- The main families of finite elements
- Inverse inequality and Aubin-Nitsche theorem.

It has the merit of being short and comprehensible.

The rest of the book is devoted to applications of the previously introduced tools. In Chapter 6 the Laplace equation is considered and the authors present the essentials of Giraud's theory, i.e., the $C^{0,\alpha}$ theory of the potentials and jump properties associated with the Laplacian, and they deduce all the classical limit behavior at the boundary of these potentials. Using then the pseudodifferential operator results in the case of data in some Sobolev spaces, they extend these properties. They also give the coerciveness property of the simple-layer potential (with a wrong historical reference). We also must mention that the finite parts used by the authors are incorrect to treat the double-layer potentials (page 279 and following). There follow some numerical examples, quite elementary, but interesting from the pedagogical point of view. Chapter 7 is devoted to the Helmholtz equation. It contains a nice presentation of most aspects of the problem, including the radiation condition, the problem of interior eigenvalues and also some nice numerical experiments (in color). Chapter 8 concerns the plate problem and is rather confusing, although the main ideas are quite clear. The presentation of the triple or quadruple layer is probably original but only sketched. Chapter 9 contains a classical treatment of elastostatics and would be simplified by the use of a quotient space. Chapter 10 contains some aspects of error estimates with emphasis on approximation by splines (and collocation).

In conclusion, despite some weaknesses, the book is well written and quite clear. Most of the material is largely classical and already contained in some text books. But the selection of topics is good in general, and it is probably one of the first self-contained books on the subject of boundary integral equations (except [1]). This is its main interest that will make it very useful for Ph.D. students working on this subject.

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1. R. Dautray and J.-L. Lions, *Analyse mathématique et calcul numérique pour les sciences et les techniques*, tome 3, Masson, Paris, 1985.

**19[65-06, 65Lxx, 93-06].**—EDWARD J. HAUG & RODERIC C. DEYO (Editors), *Real-Time Integration Methods for Mechanical System Simulation*, NATO ASI Series, Series F: Computer and Systems Sciences, Vol. 69, Springer, Berlin, 1991, viii+352 pp., 25 cm. Price $79.00.

Among the many published proceedings, this one from an August 1989 NATO Advanced Research Workshop can be strongly recommended. The authors of the 18 contributions work in mechanical engineering and numerical mathematics. All come from industries, universities, and research institutes. The talks deal with the numerical performance of multibody system formulations for specific examples and in general. The resulting mathematical model is a differentialalgebraic equation (DAE) or, in the case of state-space coordinates, an ordinary differential equation (ODE). In applications, a DAE can be generated automatically on a computer and serves as a possible basis for a CAD/CAE package. But one has to pay a price for this automatic modelling of a multibody system. The DAE includes redundant information; this causes new theoretical and numerical problems. A desired set of state-space coordinates may require analytical work and then results in an ODE whose theoretical and numerical problems are well understood. On the other hand, it is difficult to incorporate tricky analytical solution techniques into a software package. These few remarks on DAEs, ODEs, and mechanical systems may serve as a backdrop for the contributions in this book, which are grouped in three parts.

The first part consists of seven reports, which are introductory in character. Multibody system formalisms are introduced and applied to examples in articles by C. Deyo (vehicle suspension); H. Frisch (general problem description); R. Beck (army vehicles); R. Schwertassek, W. Rulka (wheel-rail systems, vehicles, robots). The theoretical and numerical properties of DAEs are discussed by C. W. Gear (index definition) and L. Petzold (DAE solver DASSL). A coordinate partitioning method for the numerical solution of multibody systems is presented by E. Haug and J. Yen.

The second part includes six contributions mainly dealing with the question of how to overcome the index problem of DAEs. Mechanical systems with constraints on the acceleration level are of index 1; constraints on the velocity level lead to index-2, and constraints on the position level lead to index-3 DAEs. Today the solution of index-1 DAEs is well understood, whereas DAE with index greater than 1 are a topic of current research. C. Führer and B. Leimkuhler study the overdetermined approach and show the equivalence to a state-space formulation. Ostermeyer discusses the Baumgarte approach as a control-theoretical tool, see also D. Bae and S. Yang. A different view of DAEs as differential equations on manifolds is given by F. Potra and W. Rheinboldt. Parallelization techniques like waveform relaxation and multirate methods are discussed by C. W. Gear and by W. Bruijs et al.

Different DAE applications are summarized in the five contributions of the third part. J. G. de Jalon et al. present several interesting mechanical systems, developing a special multibody system approach. S. Sparschuh and P. Hagedorn discuss a discretization of the Gauss principle. Control theory and applications are discussed by W. Cotsaftis and C. Vibet. Different numerical discretization schemes—among them the BDFs—for multibody formalisms are studied by J. Meijaard and by M. Steigerwald.

In summary, these proceedings present a broad spectrum of interesting current research in multibody system dynamics and in DAE techniques. The book is a must for libraries and researchers in this field. For nonspecialists it presents a valuable introduction to modern CAD/CAE tools based on numerical techniques and engineering models, with interesting applications.

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