



Book Review

Hiroshi Konno, Phan Thien Thach and Hoang Tuy, *Optimization on Low Rank Nonconvex Structures* [Nonconvex Optimization and Its Applications Series Vol. 15]. Kluwer Academic Publishers, Dordrecht/Boston/London, 1997, 457 pages, ISBN 0-7923-4308-5.

This book is devoted on a special class of optimization problems with so-called low rank nonconvex structures. As global optimization became widely studied and applied, many different aspects of nonconvex optimization problems have been exploited in this area.. Optimizing a problem with low rank nonconvex structures is one of the most interesting subjects due to its frequent appearance in numerous engineering and economic problems. In fact, many instances of nonconvex optimization problems have been solved successfully by applying general methods such as outer approximation, cutting plane, branch and bound, inner approximation, partitioning, and decomposition, when the size of the instance is relatively small. However, we usually experienced that the computation time grows fast as the size of the instance increases. Thus, it is very useful to exploit the special structure of these problems to improve the performance of solution methods.

This book is motivated by many recent developments on efficient algorithms for solving several classes of large scale specially structured problems in such area as chemical engineering, network optimization, financial engineering, production and inventory control, engineering design and computational geometry. Most of these nonconvex optimization problems can be characterized by the property of becoming convex when a few variables are fixed or, more generally, when a vector of the form Bx is fixed, where B is some affine mapping of low rank.

In this book, the authors provide a wide scope of this special topic including fundamental global optimization concepts and principles. The book consists of three parts as follows.

Part I, entitled ‘Foundations’ introduces the theoretical basis for optimization on low rank nonconvex structures. Chapter 1 contains some fundamental concepts and properties of quasi-convex functions which have applications in many solution methods for important classes of nonconvex problems. As a tool for the variational analysis of quasi-convex minimization problems the concept of quasi-subdifferential is also discussed. Chapter 3 is devoted to a systematic study of general properties of d.c. functions and d.c. sets. Since virtually every nonconvex optimization problem can be described in terms of d.c. functions and/or d.c.

sets, the study of d.c. structures is very important for the design of efficient solution methods for these problems. More specific results concerning duality and partitioning (decomposition) on the d.c. structure are also discussed.

Based on the previous part, Part II, entitled 'Methods and Algorithms', is devoted to numerical methods and algorithms for solving typical classes of global optimization problems by exploiting their low rank nonconvex structures. Parametric-simplex algorithms are discussed in Chapter 7 for low rank nonconvex quadratic and low rank concave minimization problems. In Chapter 8 to 11, several nonconvex optimization problems such as multiplicative programming problems, monotonic problems, reverse convex programming problems, and nonconvex multi-stage problems are studied with successfully implemented solution approaches and algorithms such as parameterization/outer approximation algorithms, decomposition methods by prices, and dynamic programming approaches.

The most advantageous topics to readers who want to see how low rank nonconvex structures occur in real-world situations are included in Part III, which is entitled 'Selected Applications'. This part also illustrates how concepts and algorithms developed in the previous parts can be applied to their study areas. Classical examples, including continuous location problems (Chapter 12), engineering design problems (Chapter 13), and multiobjective and multilevel programming problems are presented.

This book also contains a list of references consisting of 402 articles and books, which provides valuable information to researchers in this field. The book contains a wealth of material, some traditional, some new and still subject to debate. It would be a valuable reference source for researchers working on algorithms for solving problems with low rank nonconvex structures.

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