RECENT ADVANCES IN NONSMOOTH OPTIMIZATION

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Preface

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. For example, decomposition methods for solving very large scale smooth problems produce lower-dimensional nonsmooth problems; penalty methods for solving constrained smooth problems result in unconstrained nonsmooth problems; nonsmooth equation methods for solving smooth variational inequalities and smooth nonlinear complementarity problems give rise to systems of nonsmooth equations.

After the early work in nonsmooth optimization, many books and proceedings have appeared in this field. The area of nonsmooth optimization is lively, with rapid developments in its applications, theoretical foundations, and available computational methods. There are three features of nonsmooth optimization.

The first feature is the variety of classes of nonsmooth optimization problems. They include not only optimization problems whose objective and constraint functions are nondifferentiable, but also optimization problems whose objective and constraint functions are first-order but not second-order differentiable. Superlinear convergence rates for the latter problems cannot be directly established using the smooth optimization techniques. Furthermore, nonsmooth variational inequality problems, nonsmooth equations, set-valued problems, bilevel programming, etc, are all in the general scope of nonsmooth optimization. Such a variety produces a wide range of analytical tools and algorithms.

The second feature is the rapid expansion of nonsmooth analysis. Starting from convex analysis, it now also includes generalized second-order derivatives, set-valued analysis, generalized convexity, and many other topics. On one hand, nonsmooth analysis is now a subject itself. On the other hand, it continuously provides useful tools for nonsmooth optimization. Terry Rockafellar plays a leading role in this field. This book includes two papers by him and his collaborators. We would like to dedicate this book to him on the occasion of his 60th birthday in October 1995.

The third feature is the development of new computational methods in nonsmooth optimization. From convergence analysis to numerical implementation, we observe a renewed surge in this frontier. Early approaches included bundle methods and the adaption of smooth methods to convex composite problems. Now there is a much wider range of methods exploiting the structure of the nonsmooth problem. More than half of this book is devoted to this frontier.

The book contains twenty five papers written by forty six authors from twenty countries in five continents. This illustrates the strong interest in nonsmooth optimization. We hope this collection will provide the reader with a glimpse of the recent advances of nonsmooth optimization and their features.

We would like to thank the authors of the papers, the anonymous referees, our associate and assistants, Dr. Xiaojun Chen, Mr. Houyuan Jiang and Mr. Zengxin Wei, and the publisher for helping us to produce this excellent collection of papers.

Ding-Zhu Du, Liqun Qi and Robert S. Womersley
University of Minnesota and University of New South Wales
May 1995

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