wide audience including

experts, researchers, students, industry developers and medical services. This book presents recent theoretical and practical aspects in the field of optimization and convex analysis. The topics covered in this volume

include: - Equilibrium models in economics. - Control theory and semi-infinite programming. - Ill-posed variational problems. - Global optimization. - Variational methods in image restoration. - Nonsmooth optimization. -

Duality theory in convex and nonconvex optimization. - Methods for large scale problems. This book explains the application of recent advances in computational intelligence – algorithms, design methodologies, and

synthesis techniques – to the design of integrated circuits and systems. It highlights new biasing and sizing approaches and optimization techniques and their application to the design of high-performance digital,

VLSI, radio-frequency, and mixed-signal circuits and systems. This first of two related volumes addresses the design of analog and mixed-signal (AMS) and radio-frequency (RF) circuits, with 17 chapters grouped into parts on analog

and mixed-signal applications, and radio-frequency design. It will be of interest to practitioners and researchers in computer science and electronics engineering engaged with the design of electronic circuits.

Analysis, Algorithms, and Engineering Applications Computational Intelligence in Analog and Mixed-Signal (AMS) and Radio-Frequency (RF) Circuit Design Recent Advances in Sustainable Process Design and

Optimization Proceedings of the 8th French-German Conference on Optimization Trier, July 21–26, 1996 Convex Optimization 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 optimization to present their recent discoveries, and to interact with people working on complementary aspects of mathematical programming. Optimality Conditions in

Convex Optimization explores an important and central issue in the field of convex optimization: optimality conditions. It brings together the most important and recent results in this area that

have been scattered in the literature—notably in the area of convex analysis—essential in developing many of the important results in this book, and not usually found in conventional texts. Unlike other

books on convex optimization, which usually discuss algorithms along with some basic theory, the sole focus of this book is on fundamental and advanced convex optimization theory. Although many results

presented in the book can also be proved in infinite dimensions, the authors focus on finite dimensions to allow for much deeper results and a better understanding of the structures involved in a convex

optimization problem. They address semi-infinite optimization problems; approximate solution concepts of convex optimization problems; and some classes of non-convex

problems which can be studied using the tools of convex analysis. They include examples wherever needed, provide details of major results, and discuss proofs of the main results. This book reviews recent advances in

the emerging field of computational network biology with special emphasis on comparative network analysis and network module detection. The chapters in this volume are contributed by leading

international researchers in computational network biology and offer in-depth insight on the latest techniques in network alignment, network clustering, and network module detection. Chapters discuss

the advantages of the respective techniques and present the current challenges and open problems in the field. Recent Advances in Biological Network Analysis: Comparative Network Analysis and Network

Module Detection will serve as a great resource for graduate students, academics, and researchers who are currently working in areas relevant to computational network biology or wish to learn more about the field.

Data scientists whose work involves the analysis of graphs, networks, and other types of data with topological structure or relations can also benefit from the book's insights. There has been much recent

progress in global optimization algorithms for nonconvex continuous and discrete problems from both a theoretical and a practical perspective. Convex analysis plays a fundamental role

in the analysis and development of global optimization algorithms. This is due to the fact that virtually all nonconvex optimization problems can be described using differences of convex functions and differences of

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refereed papers based on invited and contributing talks presented at the conference. The two themes of convexity and global optimization pervade the book. The conference provided a forum for researchers working on

different aspects of convexity and global optimization to present their recent discoveries, and to interact with people working on complementary aspects of mathematical programming. Audience: Faculty,

graduate students, and researchers in mathematical programming, computer science, and engineering.

A Finite-Dimensional View

Recent Advances in Optimization

Recent Advances and Controversies

in Gamma Knife Neurosurgery Recent Advances in Vector Optimization and Set-valued Analysis Via Convex Duality Convex optimization is widely used, in many

fields, but is nearly always constrained to problems solved in a few minutes or seconds, and even then, nearly always with a human in the loop. The advent of

parser-solvers has made convex optimization simpler and more accessible, and greatly increased the number of people using convex

optimization. Most current applications, however, are for the design of systems or analysis of data. It is possible to use convex optimization for real-time

or embedded applications, where the optimization solver is a part of a larger system. Here, the optimization algorithm must find solutions much faster

than a generic solver, and often has a hard, real-time deadline. Use in embedded applications additionally means that the solver cannot fail, and must

be robust even in the presence of relatively poor quality data. For ease of embedding, the solver should be simple, and have minimal dependencies

on external libraries. Convex optimization has been successfully applied in such settings in the past. However, they have usually necessitated a

custom, hand-written solver. This requires signficant time and expertise, and has been a major factor preventing the adoption of convex

optimization in embedded applications. This work describes the implementation and use of a prototype code generator for convex optimization, CVXGEN, that

creates high-speed solvers automatically. Using the principles of disciplined convex programming, CVXGEN allows the user to describe an optimization

problem in a convenient, high-level language, then receive code for compilation into an extremely fast, robust, embeddable solver.

This volume is composed of invited papers on learning and control. The contents form the proceedings of a workshop held in January 2008, in Hyderabad

that honored the 60th birthday of Doctor Mathukumalli Vidyasagar. The 14 papers, written by international specialists in the field, cover a

variety of interests within the broader field of learning and control. The diversity of the research provides a comprehensive overview of a

field of great interest to control and system theorists. Robust control has been a topic of active research in the last three decades

culminating in H_2/H_\infty and \mu design methods followed by research on parametric robustness, initially motivated by Kharitonov's theorem, the

extension to non-linear time delay systems, and other more recent methods. The two volumes of Recent Advances in Robust Control give a

selective overview of recent theoretical developments and present selected application examples. The volumes comprise 39 contributions

covering various theoretical aspects as well as different application areas. The first volume covers selected problems in

the theory of robust control and its application to robotic and el ectromechanica l systems. The second volume is dedicated to special topics in robust control

and problem specific solutions. Recent Advances in Robust Control will be a valuable reference for those interested in the recent

theoretical advances and for researchers working in the broad field of robotics and mechatronics. This book investigates several duality

approaches for vector optimization problems, while also comparing them. Special attention is paid to duality for linear vector optimization

problems, for which a vector dual that avoids the shortcomings of the classical ones is proposed. Moreover, the book addresses different efficiency

concepts for vector optimization problems. Among the problems that appear when the framework is generalized by considering set-valued functions, an

increasing interest is generated by those involving monotone operators, especially now that new methods for approaching them by means

of convex analysis have been developed. Following this path, the book provides several results on different properties of sums of

monotone operators. Convex Optimization & Euclidean Distance Geometry Comparative Network Analysis and Network Module Detection

Theory and Applications in Robotics and Electromechanics Convex Optimization in Signal Processing and Communications Proceedings of an

International Conference on Vector Optimization Held at the Technical University of Darmstadt, FRG, August 4–7, 1986

Convex Analysis is the calculus of

inequalities while Convex Optimization is its application. Analysis is inherently the domain of the mathematician while Optimization belongs to the engineer. In laymanâ€™s terms,

the mathematical science of Optimization is the study of how to make a good choice when confronted with conflicting requirements. The qualifier Convex means: when an optimal solution is found, then it is

guaranteed to be a best solution; there is no better choice. Any Convex Optimization problem has geometric interpretation. Conversely, recent advances in geometry and in graph theory hold

Convex Optimization within their proofsâ€™ core. This book is about Convex Optimization, convex geometry (with particular attention to distance geometry), and nonconvex,

combinatorial, and geometrical problems that can be relaxed or transformed into convex problems. A virtual flood of new applications follows by epiphany that many problems, presumed nonconvex, can be

so transformed. International Edition III This proceedings book gathers papers presented at the 4th International Conference on Advanced Engineering Theory and

Applications 2017 (AETA 2017), held on 7–9 December 2017 at Ton Duc Thang University, Ho Chi Minh City, Vietnam. It presents selected papers on 13 topical areas, including robotics, control systems, tel

ecommunications, computer science and more. All selected papers represent interesting ideas and collectively provide a state-of-the-art overview. Readers will find intriguing papers on the design and

implementation of control algorithms for aerial and underwater robots, for mechanical systems, efficient protocols for vehicular ad hoc networks, motor control, image and signal processing, energy saving,

optimization methods in various fields of electrical engineering, and others. The book also offers a valuable resource for practitioners who want to apply the content discussed to solve real-life problems

in their challenging applications. It also addresses common and related subjects in modern electric, electronic and related technologies. As such, it will benefit all scientists and engineers working in the above-

mentioned fields of application.

An accessible introduction to convex algebraic geometry and semidefinite optimization. For graduate students and researchers in mathematics and computer science.

This book constitutes the post-conference proceedings of the 4th International Conference on Machine Learning, Optimization, and Data Science, LOD 2018, held in Volterra, Italy, in September

2018.The 46 full papers presented were carefully reviewed and selected from 126 submissions. The papers cover topics in the field of machine learning, artificial intelligence, reinforcement

learning, computational optimization and data science presenting a substantial array of ideas, technologies, algorithms, methods and applications. Machine Learning, Optimization, and

Data Science
Nonlinear Optimization
Markov Random Fields for Vision and Image Processing
Optimality Conditions in Convex Optimization
Optimization
Optimization

Methods in Machine Learning: Theory and Applications

Nonsmooth optimization covers the minimization or maximization of functions which do not have the differentiability

properties required by classical methods. The field of nonsmooth optimization is significant, not only because of the existence of nondifferentiable functions arising directly in applications, but

also because several important methods for solving difficult smooth problems lead directly to the need to solve nonsmooth problems, which are either smaller in dimension or simpler in

structure.This book contains twenty five papers written by forty six authors from twenty countries in five continents. It includes papers on theory, algorithms and applications for problems with first-order

nondifferentiability (the usual sense of nonsmooth optimization) second-order nondifferentiability, nonsmooth equations, nonsmooth variational inequalities and other problems

related to nonsmooth optimization.
In vector optimization one investigates optimization problems in an abstract setting which have a not necessarily real-valued objective

function. This scientific discipline is closely related to multi-objective optimization and multi-criteria decision making. This book contains refereed contributions to the "International Conference on

Vector Optimization" held at the Technical University of Darmstadt from August 4-7, 1986. This meeting was an interdisciplinary forum devoted to new results in the theory, to applications as

well as to the solution of vector optimization problems which are relevant in practice. Because of the great variety of topics covered by the contributions, the 25 articles of this volume are

organized in different sections: Historical retrospect, mathematical theory, goal setting and decision making, engineering applications, and related topics. The papers of the

invited State-of-the-Art Tutorials given by Professors J.M. Borwein, H. Eschenauer, W. Stadler and P.L. Yu are also included.
The results presented in this book originate from the last

decade research work of the author in the ?eld of duality theory in convex optimization. The reputation of duality in the optimization theory comes mainly from the major role that it plays in

formulating necessary and suf?cient optimality conditions and, consequently, in generatingdifferent algorithmic approachesfor solving mathematical programming problems. The

investigations made in this work prove the importance of the duality theory beyond these aspects and emphasize its strong connections with different topics in convex analysis, nonlinear

analysis, functional analysis and in the theory of monotone operators. The ?rst part of the book brings to the attention of the reader the perturbation approach as a fundamental tool

for developing the so-called conjugate duality t-ory. The classical Lagrange and Fenchel duality approaches are particular instances of this general concept. More than that, the generalized interior

point regularity conditions stated in the past for the two mentioned situations turn out to be p-ticularizations of the ones given in this general setting. In our investigations, the perturbationapproa

chrepresentsthest artingpointforderivi ngnewdualityconc epts for several classes of convex optimization problems. Moreover, via this approach, generalized Morea u–Rockafellar formulae are

provided and, in connection with them, a new class of regularity conditions, called closedness-type conditions, for both stable strong duality and strong duality is introduced. By stable strong

duality we understand the situation in which strong duality still holds whenever perturbing the objective function of the primal problem with a linear continuous functional. Leading experts

provide the theoretical underpinnings of the subject plus tutorials on a wide range of applications, from automatic code generation to robust broadband beamforming. Emphasis on

cutting-edge research and formulating problems in convex form make this an ideal textbook for advanced graduate courses and a useful self-study guide. Machine Learning

and Knowledge Discovery in Databases
Recent Advances in Nonsmooth Optimization
Vector Optimization and Monotone Operators via Convex Duality
European

Conference, ECML PKDD 2015, Porto, Portugal, September 7-11, 2015, Proceedings, Part II

Non-convex Optimization for Machine Learning

Convex Optimization Algorithms and Com

plexityFoundations and Trends (R) in Machine Learning The study of Euclidean distance matrices (EDMs) fundamentally asks what can be known geometrically given onlydistance information between points in Euclidean space. Each point may represent simply

locationor, abstractly, any entity expressible as a vector in finite-dimensional Euclidean space.The answer to the question posed is that very much can be known about the points;the mathematics of this combined study of geometry and

optimization is rich and deep.Throughout we cite beacons of historical accomplishment.The application of EDMs has already proven invaluable in discerning biological molecular conformation.The emerging practice of localization in wireless sensor

networks, the global positioning system (GPS), and distance-based pattern recognitionwill certainly simplify and benefit from this theory.We study the pervasive convex Euclidean bodies and their various representations.In particular, we make convex polyhedra,

cones, and dual cones more visceral through illustration, andwe study the geometric relation of polyhedral cones to nonorthogonal bases biorthogonal expansion.We explain conversion between halfspace- and vertex-descriptions of convex cones,we

provide formulae for determining dual cones,and we show how classic alternative systems of linear inequalities or linear matrix inequalities and optimality conditions can be explained by generalized inequalities in terms of convex cones and their duals.The conic

analogue to linear independence, called conic independence, is introducedas a new tool in the study of classical cone theory; the logical next step in the progression:linear, affine, conic.Any convex optimization problem has geometric interpretation.This is

a powerful attraction: the ability to visualize geometry of an optimization problem.We provide tools to make visualization easier.The concept of faces, extreme points, and extreme directions of convex Euclidean bodiesis explained here, crucial to

understanding convex optimization.The convex cone of positive semidefinite matrices, in particular, is studied in depth.We mathematically interpret, for example,its inverse image under affine transformation, and we explainhow

higher-rank subsets of its boundary united with its interior are convex.The Chapter on "Geometry of convex functions",observes analogies between convex sets and functions:The set of all vector-valued convex functions is a closed convex

cone.Included among the examples in this chapter, we show how the real affinefunction relates to convex functions as the hyperplane relates to convex sets.Here, also, pertinent results formultidimensional convex functions are presented that are largely ignored in the

literature;tricks and tips for determining their convexityand discerning their geometry, particularly with regard to matrix calculus which remains largely unsystematizedwhen compared with the traditional practice of ordinary calculus. Consequently, we

collect some results of matrix differentiation in the appendices.The Euclidean distance matrix (EDM) is studied,its properties and relationship to both positive semidefinite and Gram matrices.We relate the EDM to the four classical axioms of the

Euclidean metric;thereby, observing the existence of an infinity of axioms of the Euclidean metric beyondthe triangle inequality. We proceed byderiving the fifth Euclidean axiom and then explain why furthering this endeavoris inefficient

because the ensuing criteria (while describing polyhedra)grow linearly in complexity and number.Some geometrical problems solvable via EDMs,EDM problems posed as convex optimization, and methods of solution arepresented;\eg, we generate a

recognizable isotonic map of the United States usingonly comparative distance information (no distance information, only distance inequalities).We offer a new proof of the classic Schoenberg criterion, that determines whether a candidate matrix is an EDM. Our

proofrelies on fundamental geometry; assuming, any EDM must correspond to a list of points contained in some polyhedron(possibly at its vertices) and vice versa.It is not widely known that the Schoenberg criterion implies nonnegativity of the

EDM entries; proved here.We characterize the eigenvalues of an EDM matrix and then devisea polyhedral cone required for determining membership of a candidate matrix(in Cayley-Menger form) to the convex cone of Euclidean distance matrices (EDM cone); \ie,a candidate

is an EDM if and only if its eigenspectrum belongs to a spectral cone for EDM^N.We will see spectral cones are not unique.In the chapter "EDM cone", we explain the geometric relationship betweenthe EDM cone, two positive semidefinite cones,

and the elliptope.We illustrate geometric requirements, in particular, for projection of a candidate matrixon a positive semidefinite cone that establish its membership to the EDM cone. The faces of the EDM cone are described,but still open is the question

whether all its faces are exposed as they are for the positive semidefinite cone.The classic Schoenberg criterion, relating EDM and positive semidefinite cones, isrevealed to be a discretized membership relation (a generalized inequality, a new

Farkas''''''-like lemma)between the EDM cone and its ordinary dual. A matrix criterion for membership to the dual EDM cone is derived thatis simpler than the Schoenberg criterion.We derive a new concise expression for the EDM cone and its

dual involvingtwo subspaces and a positive semidefinite cone."Semidefinite programming" is reviewedwith particular attention to optimality conditionsof prototypical primal and dual conic programs,their interplay, and the perturbation method

of rank reduction of optimal solutions(extant but not well-known).We show how to solve a ubiquitous platonic combinatorial optimization problem from linear algebra(the optimal Boolean solution x to Ax=b)via semidefinite program relaxation.A three-

dimensional polyhedral analogue for the positive semidefinite cone of 3X3 symmetricmatrices is introduced; a tool for visualizing in 6 dimensions.In "EDM proximity"we explore methods of solution to a few fundamental and prevalentEuclidean

distance matrix proximity problems; the problem of finding that Euclidean distance matrix closestto a given matrix in the Euclidean sense.We pay particular attention to the problem when compounded with rank minimization.We

offer a new geometrical proof of a famous result discovered by Eckart \& Young in 1936 regarding Euclideanprojection of a point on a subset of the positive semidefinite cone comprising all positive semidefinite matriceshaving rank not exceeding a

prescribed limit rho.We explain how this problem is transformed to a convex optimization for any rank rho. Recent Advances and Controversies in Gamma Knife Neurosurgery, Volume 270, the latest release in the Progress in Brain Research series,

highlights new advances in the field with this new volume presenting interesting chapters on the latest in Dosimetry, Radiobiology, Evolving Gamma Knife Technology, Imaging, Arteriovenous Malformations, Dural A-V Fistulae,

Cavernous Malformations, Vestibular Schwannoma, Other Schwannoma, Meningiomas, Pituitary Adenomas, Craniopharyngiomas, Metastases, Glioma Low Grade, Glioma High Grade, Glomus Tumors, Less Common Tumors, Orbital Indications,

Trigeminal Neuralgia, Epilepsy, Movement, Psychosurgery, and Future Trends. Provides the authority and expertise of leading contributors from an international board of authors Presents the latest release in Progress in Brain Research serials

Updated release includes the latest information on Recent Advances and Controversies in Gamma Knife Neurosurgery

We look at the integral role played by convex optimization in various machine learning problems. Over the last few

years there has been a lot of machine learning problems which have a (non)smooth convex optimization at its core. These problems generally call for fast first order iterative methods as obtaining the exact minimum is often impossible and second order methods or higher

become prohibitively expensive even on moderately sized datasets. We look at a few such optimization problems that arise in different contexts and show that a class of smoothing strategies due to Nesterov can be applied to these seemingly very

different problems to obtain theoretically faster rates of convergence than existing methods. Our experimental results validate the speed and efficacy of our methods and scale significantly well over a broad range of datasets. This thesis also explores an often

used but understudied optimization algorithm, namely the cyclic coordinate descent method, and provides a novel theoretical analysis of the first non-asymptotic convergence rates of cyclic coordinate descent under certain assumptions.

This work also sheds light on some of the recent advances in online convex optimization to minimize regret in the presence of smooth unknown functions. We also look at online learning from the point of view of stability and provide a new integral

framework which encompasses the regret analysis of all existing algorithms as specific cases of this framework. We investigate related methods of analysis and the central role played by optimization in all these seemingly different but connected domains

of machine learning research.

AETA 2017 - Recent Advances in Electrical Engineering and Related Sciences: Theory and Application

Recent Advances and Historical Development of Vector Optimization

Recent Advances and

Applications of Hybrid Simulation
Conjugate Duality in Convex Optimization
Honoring the Memory of C. Caratheodory (1873-1950)

This monograph presents the main complexity theorems in convex

optimization and their corresponding algorithms. It begins with the fundamental theory of black-box optimization and proceeds to guide the reader through recent advances in structural

optimization and stochastic optimization. The presentation of black-box optimization, strongly influenced by the seminal book by Nesterov, includes the analysis of cutting plane

methods, as well as (accelerated) gradient descent schemes. Special attention is also given to non-Euclidean settings (relevant algorithms include Frank-Wolfe, mirror descent, and dual averaging), and

discussing their relevance in machine learning. The text provides a gentle introduction to structural optimization with FISTA (to optimize a sum of a smooth and a simple non-smooth term),

saddle-point mirror prox (Nemirovski's alternative to Nesterov's smoothing), and a concise description of interior point methods. In stochastic optimization it discusses

stochastic gradient descent, mini-batches, random coordinate descent, and sublinear algorithms. It also briefly touches upon convex relaxation of combinatorial problems and the

use of randomness to round solutions, as well as random walks based methods. State-of-the-art research on MRFs, successful MRF applications, and advanced topics for future study. This

volume demonstrates the power of the Markov random field (MRF) in vision, treating the MRF both as a tool for modeling image data and, utilizing recently developed algorithms, as a means of making

inferences about images. These inferences concern underlying image and scene structure as well as solutions to such problems as image reconstruction, image segmentation, 3D

vision, and object labeling. It offers key findings and state-of-the-art research on both algorithms and applications. After an introduction to the fundamental concepts used in MRFs, the book reviews some of the main

algorithms for performing inference with MRFs; presents successful applications of MRFs, including segmentation, super-resolution, and image restoration, along with a comparison of

various optimization methods; discusses advanced algorithmic topics; addresses limitations of the strong locality assumptions in the MRFs discussed in earlier chapters;

and showcases applications that use MRFs in more complex ways, as components in bigger systems or with multiterm energy functions. The book will be an essential guide to current research on these powerful

mathematical tools.

This book provides a comprehensive, modern introduction to convex optimization, a field that is becoming increasingly important in

applied mathematics, economics and finance, engineering, and computer science, notably in data science and machine learning. Written by a leading expert in the field, this book

includes recent advances in the algorithmic theory of convex optimization, naturally complementing the existing literature. It contains a unified and rigorous presentation of the acceleration

techniques for minimization schemes of first- and second-order. It provides readers with a full treatment of the smoothing technique, which has tremendously extended the abilities of gradient-type

methods. Several powerful approaches in structural optimization, including optimization in relative scale and polynomial-time interior-point methods, are also discussed in detail.

Researchers in theoretical optimization as well as professionals working on optimization problems will find this book very useful. It presents many successful examples of how to develop very

fast specialized minimization algorithms. Based on the author’s lectures, it can naturally serve as the basis for introductory and advanced courses in convex optimization for students in engineering,

economics, computer science and mathematics. Optimization is of critical importance in engineering. Engineers constantly strive for the best possible solutions, the most economical

use of limited resources, and the greatest efficiency. As system complexity increases, these goals mandate the use of state-of-the-art optimization techniques. In recent years, the

theory and methodology of optimization have seen revolutionary improvements. Moreover, the exponential growth in computational power, along with the availability of multicore

computing with virtually unlimited memory and storage capacity, has fundamentally changed what engineers can do to optimize their designs. This is a two-way process: engineers benefit from

developments in optimization methodology, and challenging new classes of optimization problems arise from novel engineering applications. Advances and Trends in Optimization with

Engineering Applications reviews 10 major areas of optimization and related engineering applications, providing a broad summary of state-of-the-art optimization techniques most

important to engineering practice. Each part provides a clear overview of a specific area and discusses a range of real-world problems. The book provides a solid foundation for engineers and

mathematical optimizers alike who want to understand the importance of optimization methods to engineering and the capabilities of these methods. Recent Advances in AI-enabled Automated

Medical Diagnosis
Advances in Convex Analysis and Global Optimization
Semi-Infinite Programming
Honoring the Memory of C. Caratheodory (1873–1950)
Optimization for Machine Learning

Semi-infinite programming (SIP) deals with optimization problems in which either the number of decision variables or the number of constraints is finite. This book presents the state of the art in SIP in a suggestive way, bringing the powerful SIP tools close to the potential users in different scientific and

technological fields. The volume is divided into four parts. Part I reviews the first decade of SIP (1962-1972). Part II analyses convex and generalised SIP, conic linear programming, and disjunctive programming. New numerical methods for linear, convex, and continuously differentiable SIP

problems are proposed in Part III. Finally, Part IV provides an overview of the applications of SIP to probability, statistics, experimental design, robotics, optimization under uncertainty, production games, and separation problems. Audience: This book is an indispensable reference and source for advanced students and

researchers in applied mathematics and engineering.

An up-to-date account of the interplay between optimization and machine learning, accessible to students and researchers in both communities. The interplay between optimization and machine learning is one of the most important

developments in modern computational science. Optimization formulations and methods are proving to be vital in designing algorithms to extract essential knowledge from huge volumes of data. Machine learning, however, is not simply a consumer of optimization technology but a rapidly evolving

field that is itself generating new optimization ideas. This book captures the state of the art of the interaction between optimization and machine learning in a way that is accessible to researchers in both fields. Optimization approaches have enjoyed prominence in machine learning because of their wide applicability and

attractive theoretical properties. The increasing complexity, size, and variety of today's machine learning models call for the reassessment of existing assumptions. This book starts the process of reassessment. It describes the resurgence in novel contexts of established frameworks such as first-order methods,

stochastic approximations, convex relaxations, interior-point methods, and proximal methods. It also devotes attention to newer themes such as regularized optimization, robust optimization, gradient and subgradient methods, splitting techniques, and second-order methods. Many of these techniques draw

inspiration from other fields, including operations research, theoretical computer science, and subfields of optimization. The book will enrich the ongoing cross-fertilization between the machine learning community and these other fields, and within the broader optimization community.

This book covers recent advances in image processing and imaging sciences from an optimization viewpoint, especially convex optimization with the goal of designing tractable algorithms. Throughout the handbook, the authors introduce topics on the most key aspects of image acquisition and

processing that are based on the formulation and solution of novel optimization problems. The first part includes a review of the mathematical methods and foundations required, and covers topics in image quality optimization and assessment. The second part of the book discusses concepts in image

formation and capture from color imaging to radar and multispectral imaging. The third part focuses on sparsity constrained optimization in image processing and vision and includes inverse problems such as image restoration and de-noising, image classification and recognition and learning-based problems pertinent

to image understanding. Throughout, convex optimization techniques are shown to be a critically important mathematical tool for imaging science problems and applied extensively. Convex Optimization Methods in Imaging Science is the first book of its kind and will appeal to undergraduate and

graduate students, industrial researchers and engineers and those generally interested in computational aspects of modern, real-world imaging and image processing problems. This book is a compilation of the various recently developed techniques emphasizing better chemical processes and

products, with state-of-the-art contributions by world-renowned leaders in process design and optimization. It covers various areas such as grass-root design, retrofitting, continuous, batch, energy, separation, and pollution prevention, striking a balance between fundamental techniques and applications. A large

section of this book focuses on industrial applications and will serve as a good compilation of recent industrial experiences for which the process design and optimization techniques were practised. Industrial practitioners will find this book useful as a guide to practice the various techniques in their

respective plants and processes. The book is accompanied by some electronic supplements (i.e., models and programs) for selected chapters.

Semidefinite Optimization and Convex Algebraic Geometry

Algorithms and Complexity

Recent Advances

Recent Advances in Biological Network Analysis
Handbook of Convex Optimization Methods in Imaging Science