

MINIMIZATION OF NONDIFFERENTIABLE FUNCTIONS IN THE PRESENCE OF NOISE

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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

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

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

$$x^{i+1}(\omega) = x^i(\omega) - \rho_i \xi^i(x^i, \omega),$$

where

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

$\eta^i(\omega)$ being independent uniformly distributed random disturbances, $E|\eta^i|^2 < \infty$. In the following we shall sharpen the requirements towards $\eta^i(\omega)$. 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 $E|\eta^i| \leq \gamma$, where γ is sufficiently small,

$$E\rho_i = \infty, \quad \rho_i/\rho_{i+1} \rightarrow 1, \quad \rho_i \rightarrow +0,$$

$f(x)$ 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

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

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Minimization Methods For Nondifferentiable Functions

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The book delves into Minimization Methods For Nondifferentiable Functions. Minimization Methods For Nondifferentiable Functions is an essential topic that must be grasped by everyone, ranging from students and scholars to the general public. This book will furnish comprehensive and in-depth insights into Minimization Methods For Nondifferentiable Functions, encompassing both the fundamentals and more intricate discussions.

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