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book reviews

The Boundary Element Method. By C. A. Brebbia. Halsted Press, A Division of John Wiley & Sons, Inc. 1978. Pages 189. Price $27.50.

REVIEWED BY T. A. CRUSE[1]

Application of the boundary-integral equation method to the solution of significant engineering problems in potential theory and elasticity is inherently tied to the digital computer. The reviewed monograph is therefore of particular interest to graduate students and engineers who are seeking access to computer codes which allow direct exposure to this method. The author has placed a reasonable emphasis on the computer basis of this method with FORTRAN code listings, user instructions, sample problems and theoretical bases for two-dimensional potential theory and elasticity. Further, the programming approach to various levels of boundary data modeling is introduced for piecewise constant, linear, and quadratic variations; the first two levels of FORTRAN code are given for the potential theory application. While the reviewer cannot, of course, certify the listed codes, they are clearly presented with ample annotation and explanation.

The remaining half of the book is given over to a discursive treatment of the boundary-integral equation (BIE) formulation as seen by a finite-element view of mechanics. As a first step, the author has determined to call the BIE method (representing a particular integral equation formulation) the boundary element method. This reviewer strongly feels that there are many boundary element methods, but only one BIE method. Second, the author seeks to show that the BIE is but a subset of weighted residual methods in order to present a unified framework for BIE and finite-element methods. Such unified frameworks obfuscate the essential differences of the methods, and certainly do not serve the introductory user for whom this monograph may be useful. Finally and most unfortunately, the author commits some fundamental errors through cavalier treatment of the BIE formulation which the reviewer can only assume is due to the apparent haste with which this monograph was assembled. These errors concern "indirect" potential formulations (Kupradze [1]) versus "direct" potential formulations (BIE [2]), use of double corner nodes for linear variation models, definitions of principal value integrals, and a quasi-finite element formulation of the BIE.

Fortunately, the basic errors do not concern the person for whom the monograph is intended, nor the more sophisticated mechanician familiar with the research publications in this area. The number of typographical errors in the text is not great and reference to the source of the models or examples used and other current literature is reasonably generous and accurate.

References

1 Kupradze, V. D., *Potential Methods in the Theory of Elasticity,* Daniel Davey & Co., New York, 1965.

2 Cruse, T. A., "Numerical Solutions in Three-Dimensional Elastostatics," *International Journal of Solids and Structures,* Vol. 4, 1969, pp. 1259–1274.

[1] Pratt & Whitney Aircraft Group, United Technologies Corporation, East Hartford, Conn. 06108.

Foundations of Theoretical Mechanics I. By R. M. Santilli. Springer-Verlag, New York Heidelberg Berlin. 1978. Pages 266. Price $29.80.

REVIEWED BY H. H. E. LEIPHOLZ[2]

This book is a first part of a work on the foundations of theoretical mechanics which, in the view of the reviewer, is truly epoche-making. It is usually assumed that methodological formulations for describing Newtonian systems are well established. However, if one takes a closer look, it turns out to be true only for systems with forces derivable from a potential, i.e., for conservative systems. But, in fact, real systems are actually nonconservative. For example, friction in constraints is always present. As a matter of fact, theoretical mechanics in its present form does not provide methods of approach for such nonconservative systems which are equally well developed as those available for classical, conservative systems. It is the merit of the author to have recognized this situation and to have outlined a theory which is able to cover mechanical systems beyond the limit of classical assumptions. The book will therefore be a stimulation for subsequent research and will probably lead to a reformulation of theoretical mechanics removing the restrictive classical bounds of this discipline.

The author first realizes the basic importance of self-adjointness of a problem for the existence of a Lagrangian and Hamiltonian. He then studies the necessary and sufficient conditions for the availability of these two functionals on which classical mechanics is founded, and he comes up again and again with the concept of self-adjointness. Naturally, his investigations lead also to a consideration of the *inverse problem* which consists in determining whether there exists a functional which admits the known solutions of a system of equations as extremals. Essentially, this problem is equivalent with finding out whether there are variational principles available for nonconservative mechanical systems because for classical, conservative systems which are self-adjoint, the answer to the inverse problem is definitely in the affirmative.

The book is written in an abstract, mathematical way. Yet its topics and its results are of eminent practical value to the engineer. It is hoped that this will be recognized by the man in practice, who, by reading the book intelligently, will have a remarkable gain for his own approach to mechanical problems. The practical engineer would have an easier access to the material presented in the book, if the author would not only have quoted physicists and mathematicians, who had contributed to the topic, but also engineers, who over the last two decades had realized as well in a number of recent publications the need for generalized variational principles and a methodical treatment of nonconservative systems. By means of these references, examples would have been provided which would have been of greater appeal to engineers than the mostly mathematically formulated examples in the book.

Summarizing, it can be said that this is a remarkable book of highest quality and of greatest importance to anybody who is interested in the progress of theoretical mechanics to the advantage of the engineering profession.

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