

Kelley, C. T.

Iterative methods for linear and nonlinear equations. (English) Zbl 0832.65046

Frontiers in Applied Mathematics. 16. Philadelphia, PA: SIAM, Society for Industrial and Applied Mathematics. xiii, 165 p. (1995).

The book is intended for use as a tutorial and introductory reference for anyone needing to solve systems of nonlinear equations or large linear systems. It focuses on a small number of practically important methods and presents the basic theory of these methods required for an understanding of the properties of the algorithms and their implementation. Some further relevant results are cited without proof. The presentation assumes the reader to be familiar with elementary numerical analysis and linear algebra.

After some introductory chapter on basic concepts, the idea of Krylov space methods is introduced and the conjugate gradient and GMRES methods are discussed in detail utilizing a fine matrix-free formulation. Then, after a brief introduction to nonlinear systems, Newton's method and some of its variants are covered, followed by a chapter on inexact Newton methods and, especially, on the Newton-GMRES implementation. As an introduction to quasi-Newton methods, a nice discussion of Broyden's method is included. The final chapter addresses global convergence and focuses principally on some line search methods and the Armijo rule. Throughout the book, the material is illustrated with some computational examples utilizing MATLAB. The MATLAB codes are available from the publisher.

This is certainly a well-done introduction to the field which should be of interest to a wide audience.

Reviewer: **W. C. Rheinboldt** (Pittsburgh)

MSC:

65H10 Numerical computation of solutions to systems of equations

65-01 Introductory exposition (textbooks, tutorial papers, etc.) pertaining to numerical analysis

65F10 Iterative numerical methods for linear systems

Cited in **2** Reviews
Cited in **439** Documents

Keywords:

iterative method; conjugate gradient method; textbook; systems of nonlinear equations; large linear systems; algorithms; implementation; Krylov space methods; GMRES methods; inexact Newton methods; quasi-Newton methods; Broyden's method; global convergence; line search methods; Armijo rule; computational examples; MATLAB

Software:

KELLEY; Matlab