

MINIMIZATION OF NONDIFFERENTIABLE FUNCTIONS IN THE PRESENCE OF NOISE

E. A. Nurminskii

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The development of methods of minimization of nondifferentiable functions is of great interest for the solution of many problems such as minimax problems, two-stage mathematical-programming problems, etc. From the point of view of practical application it is of considerable interest to ascertain the performance of these methods in the presence of noise. The principal result of this paper consists in the fact that the specific character of nondifferentiable functions makes it possible in certain cases to get rid of the conventional conditions of stochastic approximation used for the suppression of random noise.

We shall consider nonconvex nondifferentiable functions whose properties are defined as follows [1, 2].

Definition. A continuous function $f(x)$ is said to be weakly convex if for any x there exists a set $M(x)$ of vectors g such that for any y ,

$$f(y) - f(x) \geq (g, y - x) + r(x, y) \quad (1)$$

where for $y \rightarrow x$ we have $r(x, y)/|x - y|^{-1} \rightarrow 0$ uniformly in x in any closed bounded subset of E_n .

In [1], the vector g is called the quasigradient of a weakly convex function.

For solving the problem

$$\min_{x \in E_n} f(x) \quad (2)$$

we have proposed in [2] the quasigradient method

$$x^{s+1} = x^s - \rho_s g(x^s), \quad s = 0, 1, \dots$$

and we proved its convergence under appropriate assumptions. In the present paper we shall ascertain the conditions of convergence of the algorithm

$$x^{s+1}(\omega) = x^s(\omega) - \rho_s \xi^s(x^s, \omega),$$

where

$$\xi^s(x^s, \omega) = g(x^s(\omega)) + \eta^s(\omega),$$

$\eta^s(\omega)$ being independent uniformly distributed random disturbances, $E|\eta^s|^2 < \infty$. In the following we shall sharpen the requirements towards $\eta^s(\omega)$. We shall assume that problem (2) has the following property: If we denote by X^* the set $\{x^*: 0 \in M(x^*)\}$, then there exists a positive δ such that for any $x \in X^*$ we have $g \geq \delta$, where $g \in M(x)$.

This property is not very rigorous, and it holds for practically all linear minimax problems, i.e., for problems of form (2) in which $f(x) = \max_{c \in C} (c, x)$.

We have the following theorem.

THEOREM. Let $E|\eta^s| \leq \gamma$, where γ is sufficiently small,

$$E\rho_s = \infty, \quad \rho_s/\rho_{s+1} \rightarrow 1, \quad \rho_s \rightarrow +0,$$

$f(x)$ assumes on X^* not more than a countable number of values, and the set $\{f(x) \leq f(x^*) + C\}$ is bounded for a positive C . Then the algorithm

$$x^{s+1}(\omega) = \begin{cases} x^s(\omega) - \rho_s \xi^s(x^s, \omega), & f(x^s) \leq f(x^*) + C, \\ x^s & \text{otherwise} \end{cases}$$

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Minimization Methods For Nondifferentiable Functions

N Noddings



Minimization Methods For Nondifferentiable Functions:

Minimization Methods for Non-Differentiable Functions N.Z. Shor, 2012-12-06 In recent years much attention has been given to the development of automatic systems of planning design and control in various branches of the national economy Quality of decisions is an issue which has come to the forefront increasing the significance of optimization algorithms in mathematical software packages for automatic systems of various levels and purposes Methods for minimizing functions with discontinuous gradients are gaining in importance and the experts in the computational methods of mathematical programming tend to agree that progress in the development of algorithms for minimizing nonsmooth functions is the key to the construction of efficient techniques for solving large scale problems This monograph summarizes to a certain extent fifteen years of the author's work on developing generalized gradient methods for nonsmooth minimization This work started in the department of economic cybernetics of the Institute of Cybernetics of the Ukrainian Academy of Sciences under the supervision of V S Mikhalevich a member of the Ukrainian Academy of Sciences in connection with the need for solutions to important practical problems of optimal planning and design In Chap I we describe basic classes of nonsmooth functions that are differentiable almost everywhere and analyze various ways of defining generalized gradient sets In Chap 2 we study in detail various versions of the subgradient method show their relation to the methods of Fejer type approximations and briefly present the fundamentals of the subgradient methods

Minimization Methods for Non-Differentiable Functions

N. Z. Shor, K. C. Kiwiel, A. Ruszczyński, 1984-12-01 Nondifferentiable Optimization and Polynomial Problems N.Z. Shor, 2013-04-17 Polynomial extremal problems PEP constitute one of the most important subclasses of nonlinear programming models Their distinctive feature is that an objective function and constraints can be expressed by polynomial functions in one or several variables Let $e \in \mathbb{R}^n$ be the vector in n dimensional real linear space \mathbb{R}^n $P_0 \in \mathbb{R}^m$ $P_1 \in \mathbb{R}^m$ are polynomial functions in \mathbb{R}^n with real coefficients In general a PEP can be formulated in the following form $0 \leq x \leq 1$ find x subject to constraints $0 \leq P_i(x) \leq 1$ $i = 1, \dots, m$ a constraint in the form of inequality can be written in the form of equality by introducing a new variable for example $P(x) \leq 0$ is equivalent to $P(x) + y^2 = 0$ Boolean and mixed polynomial problems can be written in usual form by adding for each boolean variable z the equality $z^2 = z$ Let $a = (a_1, \dots, a_n)$ be integer vector with nonnegative entries $a_i \in \mathbb{N}$ Denote by R a monomial in n variables of the form $R = x_1^{a_1} \dots x_n^{a_n}$ $\deg R = \sum_{i=1}^n a_i$ is the total degree of monomial R Each polynomial in n variables can be written as sum of monomials with nonzero coefficients $P \in \mathbb{R}[x]$ $P = \sum_{R \in A} c_R R$ Nondifferentiable optimization and polynomial problems where $A \subseteq \mathbb{R}[x]$ is the set of monomials contained in polynomial P

Computational Methods in Science and Engineering George Maroulis, Theodore E. Simos, 2009-09-02 The aim of ICCMSE 2008 is to bring together computational scientists and engineers from several disciplines in order to share methods methodologies and ideas The potential readers are all the scientists with interest in Computational Mathematics Theoretical Physics Computational Physics Theoretical Chemistry Computational Chemistry Mathematical Chemistry Computational

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Numerical Techniques for Stochastic Optimization И.У.риі Mikhaïlovich Ermol'ev,Roger J.-B. Wets,1988 **From Convexity to Nonconvexity** R.P. Gilbert,Panagiotis D. Panagiotopoulos,Panos M. Pardalos,2001-09-30 The book contains a collection of invited papers dedicated to the memory of two great mathematicians Gaetano Fichera and Panagiotopoulos The theme of the collection is centered around the seminal research of G Fichera on the Signorini problem hemivariational inequalities pioneered by Panagiotopoulos nonsmooth global optimization and regularity results for

variational inequalities Audience The book is addressed to faculty graduate students and researchers in mathematical programming and engineering Dynamic Modelling and Control of National Economies, 1989 Nicos M. Christodoulakis,1990 The Symposium aimed at analysing and solving the various problems of representation and analysis of decision making in economic systems starting from the level of the individual firm and ending up with the complexities of international policy coordination The papers are grouped into subject areas such as game theory control methods international policy coordination and the applications of artificial intelligence and experts systems as a framework in economic modelling and control The Symposium therefore provides a wide range of important information for those involved or interested in the planning of company and national economics *Mathematical Reviews* ,2003 **Vestnik** Leningrad (R.S.F.S.R.). Universitet,1983 **A M. Kir. Ferencz Jozsef-Tudományegyetem tudományos közleményei. Matematikai tudományok** József Attila Tudományegyetem,1986 **Iterative Methods for Solving Linear Complementarity and Linear Programming Problems** Yun-Chian Cheng,1981

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Table of Contents Minimization Methods For Nondifferentiable Functions

1. Understanding the eBook Minimization Methods For Nondifferentiable Functions
 - The Rise of Digital Reading Minimization Methods For Nondifferentiable Functions
 - Advantages of eBooks Over Traditional Books
2. Identifying Minimization Methods For Nondifferentiable Functions
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Minimization Methods For Nondifferentiable Functions
 - User-Friendly Interface
4. Exploring eBook Recommendations from Minimization Methods For Nondifferentiable Functions
 - Personalized Recommendations
 - Minimization Methods For Nondifferentiable Functions User Reviews and Ratings
 - Minimization Methods For Nondifferentiable Functions and Bestseller Lists
5. Accessing Minimization Methods For Nondifferentiable Functions Free and Paid eBooks
 - Minimization Methods For Nondifferentiable Functions Public Domain eBooks
 - Minimization Methods For Nondifferentiable Functions eBook Subscription Services
 - Minimization Methods For Nondifferentiable Functions Budget-Friendly Options

6. Navigating Minimization Methods For Nondifferentiable Functions eBook Formats
 - ePub, PDF, MOBI, and More
 - Minimization Methods For Nondifferentiable Functions Compatibility with Devices
 - Minimization Methods For Nondifferentiable Functions Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Minimization Methods For Nondifferentiable Functions
 - Highlighting and Note-Taking Minimization Methods For Nondifferentiable Functions
 - Interactive Elements Minimization Methods For Nondifferentiable Functions
8. Staying Engaged with Minimization Methods For Nondifferentiable Functions
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Minimization Methods For Nondifferentiable Functions
9. Balancing eBooks and Physical Books Minimization Methods For Nondifferentiable Functions
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Minimization Methods For Nondifferentiable Functions
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Minimization Methods For Nondifferentiable Functions
 - Setting Reading Goals Minimization Methods For Nondifferentiable Functions
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Minimization Methods For Nondifferentiable Functions
 - Fact-Checking eBook Content of Minimization Methods For Nondifferentiable Functions
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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