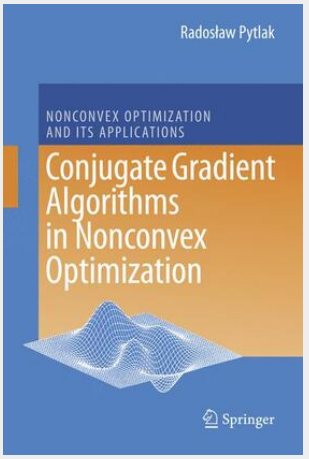
Pytlak

Conjugate Gradient Algorithms in Nonconvex Optimization

Conjugate direction methods were proposed in the early 1950s. When high speed digital computing machines were developed, attempts were made to lay the fo- dations for the mathematical aspects of computations which could take advantage of the ef?ciency of digital computers. The National Bureau of Standards sponsored the Institute for Numerical Analysis, which was established at the University of California in Los Angeles. A seminar held there on numerical methods for linear equationswasattendedbyMagnusHestenes, EduardStiefel andCorneliusLanczos. This led to the ?rst communication between Lanczos and Hestenes (researchers of the NBS) and Stiefel (of the ETH in Zurich) on the conjugate direction algorithm. The method is attributed to Hestenes and Stiefel who published their joint paper in 1952 [101] in which they presented both the method of conjugate gradient and the conjugate direction methods including conjugate Gram–Schmidt processes. A closelyrelatedalgorithmwasproposedbyLanczos[114]whoworkedonalgorithms for determiningeigenvalues of a matrix. His iterative algorithm yields the similarity transformation of a matrix into the tridiagonal form from which eigenvalues can be well approximated.Thethree-termrecurrencerelationofthe Lanczosprocedurecan be obtained by eliminating a vector from the conjugate direction algorithm scheme. Initially the conjugate gradient algorithm was called the Hestenes–Stiefel–Lanczos method [86].

This up-to-date book is on algorithms for large-scale unconstrained and bound constrained optimization. Optimization techniques are shown from a conjugate gradient algorithm perspective. Large part of the book is devoted to preconditioned conjugate gradient algorithms. In particular memoryless and limited memory quasi-Newton algorithms are presented and numerically compared to standard conjugate gradient algorithms. The special attention is paid to the methods of shortest residuals developed by the author. Several effective optimization techniques based on these methods are presented. Because of the emphasis on practical methods, as well as rigorous mathematical treatment of their convergence analysis, the book is aimed at a wide audience. It can be used by researches in optimization, graduate students in operations research, engineering, mathematics and computer science. Practitioners can benefit from numerous numerical comparisons of professional optimization codes discussed in the book.



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