Journal of Applied Mechanics

Book Reviews

Structural Modelling and Optimization. By D. G. Carmichael. Ellis Horwood Ltd., Chichester, England, 1981. 306 Pages. Price $69.95

REVIEWED BY J. E. TAYLOR[1]

This unique book on optimal structural design features a broad, nicely integrated, and well-documented exposition on mathematical methods in optimization. Special attention given to details of organization have resulted in a form and style of presentation that is both unusually orderly and functionally effective. The author states that his book is "aimed at the graduate student and reference text level." It should in fact prove to be unusually useful as a source book for serious analysts in any of the various disciplines where methods of optimization or control theory are applied.

The author's object in preceding the material on optimization with a treatment of modeling is to establish right at the start a well-organized scheme for the representation of structural analysis. Thus the material of Part A of the book serves to fix the technique and nomenclature for analysis in a style identified as an "engineering systems approach." Topics by chapter title are: A Basis for Modelling (multilevel and single level systems representations are discussed), Single Level State Space Modelling, Model Decomposition, and Staged Systems.

A discussion of "design," stated in general terms, is provided in the 25-page second section of the book. Ideas related to design "in a systems sense," and to the "design process" are presented. A definitive statement on the theory of optimal control is given along with a detailed description of the "The Optimal Control Problem." This material reflects the author's uniform commitment to relate his presentations wherever possible to the style and methods of control theory. A basis for categorization of problems is introduced here as well. The categories are identified with the respective form of equations for analysis: ordinary differential, partial differential, algebraic, and difference.

The major substance of the book is comprised of the material in Part C, entitled, "Deterministic Optimization." A rather comprehensive treatment of mathematical methods is provided in chapters titled: Mathematical Programming, Dynamic Programming, Pontryagin's Principle: Variational Calculus, Singular Control, Multicriteria Optimization, Multilevel Optimization, Lyapunov Theory in Design (to accommodate treatment of stability problems), and Energy and "Optimality Criteria" Based Design. Example structural optimization problems are included in most of these chapters.

Treatments in the text are tied together chapter-by-chapter to developments in the literature via the brief discussions furnished in separate sections entitled, Notes, Comments, and Bibliography. Those sections collectively comprise a valuable annotated listing of roughly 800 references.

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Recent Developments in Thermomechanics of Solids. Edited by G. Lebon and P. Perzyna. Springer-Verlag, New York, 1981. 415 Pages. Price $43.70

REVIEWED BY W. O. WILLIAMS[2]

This book presents the texts of three courses presented at the International Center for the Mechanical Sciences (CISM) at Udine. The utility of such courses may be questionable; because the audience usually includes people with no knowledge of the subject and also specialists in the subject, the lecturer feels obliged to begin with very elementary ideas and proceed to very specialized ones, satisfying neither audience. With this in mind one can say that the virtue of such lectures is that they may give a flavor of the subject and a view of its breadth and may also serve as an introduction to the specialized literature. The three presentations here, to varying degrees, possess both of these virtues.

K. Wilmanski in the article "Thermodynamic Foundations of Thermoelasticity" gives an (unfortunately) brief sketch of his ideas for thermodynamics of continua based on accessibility and inherited states. He proceeds to describe the axiomatic derivation of the field equations due to Gurtin and Williams and then introduces constitutive relations, using the scheme of Müller to deduce the equations for a rigid heat conductor including dependence on temperature rate. He then discusses the conductivity types of such materials, following Chadwick and Curie, briefly relating these to the type of heat conduction equation (hyperbolic under some natural restrictions). A final section discusses waves in such materials.

P. Persyna in "Thermodynamics of Dissipative Materials" aims toward viscoplastic materials. He begins with another brief exposition of the axioms of the field theory, then goes on to discuss a class of simple materials (within the format of Noll's "New Theory") whose local states are described by configuration and the vaguely described "method of preparation." He then introduces materials whose state is described by internal state variables, dividing these into those related to internal friction and those related to thermoactivated mechanisms. The next section relates these to rate-type theories, which leads to a discussion of the internal variable description of viscoplasticity. The corresponding evolution equations are related to the behavior of dislocation and there is some discussion of experimental results. This section is quite interesting and has many references to the literature. Finally he presents a brief discussion of rate-independent plasticity theory.

G. Leblon in "Variational Principles in Thermomechanics" begins with a not completely precise but very clear description of basic variational calculus. He emphasizes the approximation of variational and quasi-variational

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