8[14Qxx, 65-06, 65D17, 68U05].—ROBERT E. BARNHILL (Editor), *Geometry Processing for Design and Manufacturing*, Geometric Design Publications, SIAM, Philadelphia, PA, 1992, x + 211 pp., $25\frac{1}{2}$ cm. Price: Softcover $36.50.

This book contains a collection of nine papers relating to geometry processing, along with a bibliography on surface-surface intersection methods. Most of the papers are based on lectures given at a SIAM conference on geometric design held in Tempe, Arizona, in 1989. The editor defines geometry processing to be the calculation of geometric properties of already constructed curves, surfaces, and solids. His stated aim for the book is to spur a unifying development of the subject.

We paraphrase here the editor's descriptions of the papers: 1) R. Farouki develops special offset curves which can be parameterized by rational functions, 2) R. Barnhill, T. Frost, and S. Kersey use a combination of geometric and numerical techniques to find self-intersections of networks of general triangular or rectangular parametric patches, 3) J. Hoschek and F.-J. Schneider develop suitable approximations for conversions between B-spline surfaces, 4) G. Farin compares knot removal and degree reduction as tools for fairing B-spline curves and surfaces, 5) E. Brechner presents general envelope methods for determining offsets, 6) R. Barnhill, B. Bloomquist, and A. Worsey develop adaptive contouring algorithms for the contouring of surfaces which are networks of triangular polynomial patches, 7) L. Piegl discusses algorithms for dealing with surfaces having special mathematical forms (such as natural quadrics and extruded surfaces), 8) N. Patrikalakis develops surface-surface intersection algorithms for the implicit-parametric and parametric-parametric cases, and 9) K. Wang discusses intersection problems for rational parametric surfaces. The SSI bibliography of G. Farin contains about 50 articles.

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9[49M45, 49M40, 49M37, 03D15].—STEPHEN A. VAVASIS, *Nonlinear Optimization: Complexity Issues*, The International Series of Monographs on Computer Science, Vol. 8, Oxford Univ. Press, New York, 1991, x + 165 pp., 24 cm. Price $39.95.

This is a well-written, concise, and accurate book covering a range of subjects in nonlinear optimization and complexity. The writing style is lively and holds the reader's attention.

Chapter 1 contains introductory material concerning convexity and optimality conditions. Chapter 2 starts with a brief introduction to complexity theory, Turing machines and models of computation, the P and NP classes of problems, and NP-completeness. In addition, several problems are proved to be NP-complete, including the general quadratic programming problem.

Chapter 3 is devoted to convex quadratic programming. The author starts with a nice example, presenting a strongly polynomial-time algorithm for separable quadratic knapsack problems. Next, an interior-point algorithm is given for the general convex quadratic minimization problem. The interior-point algorithm presented (first proposed by Renegar and Shub) is a primal dual method with logarithmic barriers. It follows a central path and takes small steps. The chapter ends with a discussion on strongly polynomial-time algorithms.

In the case of nonconvex quadratic programming, there is no known, efficient, general-purpose algorithm for computing the global minimum, since this problem is NP-complete. Chapter 4 begins with special cases of nonconvex quadratic problems that remain NP-complete, such as problems defined on the unit simplex and problems with box constraints. The problem of minimizing a quadratic function with an ellipsoid constraint is then considered. Although robust algorithms have been proposed (e.g., in trust region methods) for this problem, the complexity of the problem was not analyzed until Ye provided a polynomial-time algorithm in 1988. A similar algorithm is also credited to Karmarkar in 1989. The chapter ends with a discussion on a simple enumerative algorithm for the general indefinite quadratic problem.

Local optimization and complexity is the focus of Chapter 5. In the first section of the chapter, it is shown that the general problem of local optimality for nonconvex quadratic problems is NP-hard. This is a surprising result since, in many classical optimization algorithms, it has been assumed that local optima are easy to find. In fact, the reviewer has shown that even the problem of checking the existence of a Kuhn-Tucker point for a nonconvex quadratic problem is also NP-hard. In the other two sections of the chapter some theorems are proved that characterize local minima, and a strongly polynomial algorithm is presented for computing a local minimum of separable quadratic knapsack problems.

The last part of the book (Chapter 6) is dedicated to the black box model. In many practical optimization problems the objective function $f(x)$ is not provided analytically, but is available as a black box; that is, given x, the black box returns the value $f(x)$. In this model, it is possible to prove lower-bound complexity results based on how much information an algorithm can obtain about the objective function (information-based optimization). In the first section, it is shown that the worst-case complexity for global minimization, in the information model, is exponential in the number of variables and the number of digits of accuracy. It is then shown that, in the case of local minimization, the dependence on the number of digits remains exponential, but the running time is polynomial in the number of variables. Regarding convex minimization, however, it is shown that there is an efficient information-based algorithm for this problem.

Each chapter of the book ends with a list of carefully selected problems that complete and extend the material presented. As we can see, the book presents interesting material regarding complexity issues in nonlinear optimization. I highly recommend this book. It will be a valuable source for researchers and students in nonlinear optimization. The detailed index and the rich bibliography enhance the usefulness of this elegant publication.

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