Foreword: special issue on nonsmooth optimization and applications

**Boris Mordukhovich · Arkadi Nemirovski ·
Yurii Nesterov**

This issue of Mathematical Programming is dedicated to the life and achievements of B.T. Polyak on the occasion of his 70th birthday.

Boris Polyak was born in Moscow (Russia) and received his M.Sc. Degree at the Moscow Institute of Steel in 1958, his Ph.D. degree (Mathematics) in 1963 at Moscow State University, and his Soviet "Doctor of Sciences" degree in Engineering from the Institute of Control Problems in 1978. He accepted an appointment at the Moscow State University in 1963. In 1971, he moved to the Institute of Control Sciences of the USSR/Russian Academy of Sciences, where he still works. In 2006, Boris was elected an IFAC Fellow.

Boris Polyak is an outstanding representative of the first generation of the Russian Optimization school. Over the years, he has made major contributions to most areas of Mathematical Programming. His first area of interest was gradient methods for unconstrained minimization of smooth functions, in which he established a number of classic results that Along with Naum Shor, Polyak played a pioneering role in discovery and investigation of subgradient methods for nonsmooth convex minimization. Simultaneously, he made decisive contributions to the theory of conjugate gradients,

B. Mordukhovich
Department of Mathematics, Wayne State University, Detroit, MI 48202, USA
e-mail: boris@math.wayne.edu

A. Nemirovski (✉)
School of Industrial and Systems Engineering, Georgia Institute of Technology,
765 Ferst Drive, NW, Atlanta, GA 30332-0205, USA
e-mail: nemirovs@isye.gatech.edu

Y. Nesterov
Center for Operations Research and Econometrics, Catholic University of Louvain,
34 voie du Roman Pays, 1348 Louvain-la-Neuve, Belgium
e-mail: nesterov@core.ucl.ac.be

as well as to the theory of modified Lagrangian functions for linear and nonlinear programming. These seminal contributions underline the well-known book *Introduction to Optimization* (1983, English translation 1987).

Since moving to the Institute of Control Sciences, Polyak has worked on application of optimization methods to problems of robust identification in control. In collaboration with Ya. Tsypkin, he obtained fundamental results on stochastic approximation. In 1989, Boris Polyak obtained a breakthrough result in this direction—discovery of a new "averaged" version of stochastic approximation, in which stable behavior on the finite horizon is combined with strong asymptotic optimality properties. His other contributions in this period included significant results in nonparametric statistics and ill-posed problems.

Starting in the early 1990s, Polyak's research interests shifted toward robust control, which remains his primary area of interest to this day. His research in this area covers a unusually wide variety of topics, including robust stability, synthesis of controllers, and general-purpose results on the convexity of images of nonlinear and quadratic maps.

The unusual breadth of Polyak's scholarly interests and contributions should be evident even from the brief outline above. To illustrate the point further, we mention the titles of some of his recent papers: "Stabilizing Chaos with Predictive Control" (*Automation and Remote Control*, 2005), "Interval Parameter Estimation under Model Uncertainty" (with A. Nazin, *Mathematical and Computer Modelling of Dynamical Systems*, 2005), "Cubic Regularization of Newton Method and its Global Performance" (with Yu. Nesterov, *Mathematical Programming*, 2006), and "On the Complete Instability of Interval Polynomials" (with F. Dabbene and R. Tempo, *Proceedings of the 45th IEEE Conference on Decision and Control*, San Diego, 2006).

Everybody who has had the privilege of communicating and collaborating with Boris Polyak appreciates not only his outstanding scholarly abilities but also his remarkable personality. Boris is an extremely friendly, open-minded, and enthusiastic person. When Michel Balinski was visiting the USSR during the 1970s and interviewing people for a scientific exchange program, he was heard to remark: "Boris, you are very different from the colleagues I spoke with so far—you are saying what you really think!" Boris Polyak has been an extremely influential member of Russian and International scientific communities, a dedicated mentor of numerous Ph.D. students, a co-author, and a friend to many, including the authors of this Foreword.

For many who know Boris, it will come as a surprise to hear that he is already 70. His professional productivity, taste for new things, sense of humor, and attitude to life in general are characteristic of a much younger person. We wish for Boris to remain young and active for many years to come!