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Preface

Numerical Analysis 2000 Vol. IV: Optimization and Nonlinear Equations

As part of the program for this conference, the committee chose "Nonlinear and Optimization" to be the area in which we would attempt to survey the state of the art and to look forward to new lines of research that might be expected to flourish in the next few years. Accordingly, we solicited papers in the areas of unconstrained optimization, linear programming, quadratic programming, nonlinear equations, nonsmooth optimization, and optimization software. Within these areas we sought papers that would survey recent developments, point out promising new directions for research, or present state-of-the-art algorithms for important classes of problems. We also encouraged submissions from researchers in related fields who could point out problems in our areas of specialization that are crying for attention, or apply optimization techniques in novel ways.

The response to our call for papers was very encouraging. We received 95 papers, which is a large number for a conference of this size. Each paper was refereed by at least two referees, and most were refereed by three. Because of the limited space available in this volume, we could accept only 38 papers, a rejection rate of 60%. We regret that we could not accept more papers, but we had to set high standards in order to present a coherent picture of the current state of optimization and nonlinear equations.

The papers in this volume reflect the diversity of the conference as a whole. They range from theoretical studies of algorithms to descriptions of large-scale applications in science and engineering. Many papers combine theory and computation in an effective way. Some papers present algorithms that are entirely new, while others propose significant improvements in existing methods. Several papers describe useful software packages, and a few papers are primarily tutorial in nature. We have tried to group the papers in this volume according to their primary emphasis, but many papers could easily be placed in more than one section.

The first section of the volume contains seven papers on unconstrained optimization and linear programming. Two of these papers survey recent developments in derivative-free methods for unconstrained optimization. Powell describes recent work on methods that construct linear or quadratic models based on interpolation to the objective function on a set of sample points, and Wright surveys direct search methods, which explore the objective function using only function values, without explicit derivative approximations. Two papers present new algorithms for large-scale unconstrained optimization. Nash and Sofer describe a limited-memory variable-metric method based on a preconditioned conjugate gradient inner iteration, and Liu and Nocedal propose a limited-memory BFGS method that uses a scaling matrix obtained from the conjugate gradient iterations. Two papers study the behavior of steepest descent methods. Nocedal, Sartenaer and Zhu analyze a classical steepest descent method proposed by Goldstein in 1962, and Raydan and Svaiter present a new steepest descent method that allows occasional increases in the objective function. Finally, Conn, Gould and Toint present a new trust-region algorithm for problems with simple bound constraints.

The second section contains six papers on linear programming, quadratic programming, and complementarity problems. Two papers present new algorithms for linear programming. Mehrotra describes a new primal-dual interior point method for linear programming based on a power series expansion of the central path, and Vanderbei proposes a new interior point method based on affine scaling. Two papers study degeneracy in interior point methods for linear programming. Hall and McKinnon show that the sequence of steps taken by the Dikin affine scaling algorithm can converge to a nonoptimal point if the optimal face is degenerate, and Tapia, Zhang and Saltzman show that under primal and dual nondegeneracy assumptions, infeasible-interior-point algorithms will identify active inequality constraints in a finite number of iterations. Wright studies the convergence of primal-dual interior point algorithms for linear programming in the absence of assumptions of nondegeneracy or linear independence of constraint gradients. Her analysis explains why these algorithms often perform well in practice. Ye presents a polynomial-time algorithm for a certain class of convex quadratic programming problems.

The third section contains seven papers on nonlinear equations and nonsmooth optimization. Li surveys the theory and practice of smoothing methods for nonsmooth equations and nonsmooth optimization problems. Pang surveys Newton methods for B-differentiable equations, which arise in nonsmooth optimization and variational inequalities. Qi and Sun survey generalizations of Newton's method for nonsmooth equations. Dontchev, Lichtenstein and Veliov study the Lipschitz stability of Hamiltonian systems arising in nonlinear optimal control. Burke and Tseng show that the Gauss–Newton method is well-behaved for a generic set of problems, even though it may fail on problems with nonisolated zeros. Finally, Ralph and Wright show that Newton's method can be applied to mathematical programs with equilibrium constraints, despite the violation of standard constraint qualifications.

The fourth section contains eight papers on optimization software and large-scale optimization. Bongartz, Conn, Gould and Toint present CUTE, a widely used testing environment for optimization software. Czyzyk, Mesnier and Moré describe the NEOS Server, which provides remote access to optimization software via the Internet. Gay describes AMPL, a modeling language that has become very popular for large-scale optimization. Gertz and Wright describe object-oriented software for quadratic programming. Hough, Kolda and Torczon present asynchronous parallel pattern search methods for nonlinear optimization. Lucia and Kennington survey recent advances in using interior point methods for large-scale nonlinear programming. Tomlin and Welch describe extensions to the simplex method for handling piecewise linear functions and logical constraints.

The fifth section contains six papers on applications of optimization and nonlinear equations. Bortz and Kelley consider the problem of estimating parameters in differential equations with discontinuities. Dennis, El-Alem and Williamson use trust-region methods to design phased and filtered antenna-array patterns. Eldersveld and Saunders describe an interior point algorithm for multicommodity flows. Lasdon, Plummer and Yu report on their experience with generalized reduced gradient codes for large sparse nonlinear programs. Polak and Wardi study the problem of minimizing the maximum eigenvalue of a symmetric matrix that depends on a vector of parameters. Vicente and Calamai formulate and study bilevel and multilevel programming problems with convex lower level problems.

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Numerical Analysis 2000 Vol 4 Nonlinear Equations And Optimisation

Rosina Ehmann

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