Despite these critical remarks there is no doubt that the book will help to decrease the gap between abstract differential geometry and its applications in computational mechanics. It may be recommended to all mathematicians and engineers who are interested in the theoretical analysis of constrained mechanical systems and in practical applications of differential geometry.

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12[90C30, 90C25, 65K05]—*Trust-region methods*, by Andrew R. Conn, Nicholas I. M. Gould, and Philippe L. Toint, SIAM, Philadelphia, PA, 2000, xix+959 pp., 26 cm, softcover, $119.00

This giant monograph is the first book (until now, it is also the only one) published on trust-region methods. Trust-region methods are a class of numerical methods for solving nonlinear optimization problems. These methods are reliable and robust, they can be applied to ill-conditioned problems, and they have very strong convergence properties. The authors are three distinguished researchers having long been involved in the development and implementation of algorithms for large-scale numerical optimization. They were corecipients of the 1994 Beale–Orchard–Hays prize for their work on the LANCELOT optimization package.

The aims of the book are best stated by the authors in the Preface:

> *Three major aims are, firstly, a detailed description of the basic theory of trust-region methods and the resulting algorithms for unconstrained, linearly constrained, and generally constrained optimization; secondly, the inclusion of implementation and computational details; and finally, substantive material on less well-known advanced topics, including structured trust regions, derivative-free methods, approximate methods (including noise), nonmonotone algorithms, and nonsmooth problems.*

Chapter 1 is a brief introduction, which gives a description of fundamental trust-region ideas, overviews the history of trust-region methods, and tables some references of applications of trust-region methods in science and engineering. Chapters 2 to 5 are some background mathematics, including vector spaces, matrix analysis, optimality conditions, and methods for solving linear systems and eigenproblems.

Chapters 6 to 11 are about trust-region methods for unconstrained optimization. The formal description of a Basic Trust Region (BTR) algorithm is given and convergence analysis is presented. One whole chapter is devoted to the trust-region subproblem, including its theoretical properties and the numerical methods for solving it. The final chapter of this part of the book is about trust-region methods for nonsmooth problems.

Trust-region methods for convex constrained problems are the focus of Chapters 12 and 13. One chapter is about projection methods and the other is about barrier methods.

Chapters 14 to 16 are dedicated to general nonlinear constrained problems. Various penalty function methods are described in Chapter 14, and in this chapter, trust-region methods are not mentioned except that they are used for minimizing the penalty functions. Trust-region methods based on Sequential Quadratic Programming (SQP) type approaches are discussed extensively in Chapter 15, which is the longest chapter in the book. Chapter 16 is about methods for nonlinear equations, nonlinear least squares, and nonlinear complementarity problems.

The last chapter of the boo, Chapter 17, is devoted to software and implementation issues. Questions, such as how to choose algorithmic parameters, how to choose initial trust-region radius, and how to compute Cauchy points, are addressed in this chapter.

The book gives a detailed, systematic, and comprehensive description of trust-region methods. It is a very good summary of works having been done. In some sense, it can be regarded as an encyclopedia of trust-region methods, and I believe that it will be an important reference in this area for many years. I like very much the comments under the title "Notes and References" at the end of each section. These discussions are not only good supplements to the main text but also give nice guidance for further research ideas. The long list of annotated bibliography entries is very helpful to researchers and graduate students who want to explore the field in depth.

The thickness (consequently the price) might be a burden if the book is used as a graduate text book. Also, for graduate students, it would be better if exercises were added at the end of each chapter.

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13[65F05, 65F25, 65F35]—*Fast reliable algorithms for matrices with structure*, T. Kailath and A. H. Sayed (Editors), SIAM, Philadelphia, PA, 1999, xvi+342 pp., 25 1/2 cm, softcover, \$59.50

The topic of these unusual proceedings is the design of fast and reliable algorithms for large scale matrix problems with structure. Here structure is mostly understood as "displacement structure" and encompasses Toeplitz-, Hankel-, Loewner-, Cauchy-matrices and others. As the standard stable matrix algorithms usually destroy the structure and are thus not fast, it is a problem to construct fast and reliable ones. Three recent meetings in Santa Barbara, USA, Cortona, Italy,