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Book Review

Yair Censor and Stavros A. Zenios, *Parallel Optimization — Theory, Algorithms, and Applications*. Oxford University Press, New York/Oxford, 1997, xxviii+539 pages. ISBN 0-19-510062-X (US $ 85.00)

This work presents and informative and elegant exposition of high-performance computing concepts, alorithms, and applications using multiple processors. Parallelism – due to inherent model structure or to solution algorithm structure – can be effectively exploited, to become a crucial factor in solving large-scale and/or complicated, numerically intensive optimization models. The subject is of high general interest for OR/MS and computer science professionals. This is particularly valid in the context of global optimization (GO), even if the latter subject is not treated explicitly in the work reviewed.

The book is divided into three major parts – respectively on theory, algorithms, and applications – and has 15 chapters. Chapter 1 precedes the main body of the text, by providing a concise inroduction to parallel computing, computers and algorithms.

Part I consists of three chapters. Chapter 2 deals with generalized distances and projections, discussing examples (Bregman functions and Csiszár divergences). These will serve as a basis to iterative algorithms discussed subsequently in detail. Proximal minimization methods – based on model regularization applying Euclidean and generalized distances – are introduced in Chapter 3. Penalty, barrier and augmented Lagrangian methods are the subject of Chapter 4: these approaches are not only effective in solving large-scale (convex) optimization problems, but are also put to use in model decomposition schemes discussed later in the book. The fundamentals of duality theory and the primal-dual algorithm scheme are also included.

Part II consists of four chapters. Chapter 5 is devoted to iterative methods for solving convex feasibility problems: classical projection methods, as well as computationally more advantageous variants and extensions of these are presented. Chapter 6 deals with algorithms for linearly constrained models; several algorithm-variants are discussed in full detail. Model decomposition – facilitated by the problem structure – is discussed in Chapter 7: a general framework is given, followed by the linear-quadratic penalty algorithm. Finally, interior point methods and the role of decomposition in their context are discussed in Chapter 8.

Part III introduces important, large-scale applications from several areas. These include matrix estimation problems (Chapter 9), image reconstruction from projections (Chapter 10), radiation therapy treatment planning (Chapter 11), multicommodity network flow models (Chapter 12), and several stochastic programming models (Chapter 13). Chapter 14 is of more general character, discussing decompositions for parallel computing. Finally, Chapter 15 deals with key aspects of numerical studies in parallel optimization: namely, a summary on reporting computational experiments is followed by results to the case studies presented in the book, and by a short description of parallel machines used in these experiments.

Some 800 references and a well-detailed index assist the further orientation and studies of Readers. (A few typos – practically unavoidable in a book of this size and complexity – are corrected on Errata pages provided separately.)

The exposition is clear and well detailed throughout the work. Each chapter starts with an informal and clear introduction to its subject, and is concluded by additional notes and related precise references. Examples and figures supplement the discussion throughout. The book describes numerous algorithms, in sufficient details ready to implement. (Without doubt, this feature can be put to good use, also in constructing local search components in – automated or menu-driven – GO strategies.) The computational aspects are appropriately emphasized.

Although the book focuses on convex proramming techniques, its relevance for global optimization – from several perspectives – is evident. For future editions, one could suggest to the authors to extend the discussion, to cover at least some of the more closely related subjects from GO.

In summary, the work of Censor and Zenios is recommended for professors and graduate students, researchers and practicioners working in operations research, management science, computer science, and their applications. In the Preface, notes on recommended courses based on the text are also provided.

It is a pleasure to note finally that the authors received the 1999 INFORMS Computing Society Prize for research excellence in the interface between OR and CS, for their book.

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