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BOOK REVIEW

János D. Pintér, ed. (2006), Global Optimization: Scientific and Engineering Case Studies, Springer Verlag Nonconvex Optimization and its Applications series, 546 pp., ISBN 0-387-30408-8.

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The general subject of global optimization deals with finding the overall minimum of a nonlinear, non-convex objective function, subject to nonlinear, non-convex equality and inequality constraints and (possibly) bounds on the variables. Although important in applications, a direct general solution of this problem is not possible; in particular, no algorithm is known to solve all instances of the general problem in a time that increases less than exponentially with the number of variables and constraints. Moreover, certain important instances of this problem are known to be difficult to solve, even though these instances have only a small number of variables.

Thus, even high-quality commercial packages that address the general global optimization problem may fail to deliver a solution in a practical amount of time. However, efficient solution of particular instances of global optimization problems gives substantial business, scientific, or engineering benefits. Fortunately, many such particular global optimization problems can be solved by taking advantage of structure particular to the problem. Success in such endeavors often is the result of a concerted interdisciplinary effort between experts in the field, modelers, and experts in the mathematical and algorithmic aspects of optimization.

During the past decade experience has amassed with ad hoc techniques for particular problems arising in business, science, and engineering. Persons wishing to deal with models whose analysis involves difficult global optimization problems are well-advised to learn from this experience. This can be done partly by studying collections of case studies. The book *Global Optimization: Scientific and Engineering Case Studies* is such a collection of case studies. The studies in this collection are (listed as in the editor's preface):

- agroecosystem management
- assembly line design
- bioinformatics

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- biophysics
- black box systems optimization
- chemical process optimization
- chemical product design
- composite structure design
- computational modeling of atomic and molecular structures
- controller design for induction motors
- electrical engineering design
- feeding strategies in animal husbandry
- inverse position problem in advanced kinematics
- laser design
- learning in neural nets
- mechanical engineering design
- numerical solution of equations
- radiotherapy planning
- robot design
- satellite data analysis
- water resources systems
- wireless communications systems

These chapters vary in style, and represent work varying from that of a single researcher to a large group or laboratory. Nonetheless, a common thread running through these chapters is that they describe in some detail the application area, then describe the solution methodology, then describe successes and open questions. In some of the chapters, significant successes, such as discovery of better designs, discovery of previously unknown but physically meaningful configurations, or discovery of feasible points with significantly lower values of the objective function, are touted. In others, weaknesses in the present methods and techniques are revealed, and the need for further research is explained.

This collection should thus be of use to researchers in algorithms and theory of global optimization, especially those involved in consulting or on teams dealing with practical models. For instance, researchers can gain a better idea of what works in practice and where additional advances would be useful. The collection should also be of use to researchers in particular applications and other consumers of optimization results, since the problems and solution techniques are described in enough detail to allow others to gain from the authors' experiences.

The contributing authors are L. E. K. Achenie, G. M. Ostrovsky and M. Sinha (solvent design); D. L. J. Alexander, P. C. H. Morel and G. R. Wood (maximizing gross margin in pig production); S. Allen, S. Hurley, V. Samko and R. Whitaker (optimized design of dynamic networks), A. M. Azmi, R. H. Byrd, E. Eskow and R. B. Schnabel (protein conformation); J. P. K. Doye (atomic clusters); B. Hartke (atomic clusters); A. G. Hatzigeorgiou and M. S. Megraw (DNA sequences); G. Isenor, J. D. Pintér and M. Cada (laser cavity field solution); C. Lavor, L. Liberti and N. Macaulan (molecular distance geometry); . Liberatore, G. M. Sechi and P. Zuddas (water resource systems); P. Maponi and F. Zirilli (the phase unwrapping problem); A. Osyczka and S. Krenich (evolutionary algorithms); O. Ozturk, P. C. Doerschuk and S. B. Gelfand (determining the 3-D structure of spherical viruses); C. S. Pedamallu and L. Özdamar (the inverse position problem); V. P. Plagianakos, G. D. Magoulos and M. N. Vrahatis (improved learning of neural nets); B. Rekiek, P. De Lit and A. Delchambre (design of assembly lines); R. Seppelt (agroecosystem management); Ya. D. Sergeyev (finding the minimal root of an equation); J. Tervo, P. Kolmonen, J. D. Pintér and T. Lyyra-Lahtinen (optimization of radiation therapy dose); Y. Wu, L. Özdamar and A. Kumar (black box optimization); Z. B. Zabinsky, M. E. Tuttle and C. Khompatraporn (composite structure design), and Q. M. Zhu, L. Z. Guo and Z. Ma (controller design for induction motors).