RECENT DEVELOPMENTS IN LIPSCHITZ GLOBAL OPTIMIZATION[1]

Ya.D. Sergeyev

University of Calabria, Rende (Italy)
N.I.Lobachevsky State University of Nizhni Novgorod (Russia)
e-mail: yaro@si.dimes.unical.it

In this lecture, the global optimization problem of a multidimensional function satisfying the Lipschitz condition over a hyperinterval with an unknown Lipschitz constant is considered. It is supposed that the objective function can be "black box", multiextremal, and non-differentiable. It is also assumed that evaluation of the objective function at a point is a time-consuming operation. Many algorithms for solving this problem have been discussed in literature (see [1–8] and references given therein). They can be distinguished, for example, by the way of obtaining information about the Lipschitz constant and by the strategy of exploration of the search domain. Different exploration techniques based on various adaptive partition strategies are analyzed.

The main attention is dedicated to two types of algorithms: (i) methods using space-filling curves to reduce the dimensionality of the global optimization problem; (ii) diagonal global optimization algorithms. Both classes of methods have a number of attractive theoretical properties and have proved to be efficient in solving applied problems. Several families of deterministic derivative-free numerical algorithms are discussed. A number of unconventional ideas, such as adaptive strategies for estimating Lipschitz constant, balancing global and local information to accelerate the search, etc. are presented. Results of extensive numerical experiments performed on the GKLS-generator (see [1]) demonstrate advantages of the proposed methods with respect to a number of traditional algorithms.

REFERENCES

1. M. Gaviano, D.E. Kvasov, D. Lera, and Ya.D. Sergeyev, *Algorithm 829: Software for generation of classes of test functions with known local and global minima for global optimization* — ACM Transactions on Mathematical Software, vol. 29(4), 2003, pp. 469-480.
2. D.E. Kvasov and Ya.D. Sergeyev, *Lipschitz gradients for global optimization in a one-point-based partitioning scheme* — Journal of Computational and Applied Mathematics, vol. 236(16), 2012, pp. 4042-4054.
3. D. Lera and Ya.D. Sergeyev, *Acceleration of univariate global optimization algorithms working with Lipschitz functions and Lipschitz first derivatives* — SIAM Journal on Optimization, vol. 23(1), 2013, pp. 508-529.
4. R. Paulavičius and J. Žilinskas, *Simplicial Global Optimization* — Springer, New York, 2014.
5. Ya.D. Sergeyev and D.E. Kvasov, *Diagonal Global Optimization Methods* — FizMatLit, Moscow, 2008. In Russian.
6. Ya.D. Sergeyev, R.G. Strongin, and D. Lera, *Introduction to Global Optimization Exploiting Space-Filling Curves* — Springer, New York, 2013.
7. R.G. Strongin, *Numerical Methods in Multi-Extremal Problems (Information-Statistical Algorithms)* — Nauka, Moscow, 1978. In Russian.
8. R.G. Strongin and Ya.D. Sergeyev, *Global Optimization with Non-Convex Constraints: Sequential and Parallel Algorithms* — Kluwer, Dordrecht, 2000.

[1]This research was partially supported by the INdAM–GNCS 2014 Research Project of the Italian National Group for Scientific Computation of the National Institute for Advanced Mathematics "F. Severi".