Iterative Solution Of Nonlinear Equations In Several Variables Computer Science Applied Mathematics Monograph

Mathematics of Computing -- Numerical Analysis.

Iterative Solution of Nonlinear Equations in Several VariablesElsevier

Computer Science and Applied Mathematics: Iterative Solution of Nonlinear Equations in Several Variables presents a survey of the basic theoretical results about nonlinear equations in n dimensions and analysis of the major iterative methods for their numerical solution. This book discusses the gradient mappings and minimization, contractions and the continuation property, and degree of a mapping. The general iterative and minimization methods, rates of convergence, and one-step stationary and multistep methods are also elaborated. This text likewise covers the contractions and nonlinear majorants, convergence under partial ordering, and convergence of minimization methods. This publication is a good reference for specialists and readers with an extensive functional analysis background.

In 1964, Zarantonello published a constructive method for the solution of certain nonlinear problems in a Hilbert space. The present report extends the method in various directions including a generalization to a Banach space setting. A revealing geometric interpretation of the method yields guidelines for the analysis. (Author).

This book focuses on the approximation of nonlinear equations using iterative methods. Nine contributions are presented on the construction and analysis of these methods, the coverage encompassing convergence, efficiency, robustness, dynamics, and applications. Many problems are stated in the form of nonlinear equations, using mathematical modeling. In particular, a wide range of problems in Applied Mathematics and in Engineering can be solved by finding the solutions to these equations. The book reveals the importance of studying convergence aspects in iterative methods and shows that selection of the most efficient and robust iterative method for a given problem is crucial to guaranteeing a good approximation. A number of sample criteria for selecting the optimal method are presented, including those regarding the order of convergence, the computational cost, and the stability, including the dynamics. This book will appeal to researchers whose field of interest is related to nonlinear problems and equations, and their approximation.

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.

Contains trouble-shooting guides to the major algorithms for Newton's method, their common failure modes, and the likely causes of failure.

Many of the problems in experimental sciences and other disciplines can be expressed in the form of nonlinear equations. The solution of these equations is rarely obtained in closed form. With the development of computers, these problems can be addressed by numerical algorithms that approximate the solution. Specifically, fixed point iterative methods are used, which generate a convergent sequence presumably to the solution of the equation or system of equations. Since J.F. Traub (Iterative methods for the solution of equations, Prentice-Hall, N.J. 1964) initiated the qualitative as well the quantitative analysis of iterative methods in the 1960s, iterative methods for nonlinear systems has been a constantly interesting field of study for numerical analysts. Our contribution to this field is the analysis and construction of new iterative methods, by improving the order of convergence and computational efficiency either of these or other known methods. To study the new iterative methods that we have proposed, we reviewed analyzed and improved classic concepts of computational order of convergence, the error equation, and the computational cost of an iterative method for both an equation and a system of nonlinear equations. Specifically, we have worked on the following points: - We computed the local order of convergence for known two-step and new multi-step iterative methods by means of expansions in formal developments in power series of the function F, the Jacobian operator, the inverse Jacobian operator and the divided difference operator and its inverse operator. - We generated some measures that approximate the order of convergence. Four new variants for computing the computational order of convergence (COC) are given: one requires the value of the root, whilst the other three do not. - We constructed families of iterative schemes that are variants of Newton's method and Chebyshev's method and improve the order and the efficiency. - We studied several families of the modified Secant method (Secant, Kurchatov and Steffensen), evaluated variants of these methods and chose the most efficient. - We generalized the concepts of efficiency index and computational efficiency for nonlinear equations to systems of nonlinear equations. This has been termed the computational efficiency index (CEI). - We considered that in iterative process using variable precision, the accuracy will increase as the computation proceeds. The final result will be obtained as precisely as possible, depending on the computer and the software. - We expressed the cost of evaluating elementary functions in terms of products. This cost depends on the computer, the software and the arithmetic that we used. The above numerical calculations were performed in the algebraic system called MAPLE. - We presented a new way of comparing elapsed time for different iterative schemes. This consists of estimating the time required to achieve a correct decimal of the solution by the method selected. That is, we measured the relationship between the time to fulfill the stop criterion and the total number of correct decimals obtained by method. The five papers selected for this compendium were published in scientific journals in the area of applied mathematics. The impact factor of these journals is, in all cases, in the first third according to the classification of the Journal of Citation Reports. There are four preceding papers that no are part of this report by its publication date.

This book has become the standard for a complete, state-of-the-art description of the methods for unconstrained optimization and systems of nonlinear equations. Originally published in 1983, it provides information needed to understand both the theory and the practice of these methods and provides pseudocode for the problems. The algorithms covered are all based on Newton's method or "quasi-Newton" methods, and the heart of the book is the material on computational methods for multidimensional unconstrained optimization and nonlinear equation problems. The republication of this book by SIAM is driven by a continuing demand for specific and sound advice on how to solve real problems. The level of presentation is consistent throughout, with a good mix of examples and theory, making it a valuable text at both the graduate and undergraduate level. It has been praised as excellent for courses with approximately the same name as the book title and would also be useful as a supplemental text for a nonlinear programming or a numerical analysis course. Many exercises are provided to illustrate and develop the ideas in the text. A large appendix provides a mechanism for class projects and a reference for readers who want the details of the algorithms. Practitioners may use this book for self-study and reference. For complete understanding, readers should have a

background in calculus and linear algebra. The book does contain background material in multivariable calculus and numerical linear algebra.
Since Banach's fixed point theorem was proved by Banach in 1922, many authors have used this theorem to show the existence and uniqueness of solutions for differential and integral equations, a system of simultaneous linear algebraic equations by methods of successive approximations, etc., and have extended, generalised and improved this theorem in several ways. The purpose of this book is to give a comprehensive introduction to the study of iterative approximation methods for solutions of nonlinear equations involving some kinds of nonlinear mappings and multi-valued mappings in Banach spaces and normed linear spaces by the Mann and Ishikawa iterative sequences (with errors and mixed errors) and the generalised steepest descent approximations.

This monograph gives an introductory treatment of the most important iterative methods for constructing fixed points of nonlinear contractive type mappings. For each iterative method considered, it summarizes the most significant contributions in the area by presenting some of the most relevant convergence theorems. It also presents applications to the solution of nonlinear operator equations as well as the appropriate error analysis of the main iterative methods.

In the second edition of this classic monograph, complete with four new chapters and updated references, readers will now have access to content describing and analysing classical and modern methods with emphasis on the algebraic structure of linear iteration, which is usually ignored in other literature. The necessary amount of work increases dramatically with the size of systems, so one has to search for algorithms that most efficiently and accurately solve systems of, e.g., several million equations. The choice of algorithms depends on the special properties the matrices in practice have. An important class of large systems arises from the discretization of partial differential equations. In this case, the matrices are sparse (i.e., they contain mostly zeroes) and well-suited to iterative algorithms. The first edition of this book grew out of a series of lectures given by the author at the Christian-Albrecht University of Kiel to students of mathematics. The second edition includes quite novel approaches.

Numerical Solution of Nonlinear Elliptic Problems Via Preconditioning Operators - Theory & Applications

This book is the first on the topic and explains the most cutting-edge methods needed for precise calculations and explores the development of powerful algorithms to solve research problems. Multipoint methods have an extensive range of practical applications significant in research areas such as signal processing, analysis of convergence rate, fluid mechanics, solid state physics, and many others. The book takes an introductory approach in making qualitative comparisons of different multipoint methods from various viewpoints to help the reader understand applications of more complex methods. Evaluations are made to determine and predict efficiency and accuracy of presented models useful to wide a range of research areas along with many numerical examples for a deep understanding of the usefulness of each method. This book will make it possible for the researchers to tackle difficult problems and deepen their understanding of problem solving using numerical methods. Multipoint methods are of great practical importance, as they determine sequences of successive approximations for evaluative purposes. This is especially helpful in achieving the highest computational efficiency. The rapid development of digital computers and advanced computer arithmetic have provided a need for new methods useful to solving practical problems in a multitude of disciplines such as applied mathematics, computer science, engineering, physics, financial mathematics, and biology. Provides a succinct way of implementing a wide range of useful and important numerical algorithms for solving research problems Illustrates how numerical methods can be used to study problems which have applications in engineering and sciences, including signal processing, and control theory, and financial computation Facilitates a deeper insight into the development of methods, numerical analysis of convergence rate, and very detailed analysis of computational efficiency Provides a powerful means of learning by systematic experimentation with some of the many fascinating problems in science Includes highly efficient algorithms convenient for the implementation into the most common computer algebra systems such as Mathematica, MatLab, and Maple

This second edition provides much-needed updates to the original volume. Like the first edition, it emphasizes the ideas behind the algorithms as well as their theoretical foundations and properties, rather than focusing strictly on computational details; at the same time, this new version is now largely self-contained and includes essential proofs. Additions have been made to almost every chapter, including an introduction to the theory of inexact Newton methods, a basic theory of continuation methods in the setting of differentiable manifolds, and an expanded discussion of minimization methods. New information on parametrized equations and continuation incorporates research since the first edition.

An iterative method is presented to solve the internal and external camera calibration parameters, given model target points and their images from one or more camera locations. The direct linear transform formulation was used to obtain a guess for the iterative method, and herein lies one of the strengths of the present method. In all test cases, the method converged to the correct solution. In general, an overdetermined system of nonlinear equations is solved in the least-squares sense. The iterative method presented is based on Newton-Raphson for solving systems of nonlinear algebraic equations. The Jacobian is analytically derived and the pseudo-inverse of the Jacobian is obtained by singular value decomposition.Samtaney, RaviAmes Research CenterCCD CAMERAS; CALIBRATING; PHOTOGRAMMETRY; IMAGES; ITERATIVE SOLUTION; NEWTON-RAPHSON METHOD; NONLINEAR EQUATIONS; FLOW VISUALIZATION; UNIQUENESS...

Numerical Solution of Systems of Nonlinear Algebraic Equations contains invited lectures of the NSF-CBMS Regional Conference on the Numerical Solution of Nonlinear Algebraic Systems with Applications to Problems in Physics, Engineering and Economics, held on July 10-14, 1972. This book is composed of 10 chapters and begins with the concepts of nonlinear algebraic equations in continuum mechanics. The succeeding chapters deal with the numerical

solution of quasilinear elliptic equations, the nonlinear systems in semi-infinite programming, and the solution of large systems of linear algebraic equations. These topics are followed by a survey of some computational techniques for the nonlinear least squares problem. The remaining chapters explore the problem of nonlinear functional minimization, the modification methods, and the computer-oriented algorithms for solving system. These chapters also examine the principles of contractor theory of solving equations. This book will prove useful to undergraduate and graduate students.
Solving nonlinear equations in Banach spaces (real or complex nonlinear equations, nonlinear systems, and nonlinear matrix equations, among others), is a non-trivial task that involves many areas of science and technology. Usually the solution is not directly affordable and require an approach using iterative algorithms. This Special Issue focuses mainly on the design, analysis of convergence, and stability of new schemes for solving nonlinear problems and their application to practical problems. Included papers study the following topics: Methods for finding simple or multiple roots either with or without derivatives, iterative methods for approximating different generalized inverses, real or complex dynamics associated to the rational functions resulting from the application of an iterative method on a polynomial. Additionally, the analysis of the convergence has been carried out by means of different sufficient conditions assuring the local, semilocal, or global convergence. This Special issue has allowed us to present the latest research results in the area of iterative processes for solving nonlinear equations as well as systems and matrix equations. In addition to the theoretical papers, several manuscripts on signal processing, nonlinear integral equations, or partial differential equations, reveal the connection between iterative methods and other branches of science and engineering.
After a review of historical developments in convergence analysis for Newton's and Newton-like methods, 18 papers deal in depth with various classical, or neo-classical approaches, as well as newer ideas on optimization and solving linear equations. A sampling of topics: truncated Newton methods, sequential quadratic programming for large- scale nonlinear optimization, and automatic differentiation of algorithms. This monograph, one of seven volumes in the set, is also published as the Journal of Computational and Applied Mathematics; v.124 (2000). Indexed only by author. c. Book News Inc.
The solution of nonlinear, state-constrained, discrete optimal control problems by mathematical programming methods is described. The iterative solution consists essentially of Newton's method with a convex (or linear) programming problem solved at each iteration. Global convergence of the iterative method is demonstrated provided a convexity and constraint set condition are both satisfied. The computational solution of nonlinear equation control problems makes use of a previously developed method for state-constrained linear equation problems. The solution method for nonlinear problems is illustrated by means of two numerical examples. (Author).