Andrei, Neculai

Interior point methods in convex optimization. (Metode de punct interior în optimizarea convexă.) (Romanian)

Zbl 1041.90070
Bucureşti: Matrix Rom (ISBN 973-685-165-6). 389 p. (2000).

This is an advanced graduated level textbook dedicated to the most recent methods of mathematical programming based on interior point technique. In ten chapters, the book covers the main theoretical and computational aspects of interior point methods, both for linear and nonlinear programming.

Chapter 1 gives some details on optimization methods, optimization principles, convexity, as well as optimality conditions. In Chapter 2 some precursors of interior point methods, i.e., Frisch, Carroll, Parisot, Huard and Fiacco and McCormick are presented. In the same context an augmented Lagrangian method is detailed and computationally illustrated on four numerical examples. Chapter 3 considers cutting plane and ellipsoid methods for convex optimization. Chapters 4, 5 and 6 are dedicated to interior point methods for linear programming. The affine-scaling, path-following and homogeneous self-dual methods are clearly presented. Chapter 4 considers the affine scaling methods for linear programming. Some variants of scaling algorithms concerning primal, dual, with constraints partitioning and affine scaling in null space are also described. Chapter 5 discusses the path-following interior point methods for linear programming. Primal-dual and predicator corrector algorithms are introduced, and their complexity is proved. The topics sparsity, the LU factorization of the sparse matrices, as well as some properties of positive semi-definite matrices are treated. All the methods and the corresponding algorithms are numerically illustrated on large-scale linear programming problems. A proof of the polynomial complexity of the corresponding algorithm using the Mizuno-Todd-Ye strategy is included. Chapter 7 describes the interior point methods for semidefinite programming. The central trajectory and methods for reduction of primal-dual potential function are presented. Chapter 8 considers, at an introductory level, the second order conic programming. Examples and applications of semidefinite and second order conic programming are presented. Chapter 9 presents the interior point methods for nonlinear programming.

The author introduces here some original extensions from linear programming to nonlinear programming with linear or nonlinear constraints. The algorithms are clearly analyzed and numerically illustrated. The last chapter considers a new mathematical perspective of interior point methods for convex optimization, trying to answer the questions concerning the barrier function. The self-concordant barrier function of Nesterov and Nemirovski is considered.

As a conclusion, Andrei's book gives a modern, comprehensive and well balanced introduction into interior point methods for convex optimization and related topics. Some original contributions to interior point methods for nonlinear programming are presented. The algorithmic side of the subject is especially emphasized, containing plenty of theoretical and computational remarks. The material is presented at a very pedagogical level which facilitates the reading and understanding of the book by students.

Reviewer: **Vincentiu Dumitru (Bucureşti)**

MSC:
90C51 Interior-point methods

90-02 Research exposition (monographs, survey articles) pertaining to operations research and mathematical programming
90C25 Convex programming

Keywords:
interior-point method; convex programming; homogeneous self-dual methods; affine scaling methods; path-following interior point methods; semidefinite programming; conic programming; second order.

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