BOOK REVIEWS


With the increase over the last years of engineering materials, the pace at which new materials are being developed and the tailoring of composites to meet design requirements, the process of materials selection has become a hot topic. It has been realized that the traditional, conservative approach to materials selection must be supplemented by a more rational selection process by which materials can be ranked within given design requirements in order to exploit the possibilities the new materials offer.

When teaching basic courses on material properties and selection, it soon becomes clear that the existing standard textbooks can be supplemented by a more specific collection of material properties for certain classes of materials. The “Handbook of materials selection for engineering applications” contains such collections of properties of selected materials in several materials classes (ferrous and nonferrous metals, polymers, ceramics, polymer matrix composites, metal matrix composites and ceramic matrix composites). The information is based on vendor-supplied data, the ASM International Handbooks, Smithells Metals Reference book and other previous publications.

The book has been organized with an introductory section on materials properties among which to select. The section is too brief to be used as a separate text and neither is it intended to be so, but rather to give an overview and supply a list of relevant references.

The book provides a good overview of specific properties of materials within the classes. Thus, the book seems to be well suited for the purpose of supplementing a standard textbook on materials properties and selection.

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The major part of the book (about 80%) is about computer aided analysis of Multibody Systems (MBS). First, several mathematical and numerical tools such as vector-matrix notation, quaternions and screw theory, are introduced. This is followed by kinematic analysis of rigid MBS, where many of the classical and newer methods that are applied to these problems are presented both for systems with higher and lower pair joints. A short chapter is then devoted to kineostatic analysis, before dynamic analysis is introduced.

In this chapter several basic approaches based on both vector mechanics and analytical mechanics are reviewed. This is followed by most of the computer oriented approaches that are in use nowadays, and it includes both non-recursive and recursive formulations. In this chapter is also a section on physical interpretation of Lagrange
multipliers, sections on numerical issues, and the possibility of introducing flexible members and feedback control in the simulations is briefly covered.

In the last part of the book accuracy, synthesis and optimization of MBS are covered, though in much less detail than the analysis part.

With the book comes a diskette with a program package called MASS (Multibody Analysis Simulation System), which runs on a PC with Windows 3.1 with Win32s, Win95 or Windows NT. The package is written so that the user defines the problem (kinematic or dynamic) in an input file, and the program then generates a FORTRAN file, which, when compiled with Microsoft Fortran 5.1, produces an executable that can solve the desired problem. With some minor modifications of the FORTRAN code it may also be compiled with other compilers. The package also includes a plotting program that can display results from the program.

The book may serve as a reference as it covers most of the approaches used in kinematics and dynamics of machinery, and at the same time it is sufficiently detailed to serve as a text book. One comment must be given, though: The many approaches described has made it difficult to be 100% consistent with notation.

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In this book, rigorous parameter sensitivity techniques are discussed for finite element discretized problems in mechanics including geometric and material nonlinearities.

The book starts with a short review, in Chapter 1, with motivating applications of system optimization, reliability-based design, system identification and stochastic finite element analysis, where the concept of parameter sensitivity and its effective numerical calculation are required. The introductory part includes a discussion of continuous and semi-discretized formulations for nonlinear solid mechanics in Chapter 2 and a short review of the concepts of sensitivity analysis for linear systems in Chapter 3. The notion of sensitivity analysis is discussed for both static and dynamic problems. Moreover, the shape sensitivity is also presented.

In the main part of the book, the sensitivity analysis of nonlinear structural systems is discussed. The two main approaches for sensitivity analysis, namely the direct differentiation method and the adjoint system method are presented for nonlinear quasistatic problems in Chapters 4 and 5. Nonlinearities due to material constitutive behaviour (elastoplasticity and elasto-visco-plasticity) and due to large deformations are covered. Chapter 6 is devoted to the notion of shape sensitivity. Sensitivity in the presence of buckling and in the post-buckling region is discussed in Chapter 7. Sensitivity of nonlinear dynamical problems is studied in Chapter 8. Applications of the sensitivity concept to metal forming processes, by means of a flow-type approximation of the problem, are discussed in some detail in Chapter 9. Sensitivity analysis for transient and steady-state nonlinear thermal problems is treated in Chapter 10.

The book closes with two short appendices with the used variational calculus, the notion of the directional derivative and the notions of stress and strain measures. A quite satisfactory list of references which includes 199 items, a subject index and a glossary of the used symbols are also included.