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Handbook for Matrix Computations

SIAM Mathematics of Computing -- Numerical Analysis.

National Conference on Frontiers in Applied and Computational Mathematics (FACM-2005)

March 04-05, 2005

Allied Publishers

Handbook for Matrix Computations

SIAM Provides the user with a step-by-step introduction to Fortran 77, BLAS, LINPACK, and MATLAB. It is a reference that spans several levels of practical matrix computations with a strong emphasis on examples and "hands on" experience.

Parallel Algorithms in Computational Science and Engineering

Springer Nature This contributed volume highlights two areas of fundamental interest in high-performance computing: core algorithms for important kernels and computationally demanding applications. The first few chapters explore algorithms, numerical techniques, and their parallel formulations for a variety of kernels that arise in applications. The rest of the volume focuses on state-of-the-art applications from diverse domains. By structuring the volume around these two areas, it presents a comprehensive view of the application landscape for high-performance computing, while also enabling readers to develop new applications using the kernels. Readers will learn how to choose the most suitable parallel algorithms for any given application, ensuring that theory and practicality are clearly connected. Applications using these techniques are illustrated in detail, including: Computational materials science and engineering Computational cardiovascular analysis Multiscale analysis of wind turbines and turbomachinery Weather forecasting Machine learning techniques Parallel Algorithms in Computational Science and Engineering will be an ideal reference for applied mathematicians, engineers, computer scientists, and other researchers who utilize high-performance computing in their work.

Computational Frameworks for the Fast Fourier Transform

SIAM The author captures the interplay between mathematics and the design of effective numerical algorithms.

Symbolic Computation

Applications to Scientific Computing

SIAM Mathematics of Computing -- Numerical Analysis.

Computational Probability and Mathematical Modeling

Frontiers Media SA In the present time, two of the most important approaches to tackle complex systems are probability and stochastic processes theory. Still from an analytic perspective, modeling and solving a problem using a stochastic approach is not a trivial issue, hence, a combination of the logic of probabilistic reasoning with computational science is needed to obtain qualitatively good solutions in a reasonable time. This eBook presents an interesting view of applications associated to fields of probability, statistics, and mathematic modeling, all of them supported by a computational context though the approach of stochasticity and simulation used in most of them. This collection contains three chapters, which bring applications in fields of biology, finance and physics, each chapter contains work(s) with specific applications. An editorial is also contained with a summarized version of each work, and each of them are widely explained in a specific section, which include a state of art to support the nature of the individual research, a methodology to solve the defined problem and the results and conclusions. We hope the present eBook can represent a potential source of knowledge for the academic community of implicated disciplines, and an inspirational starting point of starting for scientists in the amazing world of applied mathematics and the search to solve complex problems

The Total Least Squares Problem

Computational Aspects and Analysis

SIAM This is the first book devoted entirely to total least squares. The authors give a unified presentation of the TLS problem. A description of its basic principles are given, the various algebraic, statistical and sensitivity properties of the problem are discussed, and generalizations are presented. Applications are surveyed to facilitate uses in an even wider range of applications. Whenever possible, comparison is made with the well-known least squares methods. A basic knowledge of numerical linear algebra, matrix computations, and some notion of elementary statistics is required of the reader; however, some background material is included to make the book reasonably self-contained.

A Multigrid Tutorial

Second Edition

SIAM This second edition preserves the introductory spirit of the first edition while roughly doubling the amount of material covered. The topics of the first edition have been enhanced with additional discussion, new numerical experiments, and improved figures. New topics in the second edition include nonlinear equations, Neumann boundary conditions, variable mesh and variable coefficient problems, anisotropic problems, algebraic multigrid (AMG), adaptive methods, and finite elements. This introductory book is ideally suited as a companion textbook for graduate numerical analysis courses. It is written for computational mathematicians, engineers, and other scientists interested in learning about multigrid.

Optimization Software Guide

SIAM Developments in optimization theory, including emphasis on large problems and on interior-point methods for linear programming, have begun to appear in production software. Here is a reference tool that includes discussions of these areas and names software packages that incorporate the results of theoretical research. After an introduction to the major problem areas in optimization and an outline of the algorithms used to solve them, a data sheet is presented for each of the 75 software packages and libraries in the authors' survey. These include information on the capabilities of the packages, how to obtain them, and addresses for further information. Standard optimization paradigms are addressed -- linear, quadratic, and nonlinear programming; network optimization; unconstrained and bound-constrained optimization; least-squares problems; nonlinear equations; and integer programming. The most practical algorithms for the major fields of numerical optimization are outlined, and the software packages in which they are implemented are described. This format will aid current and potential users of optimization software in classifying the optimization problem to be solved, determining appropriate algorithms, and obtaining the software that implements those algorithms. Readers need only a basic knowledge of vector calculus and linear algebra to understand this book.

Multilevel Adaptive Methods for Partial Differential Equations

SIAM A practical handbook for understanding and using fast adaptive composite grid (FAC) methods for discretization and solution of partial differential equations (PDEs). Contains fundamental concepts. These so-called FAC are characterized by their use of a composite grid, which is nominally the union of various uniform grids. FAC is capable of producing a composite grid with tailored resolution, and a corresponding solution with commensurate accuracy, at a cost proportional to the number of composite grid points. Moreover, special asynchronous versions of the fast adaptive composite grid methods (AFAC) studied here have seemingly optimal complexity in a parallel computing environment. Most of the methods treated in this book were discovered only within the last decade, and in many cases their development is still in its infancy. While this is not meant to be comprehensive, it does provide a theoretical and practical guide to multilevel adaptive methods and relevant discretization techniques. It also contains new material, which is included to fill in certain gaps and to expose new avenues of research. Also, because adaptive refinement seems to demand a lot of attention to philosophical issues, personal perspectives are often brought freely into the discussion.

Mathematical Aspects of Numerical Grid Generation

SIAM Numerical grid generation plays a critical role in any scientific computing problem when the geometry of the underlying region is complex or when the solution has a complex structure. The mathematical aspects of grid generation are discussed to provide a deeper understanding of the algorithms and their imitations. Variational methods are emphasized because they are more robust, but elliptic and transcendental algebraic methods are also considered.

Computational Methods for Inverse Problems

SIAM Provides a basic understanding of both the underlying mathematics and the computational methods used to solve inverse problems.

Control and Estimation in Distributed Parameter Systems

SIAM A comprehensive and lucid text that relates frequency domain techniques to state-space or time domain approaches for infinite-dimensional systems.

Transonic Aerodynamics

Problems in Asymptotic Theory

SIAM This volume offers exciting results, perspectives, and case studies for the treatment of problems arising in transonic aerodynamics. New advances including triple deck theory, analysis of stagnation at the nose of a body, transonic choked flow, and the transonic area rule are presented. Interest in analyzing the transonic range of flight, its stability properties, and especially the question of designing reduced drag (shockless or weak shock) airfoils keeps growing. Present day commercial aircraft cruise in the transonic range. Mechanical and aeronautical engineers interested in compressible fluid flows, design of optimal wings, and an understanding of transonic flow held about wings and airfoils will find the book invaluable. This book is understandable to those with a knowledge of continuum mechanics (fluids) and asymptotic methods. It is appropriate for graduate courses in aerodynamics and mathematical methods.

Iterative Methods for Linear and Nonlinear Equations

SIAM Linear and nonlinear systems of equations are the basis for many, if not most, of the models of phenomena in science and engineering, and their efficient numerical solution is critical to progress in these areas. This is the first book to be published on nonlinear equations since the mid-1980s. Although it stresses recent developments in this area, such as Newton-Krylov methods, considerable material on linear equations has been incorporated. This book focuses on a small number of methods and treats them in depth. The

author provides a complete analysis of the conjugate gradient and generalized minimum residual iterations as well as recent advances including Newton-Krylov methods, incorporation of inexactness and noise into the analysis, new proofs and implementations of Broyden's method, and globalization of inexact Newton methods. Examples, methods, and algorithmic choices are based on applications to infinite dimensional problems such as partial differential equations and integral equations. The analysis and proof techniques are constructed with the infinite dimensional setting in mind and the computational examples and exercises are based on the MATLAB environment.

Parallel Computing

Architectures, Algorithms, and Applications

IOS Press ParCo2007 marks a quarter of a century of the international conferences on parallel computing that started in Berlin in 1983. The aim of the conference is to give an overview of the developments, applications and future trends in high-performance computing for various platforms.

Foundations of Computational Mathematics

Selected Papers of a Conference Held at Rio de Janeiro, January 1997

Springer Science & Business Media This book contains a collection of articles corresponding to some of the talks delivered at the Foundations of Computational Mathematics conference held at IMPA in Rio de Janeiro in January 1997. Some ofthe others are published in the December 1996 issue of the Journal of Complexity. Both of these publications were available and distributed at the meeting. Even in this aspect we hope to have achieved a synthesis of the mathematics and computer science cultures as well as of the disciplines. The reaction to the Park City meeting on Mathematics of Numerical Analy sis: Real Number Algorithms which was chaired by Steve Smale and had around 275 participants, was very enthusiastic. At the suggestion of Narendra Karmar mar a lunch time meeting of Felipe Cucker, Arieh Iserles, Narendra Karmarkar, Jim Renegar, Mike Shub and Steve Smale decided to try to hold a periodic meeting entitled "Foundations of Computational Mathematics" and to form an organization with the same name whose primary purpose will be to hold the meeting. This is then the first edition of FoCM as such. It has been organized around a small collection of workshops, namely - Systems of algebraic equations and computational algebraic geometry - Homotopy methods and real machines - Information-based complexity - Numerical linear algebra - Approximation and PDEs - Optimization - Differential equations and dynamical systems - Relations to computer science - Vision and related computational tools There were also twelve plenary speakers. IOS Press

Large-Scale Scientific Computing

8th International Conference, LSSC 2011, Sozopol, Bulgaria, June 6-10th, 2011. Revised Selected Papers

Springer This book constitutes the thoroughly refereed post-conference proceedings of the 8th International Conference on Large-Scale Scientific Computations, LSSC 2011, held in Sozopol, Bulgaria, in June 2011. The 74 revised full papers presented together with 3 plenary and invited papers were carefully reviewed and selected from numerous submissions. The papers are organized in topical sections on robust multigrid, multilevel and multiscale, deterministic and stochastic methods for modeling highly heterogeneous media, advanced methods for transport, control and uncertain systems, applications of metaheuristics to large-scale problems, environmental modelling, large scale computing on many-core architectures, multiscale industrial, enviromental and biomedical problems, efficient algorithms of computational geometry, high performance Monte Carlo simulations, voxel based computations and contributed papers.

SIAM Journal on Matrix Analysis and Applications

A Publication of the Society for Industrial and Applied Mathematics

Applied Mechanics Reviews

Open Problems in Mathematical Systems and Control Theory

Springer Science & Business Media System and Control theory is one of the most exciting areas of contemporary engineering mathematics. From the analysis of Watt's steam engine governor - which enabled the Industrial Revolution - to the design of controllers for consumer items, chemical plants and modern aircraft, the area has always drawn from a broad range of tools. It has provided many challenges and possibilities for interaction between engineering and established areas of 'pure' and 'applied' mathematics. This impressive volume collects a discussion of more than fifty open problems which touch upon a variety of subfields, including: chaotic observers, nonlinear local controlability, discrete event and hybrid systems, neural network learning, matrix inequalities, Lyapunov exponents, and many other issues. Proposed and explained by leading researchers, they are offered with the intention of generating further work, as well as inspiration for many other similar problems which may naturally arise from them. With extensive references, this book will be a useful reference source - as well as an excellent addendum to the textbooks in the area.

Recent Advances in Total Least Squares Techniques and Errors-in-variables Modeling

SIAM An overview of the computational issues; statistical, numerical, and algebraic properties, and new generalizations and applications of advances on TLS and EIV models. Experts from several disciplines prepared overview papers which were presented at the conference and are included in this book.

Parallel Multilevel Methods

Adaptive Mesh Refinement and Loadbalancing

Springer Science & Business Media Main aspects of the efficient treatment of partial differential equations are discretisation, multilevel/multigrid solution and parallelisation. These distinct topics are covered from the historical background to modern developments. It is demonstrated how the ingredients can be put together to give an adaptive and parallel multilevel approach for the solution of elliptic boundary value problems. Error estimators and adaptive grid refinement techniques for ordinary and for sparse grid discretisations are presented. Different types of additive and multiplicative multilevel solvers are discussed with respect to parallel implementation and application to adaptive refined grids. Efficiency issues are treated both for the sequential multilevel methods and for the parallel version by hash table storage techniques. Finally, space-filling curve enumeration for parallel load balancing and processor cache efficiency are discussed.

Frontiers of Evolutionary Computation

Springer Science & Business Media Frontiers of Evolutionary Computation brings together eleven contributions by international leading researchers discussing what significant issues still remain unresolved in the field of Evolutionary Computation (Ee. They explore such topics as the role of building blocks, the balancing of exploration with exploitation, the modeling of EC algorithms, the connection with optimization theory and the role of EC as a meta-heuristic method, to name a few. The articles feature a mixture of informal discussion interspersed with formal statements, thus providing the reader an opportunity to observe a wide range of EC problems from the investigative perspective of world-renowned researchers. These prominent researchers include: Heinz M]hlenbein, Kenneth De Jong, Carlos Cotta and Pablo Moscato, Lee Altenberg, Gary A. Kochenberger, Fred Glover, Bahram Alidaee and Cesar Rego, William G. Macready, Christopher R. Stephens and Riccardo Poli, Lothar M. Schmitt, John R. Koza, Matthew J. Street and Martin A. Keane, Vivek Balaraman, Wolfgang Banzhaf and Julian Miller.

Numerical Linear Algebra: Theory and Applications

Springer This book combines a solid theoretical background in linear algebra with practical algorithms for numerical solution of linear algebra problems. Developed from a number of courses taught repeatedly by the authors, the material covers topics like matrix algebra, theory for linear systems of equations, spectral theory, vector and matrix norms combined with main direct and iterative numerical methods, least squares problems, and eigenproblems. Numerical algorithms illustrated by computer programs written in MATLAB® are also provided as supplementary material on SpringerLink to give the reader a better understanding of professional numerical software for the solution of real-life problems. Perfect for a one- or two-semester course on numerical linear algebra, matrix computation, and large sparse matrices, this text will interest students at the advanced undergraduate or graduate level.

Numerical Methods for Least Squares Problems

SIAM The method of least squares was discovered by Gauss in 1795. It has since become the principal tool to reduce the influence of errors when fitting models to given observations. Today, applications of least squares arise in a great number of scientific areas, such as statistics, geodetics, signal processing, and control. In the last 20 years there has been a great increase in the capacity for automatic data capturing and computing. Least squares problems of large size are now routinely solved. Tremendous progress has been made in numerical methods for least squares problems, in particular for generalized and modified least squares problems and direct and iterative methods for sparse problems. Until now there has not been a monograph that covers the full spectrum of relevant problems and methods in least squares. This volume gives an in-depth treatment of topics such as methods for sparse least squares problems, iterative methods, modified least squares, weighted problems, and constrained and regularized problems. The more than 800 references provide a comprehensive survey of the available literature on the subject.

Krylov Subspace Methods

Principles and Analysis

Oxford University Press Describes the principles and history behind the use of Krylov subspace methods in science and engineering. The outcome of the analysis is very practical and indicates what can and cannot be expected from the use of Krylov subspace methods, challenging some common assumptions and justifications of standard approaches.

Numerical Methods in Computational Electrodynamics

Linear Systems in Practical Applications

Springer Science & Business Media treated in more detail. They are just specimen of larger classes of schemes. Es sentially, we have to distinguish between semi-analytical methods, discretiza tion methods, and lumped circuit models. The semi-analytical methods and the discretization methods start directly from Maxwell's equations. Semi-analytical methods are concentrated on the analytical level: They use a computer only to evaluate expressions and to solve resulting linear algebraic problems. The best known semi-analytical methods are the mode matching method, which is described in subsection 2. 1, the method of integral equations, and the method of moments. In the method of integral equations, the given boundary value problem is transformed into an integral equation with the aid of a suitable Greens' function. In the method of moments, which includes the mode matching method as a special case, the solution function is represented by a linear combination of appropriately weighted basis func tions. The treatment of complex geometrical structures is very difficult for these methods or only possible after geometric simplifications: In the method of integral equations, the Greens function has to satisfy the boundary condi tions. In the mode matching method, it must be possible to decompose the domain into subdomains in which the problem can be solved analytically, thus allowing to find the basis functions. Nevertheless, there are some ap plications for which the semi-analytic methods are the best suited solution methods. For example, an application from accelerator physics used the mode matching technique (see subsection 5. 4).

SIAM Journal on Computing

Computational Methods for Option Pricing

SIAM The authors review some important aspects of finance modeling involving partial differential equations and focus on numerical algorithms for the fast and accurate pricing of financial derivatives and for the calibration of parameters. This book explores the best numerical algorithms and discusses them in depth, from their mathematical analysis up to their implementation in C++ with efficient numerical libraries.

Mathematical Challenges from Theoretical/Computational Chemistry

National Academies Press Computational methods are rapidly becoming major tools of theoretical, pharmaceutical, materials, and biological chemists. Accordingly, the mathematical models and numerical analysis that underlie these methods have an increasingly important and direct role to play in the progress of many areas of chemistry. This book explores the research interface between computational chemistry and the mathematical sciences. In language that is aimed at non-specialists, it documents some prominent examples of past successful cross-fertilizations between the fields and explores the mathematical research opportunities in a broad cross-section of chemical research frontiers. It also discusses cultural differences between the two fields and makes recommendations for overcoming those differences and generally promoting this interdisciplinary work.

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Nonlinear Conjugate Gradient Methods for Unconstrained Optimization

Springer Nature Two approaches are known for solving large-scale unconstrained optimization problems—the limited-memory quasi-Newton method (truncated Newton method) and the conjugate gradient method. This is the first book to detail conjugate gradient methods, showing their properties and convergence characteristics as well as their performance in solving large-scale unconstrained optimization problems and applications. Comparisons to the limited-memory and truncated Newton methods are also discussed. Topics studied in detail include: linear conjugate gradient methods, standard conjugate gradient methods, acceleration of conjugate gradient methods, hybrid, modifications of the standard scheme, memoryless BFGS preconditioned, and three-term. Other conjugate gradient methods with clustering the eigenvalues or with the minimization of the condition number of the iteration matrix, are also treated. For each method, the convergence analysis, the computational performances and the comparisons versus other conjugate gradient methods are given. The theory behind the conjugate gradient algorithms presented as a methodology is developed with a clear, rigorous, and friendly exposition; the reader will gain an understanding of their properties and their convergence and will learn to develop and prove the convergence of his/her own methods. Numerous numerical studies are supplied with comparisons and comments on the behavior of conjugate gradient algorithms for solving a collection of 800 unconstrained optimization problems of different structures and complexities with the number of variables in the range [1000,10000]. The book is addressed to all those interested in developing and using new advanced techniques for solving unconstrained optimization complex problems. Mathematical programming researchers, theoreticians and practitioners in operations research, practitioners in engineering and industry researchers, as well as graduate students in mathematics, Ph.D. and master students in mathematical programming, will find plenty of information and practical applications for solving large-scale unconstrained optimization problems and applications by conjugate gradient methods.

SIAM Journal on Scientific and Statistical Computing

Applied Parallel Computing

State of the Art in Scientific Computing

Springer Science & Business Media This book constitutes the refereed proceedings of the 7th International Conference on Applied Parallel Computing, PARA 2004, held in June 2004. The 118 revised full papers presented together with five invited lectures and 15 contributed talks were carefully reviewed and selected for inclusion in the proceedings. The papers are organized in topical sections.

Frontiers In Orthogonal Polynomials And Q-series

World Scientific This volume aims to highlight trends and important directions of research in orthogonal polynomials, q-series, and related topics in number theory, combinatorics, approximation theory, mathematical physics, and computational and applied harmonic analysis. This collection is based on the invited lectures by well-known contributors from the International Conference on Orthogonal Polynomials and q-Series, that was held at the University of Central Florida in Orlando, on May 10–12, 2015. The conference was dedicated to Professor Mourad Ismail on his 70th birthday. The editors strived for a volume that would inspire young researchers and provide a wealth of information in an engaging format. Theoretical, combinatorial and computational/algorithmic aspects are considered, and each chapter contains many references on its topic, when appropriate. Contents: Mourad Ismail (Richard Askey)Binomial Andrews–Gordon–Bressoud Identities (Dennis Stanton)Symmetric Expansions of Very Well-Poised Basic Hypergeometric Series (George E Andrews)A Sturm–Liouville Theory for Hahn Difference Operator (M H Annaby, A E Hamza and S D Makharesh)Solvability of the Hankel Determinant Problem for Real Sequences (Andrew Bakan and Christian Berg)Convolution and Product Theorems for the Special Affine Fourier Transform (Ayush Bhandari and Ahmed I Zayed)A Further Look at Time-and-Band Limiting for Matrix Orthogonal Polynomials (M Castro, F A Grünbaum, I Pacharoni and I Zurrián)The Orthogonality of Al-Salam–Carlitz Polynomials for Complex Parameters (Howard S Cohl, Roberto S Costas-Santos and Wenqing Xu)Crouching AGM, Hidden Modularity (Shaun Cooper, Jesús Guillera, Armin Straub and Wadim Zudilin)Asymptotics of Orthogonal Polynomials and the Painlevé Transcendents (Dan Dai)From the Gaussian Circle Problem to Multivariate Shannon Sampling (Willi Freeden and M Zuhair Nashed)Weighted Partition Identities and Divisor Sums (F G Garvan)On the Ismail–Letessier–Askey Monotonicity Conjecture for Zeros of Ultraspherical Polynomials (Walter Gautschi)A Discrete Top-Down Markov Problem in Approximation Theory (Walter Gautschi)Supersymmetry of the Quantum Rotor (Vincent X Genest, Luc Vinet, Guo-Fu Yu and Alexei Zhedanov)The Method of Brackets in Experimental Mathematics (Ivan Gonzalez, Karen Kohl, Lin Jiu and Victor H Moll)Balanced Modular Parameterizations (Tim Huber, Danny Lara and Esteban Melendez)Some Smallest Parts Functions from Variations of Bailey's Lemma (Chris Jennings-Shaffer)Dual Addition Formulas Associated with Dual Product Formulas (Tom H Koornwinder)Holonomic Tools for Basic Hypergeometric Functions (Christoph Koutschan and Peter Paule)A Direct Evaluation of an Integral of Ismail and Valent (Alexey Kuznetsov)Algebraic Generating Functions for Gegenbauer Polynomials (Robert S Maier)q-Analogues of Two Product Formulas of Hypergeometric Functions by Bailey (Michael J Schlosser)Summation Formulae for Noncommutative Hypergeometric Series (Michael J Schlosser)Asymptotics of Generalized Hypergeometric Functions (Y Lin and R Wong)Mock Theta-Functions of the Third Order of Ramanujan in Terms of Appell–Lerch Series (Changgui Zhang)On Certain Positive Semidefinite Matrices of Special Functions (Ruiming Zhang) Readership: Graduate students and researchers interested in orthogonal polynomials and

Finite Elements II

Galerkin Approximation, Elliptic and Mixed PDEs

Springer Nature This book is the second volume of a three-part textbook suitable for graduate coursework, professional engineering and academic research. It is also appropriate for graduate flipped classes. Each volume is divided into short chapters. Each chapter can be covered in one teaching unit and includes exercises as well as solutions available from a dedicated website. The salient ideas can be addressed during lecture, with the rest of the content assigned as reading material. To engage the reader, the text combines examples, basic ideas, rigorous proofs, and pointers to the literature to enhance scientific literacy. Volume II is divided into 32 chapters plus one appendix. The first part of the volume focuses on the approximation of elliptic and mixed PDEs, beginning with fundamental results on well-posed weak formulations and their approximation by the Galerkin method. The material covered includes key results such as the BNB theorem based on inf-sup conditions, Céa's and Strang's lemmas, and the duality argument by Aubin and Nitsche. Important implementation aspects regarding quadratures, linear algebra, and assembling are also covered. The remainder of Volume II focuses on PDEs where a coercivity property is available. It investigates conforming and nonconforming approximation techniques (Galerkin, boundary penalty, Crouzeix—Raviart, discontinuous Galerkin, hybrid high-order methods). These techniques are applied to elliptic PDEs (diffusion, elasticity, the Helmholtz problem, Maxwell's equations), eigenvalue problems for elliptic PDEs, and PDEs in mixed form (Darcy and Stokes flows). Finally, the appendix addresses fundamental results on the surjectivity, bijectivity, and coercivity of linear operators in Banach spaces.

Solving Nonlinear Equations with Newton's Method

SIAM This book on Newton's method is a user-oriented guide to algorithms and implementation. In just over 100 pages, it shows, via algorithms in pseudocode, in MATLAB, and with several examples, how one can choose an appropriate Newton-type method for a given problem, diagnose problems, and write an efficient solver or apply one written by others. It contains trouble-shooting guides to the major algorithms, their most common failure modes, and the likely causes of failure. It also includes many worked-out examples (available on the SIAM website) in pseudocode and a collection of MATLAB codes, allowing readers to experiment with the algorithms easily and implement them in other languages.