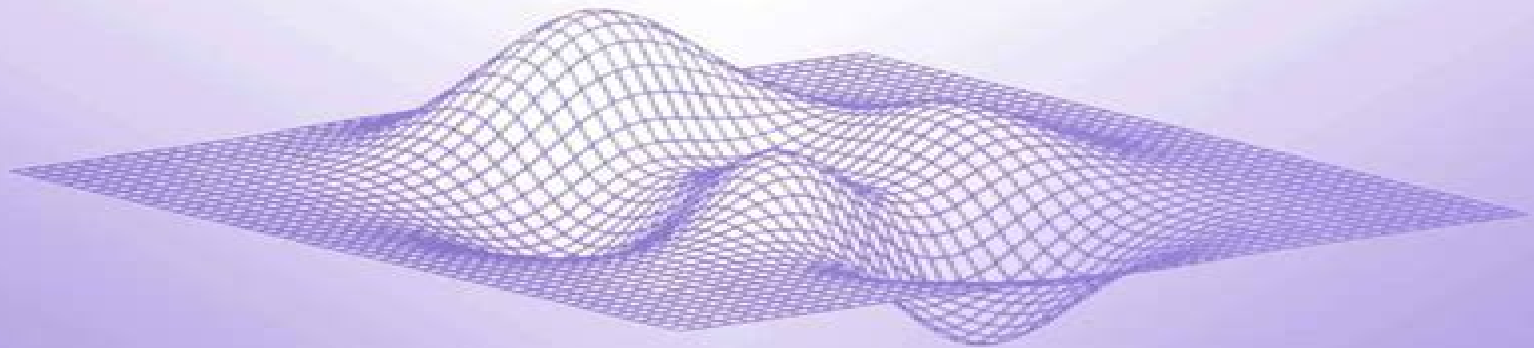


NONCONVEX OPTIMIZATION AND ITS APPLICATIONS

Nonsmooth Equations in Optimization

Regularity, Calculus, Methods and Applications

Diethard Klatte and Bernd Kummer



Kluwer Academic Publishers

Nonsmooth Equations In Optimization Nonsmooth Equations In Optimization

Fredi Tröltzsch



Nonsmooth Equations In Optimization Nonsmooth Equations In Optimization:

Nonsmooth Equations in Optimization Diethard Klatte, B. Kummer, 2002-05-31 The book establishes links between regularity and derivative concepts of nonsmooth analysis and studies of solution methods and stability for optimization complementarity and equilibrium problems In developing necessary tools it presents in particular an extended analysis of Lipschitz functions and the calculus of their generalized derivatives including regularity successive approximation and implicit functions for multivalued mappings a unified theory of Lipschitzian critical points in optimization and other variational problems with relations to reformulations by penalty barrier and NCP functions an analysis of generalized Newton methods based on linear and nonlinear approximations the interpretation of hypotheses generalized derivatives and solution methods in terms of original data and quadratic approximations a rich collection of instructive examples and exercises LIST Audience Researchers graduate students and practitioners in various fields of applied mathematics engineering OR and economics Also university teachers and advanced students who wish to get insights into problems future directions and recent developments *Reformulation: Nonsmooth, Piecewise Smooth, Semismooth and Smoothing Methods* Masao Fukushima, Liqun Qi, 2013-04-17 The concept of reformulation has long been playing an important role in mathematical programming A classical example is the penalization technique in constrained optimization that transforms the constraints into the objective function via a penalty function thereby reformulating a constrained problem as an equivalent or approximately equivalent unconstrained problem More recent trends consist of the reformulation of various mathematical programming problems including variational inequalities and complementarity problems into equivalent systems of possibly nonsmooth piecewise smooth or semismooth nonlinear equations or equivalent unconstrained optimization problems that are usually differentiable but in general not twice differentiable Because of the recent advent of various tools in nonsmooth analysis the reformulation approach has become increasingly profound and diversified In view of growing interests in this active field we planned to organize a cluster of sessions entitled Reformulation Nonsmooth Piecewise Smooth Semismooth and Smoothing Methods in the 16th International Symposium on Mathematical Programming ismp97 held at Lausanne EPFL Switzerland on August 24-29 1997 Responding to our invitation thirty eight people agreed to give a talk within the cluster which enabled us to organize thirteen sessions in total We think that it was one of the largest and most exciting clusters in the symposium Thanks to the earnest support by the speakers and the chairpersons the sessions attracted much attention of the participants and were filled with great enthusiasm of the audience *Nonsmooth Optimization Methods* F. Giannessi, 2024-12-20 Nonsmooth Optimization Methods and Applications provides an overview of this branch of mathematics concentrating on the interaction between the theory and its applications **Optimization and Nonsmooth Analysis** Frank H. Clarke, 1990-01-01 This book has appeared in Russian translation and has been praised both for its lively exposition and its fundamental contributions The author first develops a general theory of nonsmooth analysis and geometry

which together with a set of associated techniques has had a profound effect on several branches of analysis and optimization Clarke then applies these methods to obtain a powerful unified approach to the analysis of problems in optimal control and mathematical programming Examples are drawn from economics engineering mathematical physics and various branches of analysis in this reprint volume *Encyclopedia of Optimization* Christodoulos A. Floudas, Panos M. Pardalos, 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 **Optimal Control, Stabilization and Nonsmooth Analysis** Marcio S. de Queiroz, Michael Malisoff, Peter Wolenski, 2004-04-20 This edited book contains selected papers presented at the Louisiana Conference on Mathematical Control Theory MCT 03 which brought together over 35 prominent world experts in mathematical control theory and its applications The book forms a well integrated exploration of those areas of mathematical control theory in which nonsmooth analysis is having a major impact These include necessary and sufficient conditions in optimal control Lyapunov characterizations of stability input to state stability the construction of feedback mechanisms viscosity solutions of Hamilton Jacobi equations invariance approximation theory impulsive systems computational issues for nonlinear systems and other topics of interest to mathematicians and control engineers The book has a strong interdisciplinary component and was designed to facilitate the interaction between leading mathematical experts in nonsmooth analysis and engineers who are increasingly using nonsmooth analytic tools **Optimization and Control for Partial Differential Equations** Roland Herzog, Matthias Heinkenschloss, Dante Kalise, Georg Stadler, Emmanuel Trélat, 2022-03-07 This book highlights new developments in the wide and growing field of partial differential equations PDE constrained optimization Optimization problems where the dynamics evolve according to a system of PDEs arise in science engineering and economic applications and they can take the form of inverse problems optimal control problems or optimal design problems This book covers new theoretical computational as well as implementation aspects for PDE constrained optimization problems under uncertainty in shape optimization and in feedback control and it illustrates the new developments on representative problems from a variety of applications **Nonsmooth Analysis and Geometric Methods in Deterministic Optimal Control** Boris S. Mordukhovich, Hector J. Sussmann, 2012-12-06 This IMA Volume in Mathematics and its Applications NONSMOOTH ANALYSIS AND GEOMETRIC METHODS IN DETERMINISTIC OPTIMAL CONTROL is based on the proceedings of a workshop that was an integral part of the 1992 93 IMA program on Control Theory The purpose of this workshop was to concentrate on powerful mathematical techniques that have been developed in deterministic optimal control theory after the

basic foundations of the theory existence theorems maximum principle dynamic programming sufficiency theorems for sufficiently smooth fields of extremals were laid out in the 1960s These advanced techniques make it possible to derive much more detailed information about the structure of solutions than could be obtained in the past and they support new algorithmic approaches to the calculation of such solutions We thank Boris S Mordukhovich and Hector J Sussmann for organizing the workshop and editing the proceedings We also take this opportunity to thank the National Science Foundation and the Army Research Office whose financial support made the workshop possible Avner Friedman Willard Miller Jr

PREFACE This volume contains the proceedings of the workshop on Nonsmooth Analysis and Geometric Methods in Deterministic Optimal Control held at the Institute for Mathematics and its Applications on February 8-17, 1993 during a special year devoted to Control Theory and its Applications The workshop whose organizing committee consisted of V Jurdjevic, B S Mordukhovich, R T Rockafellar and H J

Recent Advances In Nonsmooth Optimization Ding-zhu Du, Frank Kwang-ming Hwang, Li-qun Qi, Robert S Womersley, 1995-09-20 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

Nonsmooth Optimization: Analysis And Algorithms With Applications To Optimal Control Marko M Makela, Pekka Neittaanmaki, 1992-05-07 This book is a self-contained elementary study for nonsmooth analysis and optimization and their use in solution of nonsmooth optimal control problems The first part of the book is concerned with nonsmooth differential calculus containing necessary tools for nonsmooth optimization The second part is devoted to the methods of nonsmooth optimization and their development A proximal bundle method for nonsmooth nonconvex optimization subject to nonsmooth constraints is constructed In the last part nonsmooth optimization is applied to problems arising from optimal control of systems covered by partial differential equations Several practical problems like process control and optimal shape design problems are considered

Optimale Steuerung partieller Differentialgleichungen Fredi Tröltzsch, 2010-02-21 Die mathematische Theorie der optimalen Steuerung hat sich im Zusammenhang mit Berechnungen für die Luft- und Raumfahrt schnell zu einem wichtigen und eigenständigen Gebiet der angewandten Mathematik entwickelt Die optimale Steuerung durch partielle Differentialgleichungen modellierter Prozesse wird eine numerische Herausforderung der Zukunft sein Im Buch werden entsprechende Grundlagen mit langsam steigendem Schwierigkeitsgrad entwickelt Es enthält

viele Beispiele und eignet sich als Grundlage für Vorlesungen und Seminare Der Text wurde für die 2. Auflage grundlegend bearbeitet Die Darstellung der numerischen Methoden orientiert sich stärker an den konkret zu rechnenden Systemen Neueste Ergebnisse zur maximalen Regularität parabolischer Differentialgleichungen sind eingearbeitet Lösungshinweise zu den Übungsaufgaben findet der Studierende nun im OnlinePLUS Service des Verlages

Numerische Verfahren der konvexen, nichtglatten Optimierung Walter Alt, 2013-03-12 Konvexe Optimierungsprobleme mit einer nichtglatten Zielfunktion treten in vielen Anwendungen auf beispielsweise im Zusammenhang mit Penalty Verfahren für differenzierbare Optimierungsprobleme mit der Lagrange Relaxation bei kombinatorischen Optimierungsproblemen oder bei der Strukturoptimierung von Stabwerken Die wichtigsten numerischen Verfahren zur Lösung solcher Optimierungsprobleme sind Subgradienten und Bundle Verfahren Das Buch gibt eine kompakte Einführung in die Grundlagen dieser Verfahren die den Leser in die Lage versetzt einfache Versionen der Verfahren selbst zu implementieren

Generalized Newton-type Methods for Nonsmooth Equations in Optimization and Complementarity Problems Stephan Bütikofer, 2008

Nonsmooth Approach to Optimization Problems with Equilibrium Constraints Jiri Outrata, M. Kocvara, J. Zowe, 2013-06-29 In the early fifties applied mathematicians engineers and economists started to pay close attention to the optimization problems in which another lower level optimization problem arises as a side constraint One of the motivating factors was the concept of the Stackelberg solution in game theory together with its economic applications Other problems have been encountered in the seventies in natural sciences and engineering Many of them are of practical importance and have been extensively studied mainly from the theoretical point of view Later applications to mechanics and network design have led to an extension of the problem formulation Constraints in form of variational inequalities and complementarity problems were also admitted The term generalized bilevel programming problems was used at first but later probably in Harker and Pang 1988 a different terminology was introduced Mathematical programs with equilibrium constraints or simply MPECs In this book we adhere to MPEC terminology A large number of papers deals with MPECs but to our knowledge there is only one monograph Luo et al 1997 This monograph concentrates on optimality conditions and numerical methods Our book is oriented similarly but we focus on those MPECs which can be treated by the implicit programming approach the equilibrium constraint locally defines a certain implicit function and allows to convert the problem into a mathematical program with a nonsmooth objective

Methods of Dynamic and Nonsmooth Optimization Frank H. Clarke, 1989-01-01 Presents the elements of a unified approach to optimization based on nonsmooth analysis a term introduced in the 1970s by the author who is a pioneer in the field Based on a series of lectures given at a conference at Emory University in 1986 this volume presents its subjects in a self contained and accessible manner The topics treated here have been in an active state of development and this work therefore incorporates more recent results than those presented in 1986 Focuses mainly on deterministic optimal control the calculus of variations and mathematical programming In addition it features a tutorial in

nonsmooth analysis and geometry and demonstrates that the method of value function analysis via proximal normals is a powerful tool in the study of necessary conditions sufficient conditions controllability and sensitivity analysis The distinction between inductive and deductive methods the use of Hamiltonians the verification technique and penalization are also emphasized

Handbook of Global Optimization R. Horst, Panos M. Pardalos, 2013-12-11 Global optimization is concerned with the computation and characterization of global optima of nonlinear functions During the past three decades the field of global optimization has been growing at a rapid pace and the number of publications on all aspects of global optimization has been increasing steadily Many applications as well as new theoretical algorithmic and computational contributions have resulted The Handbook of Global Optimization is the first comprehensive book to cover recent developments in global optimization Each contribution in the Handbook is essentially expository in nature but scholarly in its treatment The chapters cover optimality conditions complexity results concave minimization DC programming general quadratic programming nonlinear complementarity minimax problems multiplicative programming Lipschitz optimization fractional programming network problems trajectory methods homotopy methods interval methods and stochastic approaches The Handbook of Global Optimization is addressed to researchers in mathematical programming as well as all scientists who use optimization methods to model and solve problems

Second-Order Variational Analysis in Optimization, Variational Stability, and Control Boris S. Mordukhovich, 2024-05-21 This fundamental work is a sequel to monographs by the same author Variational Analysis and Applications 2018 and the two Grundlehren volumes Variational Analysis and Generalized Differentiation I Basic Theory II Applications 2006 This present book is the first entirely devoted to second order variational analysis with numerical algorithms and applications to practical models It covers a wide range of topics including theoretical numerical and implementations that will interest researchers in analysis applied mathematics mathematical economics engineering and optimization Inclusion of a variety of exercises and commentaries in each chapter allows the book to be used effectively in a course on this subject This area has been well recognized as an important and rapidly developing area of nonlinear analysis and optimization with numerous applications Consisting of 9 interrelated chapters the book is self contained with the inclusion of some preliminaries in Chapter 1 Results presented are useful tools for characterizations of fundamental notions of variational stability of solutions for diverse classes of problems in optimization and optimal control the study of variational convexity of extended real valued functions and their specifications and variational sufficiency in optimization Explicit calculations and important applications of second order subdifferentials associated with the achieved characterizations of variational stability and related concepts to the design and justification of second order numerical algorithms for solving various classes of optimization problems nonsmooth equations and subgradient systems are included Generalized Newtonian algorithms are presented that show local and global convergence with linear superlinear and quadratic convergence rates Algorithms are implemented to address interesting practical

problems from the fields of machine learning statistics imaging and other areas

Progress in Optimization Andrew Eberhard, Robin Hill, Daniel Ralph, Barney M. Glover, 2013-12-01 Although the monograph Progress in Optimization I Contributions from Australasia grew from the idea of publishing a proceedings of the Fourth Optimization Day held in July 1997 at the Royal Melbourne Institute of Technology the focus soon changed to a refereed volume in optimization The intention is to publish a similar book annually following each Optimization Day The idea of having an annual Optimization Day was conceived by Barney Glover the first of these Optimization Days was held in 1994 at the University of Ballarat Barney hoped that such a yearly event would bring together the many but widely dispersed researchers in Australia who were publishing in optimization and related areas such as control The first Optimization Day event was followed by similar conferences at The University of New South Wales 1995 The University of Melbourne 1996 the Royal Melbourne Institute of Technology 1997 and The University of Western Australia 1998 The 1999 conference will return to Ballarat University being organized by Barney's long time collaborator Alex Rubinov In recent years the Optimization Day has been held in conjunction with other locally held national or international conferences This has widened the scope of the monograph with contributions not only coming from researchers in Australia and neighboring regions but also from their collaborators in Europe and North America

An Introduction to Nonlinear Optimization Theory Marius Durea, Radu Strugariu, 2014-01-01 The goal of this book is to present the main ideas and techniques in the field of continuous smooth and nonsmooth optimization Starting with the case of differentiable data and the classical results on constrained optimization problems and continuing with the topic of nonsmooth objects involved in optimization theory the book concentrates on both theoretical and practical aspects of this field This book prepares those who are engaged in research by giving repeated insights into ideas that are subsequently dealt with and illustrated in detail

System Modelling and Optimization J. Dolezal, Jiri Fidler, 2013-06-05 Proceedings volume contains carefully selected papers presented during the 17th IFIP Conference on System Modelling and Optimization Optimization theory and practice optimal control system modelling stochastic optimization and technical and non technical applications of the existing theory are among areas mostly addressed in the included papers Main directions are treated in addition to several survey papers based on invited presentations of leading specialists in the respective fields Publication provides state of the art in the area of system theory and optimization and points out several new areas e.g. fuzzy set neural nets where classical optimization topics intersects with computer science methodology

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