Finite Elements in Biomechanics. By R. H. Gallagher, B. R. Simon, P. C. Johnson, and J. F. Gross. Wiley, New York, 1982. pp. xiv–404. Price $48.50.

REVIEWED BY R. D. CROWNINSHIELD[3]

The First International Conference on Finite Elements in Biomechanics was held in Tucson, Ariz. February 18–20, 1980. This conference, which was sponsored by the United States National Science Foundation and the College of Engineering of the University of Arizona, contained about 60 presentations which covered a wide variety of finite element applications in biomechanics. The conference organizers (editors of this book) invited the authors of 18 of these presentations to prepare manuscripts for publication in this book.

The book starts with the introduction of a clinician's view and then a finite element specialist view of the method. G. T. Rab presents his views on the finite element method, special model problems with biologic materials, and problem of clinician-engineer collaboration. O. C. Zienkiewicz and D. W. Kelley then present the basic outline of the finite element process, its historical development, present trends, and its impact on the field of bioengineering.

The remainder of the book presents a diverse array of finite element applications in biomechanics. Two chapters address the mechanics of biologic fluid flow. Normal mechanics of capillary flow, arterial flow, blood cell deformation, and peristaltic flow are discussed. Special problems of pulsatile flow through a stenosis and through an aneurysm are also considered.

The application of the finite element method in soft tissue mechanics is demonstrated in an introductory chapter and a subsequent series of chapters dealing with the mechanics of the lungs and heart. Analyses of the role of interfacial forces in lung deformation, lung parenchyma, and the heart's left ventricle are discussed.

The remainder of the book, and by far the most indepth treatment of a subject, is devoted to the finite element method applied to solid mechanics, predominantly orthopaedic problems. After a survey chapter on the role of finite element models in orthopaedics, subsequent chapters address specific orthopaedic applications. An application of the finite method to external fracture fixation devices is followed by studies of stress-morphology relationships in trabecular bone, stress distributions in the femoral head, intervertebral disk function, the mechanics of artificial joint fixation, cement-bone failure, the function of femoral endoprostheses, and head and neck injury mechanisms.

This book assembles the highlights of what was a very interesting biomechanics conference. The presentations chosen for inclusion in this book survey well the diverse application of the finite element method to biomechanics problems and illustrate important problems unique to finite element modeling of biologic systems. The reader is introduced to problems associated with biologic variability, growth and maturation, nonlinear materials, anisotropic materials, incompressible materials, viscoelastic materials, and structural pathology. The book as a whole serves as an excellent introduction for the experienced finite element programmer to the applications and special problems of biologic system modeling. The individual chapters present new data, discussion, and reference useful to the reader with interest in one or more of the specific subject areas.

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Optimality in Parametric Systems. By T. L. Vincent and W. J. Grantham. Wiley, New York, 1982. 243 Pages. Price $34.50.

REVIEWED BY W. STADLER[4]

If optimization methods are ever to become standard tools of analysis in industry, they must be introduced on a regular basis at an undergraduate level. The present book is very readable and could be used as an undergraduate text. With the exception of some supplements on differential calculus and cones in R^n, the needed mathematical background should include differential equations and linear algebra, a level usually attained by seniors in engineering.

Only about 30 pages of the book pertain to optimality in parametric systems, about half of the book concerns nonlinear programming, and the remainder is devoted to gametheoretic concepts. Throughout, it is generally assumed that the criterion functions and the constraint functions are differentiable as needed, resulting in theorems and proofs that are relatively easy to apply and follow, respectively.

With the exception of three examples and their various treatments, all of the examples are academic and there are no direct applications to mechanics. However, in mechanics, as well as in other areas, there is a need for a formal treatment of optimization problems involving the simultaneous "minimization" of several criteria. This requires some new notions of optimality. Although such concepts as Pareto optimality have been around in economics for nearly 100 years and game theory was conceived by Borel in 1921, they have only found their way into the engineering literature within the last 20 years. The authors provide a fairly detailed treatment of Pareto optimality as the optimality concept for the "vector maximum problem" and they treat Nash-equilibrium, min-max, and Stackelberg Leader-Follower solutions in a gametheoretic context. The authors, as well as others, usually introduce these concepts as possible resolutions between antagonistic "rational" players; however, they can also serve as optimality concepts for the vector maximum problem. Thus, min-max clearly is suited for worst case design, and the Nash-equilibrium concept could be used when one might wish to assure that one criterion maintain a lower bound when one of the design variables is changed with all others remaining fixed at the optimal design. Collectively, all of the games may be viewed as "games against nature" played by a single decision maker.

In summary, the book provides a needed transition from the treatment of these topics in monographs and in a research context to possible classroom use.

Theory of Dislocations (2nd ed.). By J. P. Hirth and J. Lothe. Wiley, New York, 1982. pp. xii–857. Price $72.95.

REVIEWED BY T. MURA[5]

This book is based on the lecture notes developed by the authors for courses on the theory of dislocations at Carnegie Institute of Technology, The Ohio State University, and Oslo University. The first edition of this book was published by McGraw-Hill, in 1968. The present major revision is made in the sections related to elastic theory of dislocations. Accordingly, the works of Willis, Barnett, and Asaro, among

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