BOOK REVIEWS

Items with a reviewer byline (coded R) are by AMR's corps of dedicated outside volunteer reviewers. AMR will attempt to get critical reviews of all relevant textbooks, reference works, and monographs. Items without a reviewer byline (coded N) are prepared by AMR in-house staff and are largely based on material such as a book's table of contents and editor's preface or foreword. In the interest of timeliness, most conference proceedings and multi-author contributed volumes will receive descriptive notes in this fashion. Books deemed to be somewhat peripheral to AMR's basic scope may simply be listed by title. Also listed by title when first received are books under review.

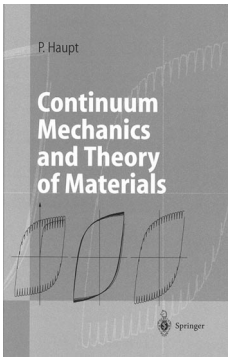
I. FOUNDATIONS & BASIC METHODS

3R1. Continuum Mechanics and Theory of Materials. - P Haupt *(Inst of Mech, Univ of Kassel, Monchebergstr 7, Kassel, 34109, Germany)*. Springer-Verlag, Berlin. 2000. 583 pp. ISBN 3-540-66114-X. $82.00.

Reviewed by JL Wegner (Dept of Mech Eng, Univ of Victoria, Eng Office Wing, Room 537, Victoria BC, V8W 3P6, Canada).

The author attempts to portray the ideas and general principles of the theory of materials within the framework of phenomenological continuum mechanics. It is a well-written rigorous mathematical treatment of classical continuum mechanics and deals with such concepts such as elasticity, plasticity, viscoelasticity, and viscoplasticity in nonlinear materials.

The volume consists of 13 chapters. Chapter 1 covers kinematics, that is the geometry of motion and the deformation of material bodies. The outline follows the script of most texts on classical continuum mechanics—the concepts of material bodies and the material derivative are introduced in Euclidean space. The deformation gradient tensor is introduced, and its physical meaning is described by the transformation of material line, surface, and volume elements. Similar to most treatments on classical continuum mechanics, the appropriate strain and stretch tensors are described. However, the introduction of convective coordinates in this volume is a departure from most treatises on classical continuum mechanics. In this volume, a treatment of strain rates in convective coordinates is provided with the argument that the choice of convective coordinates not only affords a deeper understanding of the strain tensors but also of their strain rates. Chapter 1 finishes with a section on incompatible configurations, that is when a material body can identify a configuration with a non-Euclidean space. Chapter 2 develops the classical balance relations of mechanics, for example: balance of mass in spatial and referential form, conservation of linear and rotational momentum in spatial and referential form. Here, the Cauchy, first Piola-Kirchhoff, weighted Cauchy, and the second Piola-Kirchhoff stress tensors are introduced, as well as their physical significance. This treatise finishes with the balance of mechanical energy and the balance of virtual work.



A comprehensive theory of phenomenological material behavior, based on the general principles of thermomechanics, is developed and presented in this volume. This general theory is expounded in the remaining chapters, beginning in Chapter 3 where the classical balance relations of thermodynamics are presented. In Chapter 4, the terms frame of reference, change of frame, and objectivity are clarified, in preparation for the discussion of the constitutive equations in chapter five.

Classical constitutive relations are presented in Chapter 5, that is, equations defining the perfect fluid, the linear-viscous fluid and the linear-elastic isotropic solid. Two extensions to the model of linear elasticity are also included in this treatise, namely the theories of linear viscoelasticity and plasticity.

Chapter 6 contains the results of experimental testing of different materials such as steel and elastomers. The experimental results provide invaluable insight to the reader when compared to the classical theories of continuum mechanics. The classical constitutive models do reflect significant aspects of the material behavior observed. However, there are considerable discrepancies which cannot be resolved within the context of classical theories presented thus far in the volume. Hence, the motivation for a comprehensive theory of phenomenological material behavior based on the general principles of thermomechanics.

The aim of material theory is to provide general principles and systematic methods for constructing mathematical models suitably representing the individual properties of material bodies. The general theory of material behavior, as it is developed in Chapter 7, is mainly due to W Noll.

In Chapter 9, the constitutive relations for isotropic elastic and isotropic hyperelastic (compressible, and incompressible) solids are derived. Of interest, the one-dimensional stress-strain curves for the Mooney-Rivlin and Neo-Hookean models are plotted, along with a discussion of their limitations for applications to large deformations. What separates this volume from most on continuum mechanics is the treatise in Chapter 9 on constitutive relations for anisotropic hyperelastic solids.

Chapter 10 considers nonlinear viscoelasticity, and Chapter 11 covers plasticity theory. Chapter 12 covers viscoplastisticity, which depicts rate-dependent material behavior with equilibrium hysteresis phenomena. Constitutive models, for all of these types of materials, in thermomechanics is discussed in Chapter 13.

The author achieves his goals of presenting, in a rigorous manner, the ideas and general principles of the theory of materials within the framework of phenomenological continuum mechanics, providing the reader general theories of material behavior from which a reader can select the constitutive model that applies best. *Continum Mechanics and Theory of Materials* will be invaluable to advanced graduate students of materials science in engineering and in physics.

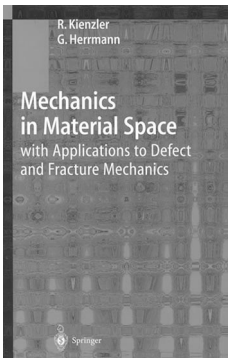
3R2. Mechanics in Material Space: With Applications to Defect and Fracture Mechanics. - R Kienzler *(Univ Bremen, Postfach 330440, Bremen, D-28334, Germany)* and G Herrmann *(Stanford Univ, Ortstrasse 7, Davos Platz, CH-7270, Switzerland)*. Springer-Verlag, Berlin. 2000. 298 pp. ISBN 3-540-66965-5. $54.00.

Reviewed by HW Haslach Jr (Dept of Mech Eng, Univ of Maryland, College Park MD 20742-3035).

The mechanics of bodies with defects is typically described by material forces which are negative gradients of an energy or by related path independent integrals. The goal of this book is to draw a parallel between classical linear elastic mechanics and the mechanics of bodies with defects, called here *Mechanics in Material Space*, which describes a mathematical model for the behavior of material defects such as inclusions, voids, cracks, or dislocations. For example, the Cauchy stress and the Eshelby tensor are viewed as corresponding concepts, as are Newtonian force and deriva-

tives of an energy such as the energy release rate.

To construct the model for mechanics in material space, the authors first introduce the mathematical ideas needed to describe conservation laws. Because their theory is applied only to linear elastic materials, a short review of linear elasticity is given in which the conservation laws are derived from a Lagrangian. This analysis is based on infinitesimal transformations of the independent and dependent variables of state space and the Noether theorem that if the action is invariant under an infinitesimal transformation, then a conservation law exists. The possible transformations depend on the Lagrangian through the Euler-Lagrange equation. A conservation law is the statement that the divergence of a vector valued function of several variables is zero. A major emphasis of this work is to show explicitly how to compute conservation laws from a given Lagrangian. Alternatively, their idea of a neutral action may be used in cases in which the mechanics is described by a system of differential equations, perhaps representing dissipation. The Euler-Lagrange equations are applied to an action with zero variation constructed from the system of differential equations.



The path independent integrals of defect analysis are obtained from conservation laws, each based on a particular infinitesimal transformation. The construction produces the J, L, and M integrals viewed as objects describing material mechanics. The authors then give a physical interpretation of the Eshelby tensor, as well as its eigenvalues and eigenvectors.

The J integral is also established for inhomogeneous functionally gradient (graded) materials (FGM), those whose properties change smoothly in a given direction, by recourse to a conservation law involving translational symmetries. The computation is analogous to that for a homogeneous material.

Linear elastodynamics fracture theory is developed by constructing conservation laws by three alternative methods. Here, a conservation law in material space and the duality with classical mechanics implies that the stress equations of motion are related to conservation of mass. Application of linear elastodynamics is made to wave motion.

Dissipative systems, those without Lagrangians, are discussed by example, including diffusion, the nonlinear wave equation, linear viscoelasticity based on the archaic spring and dashpot models. The creep C* integral is obtained from a potential for constant strain rate. The primary tool for the construction of conservation laws is the neutral action method.

Conservation laws for coupled systems, such as piezoelectric materials, linear thermoelasticity, and porous materials by analogy with thermoelasticity, are constructed from actions which superpose the subsystems. The neutral action method is used in the case of time-dependent thermoelasticity.

Finally the techniques are applied to the strength of materials description of bars, shafts, beams, and plates and shells with defects. In these cases, the construction begins with a Lagrangian appropriate to strength of materials, rather than elasticity. Shells are more difficult due to the curvature and are not fully developed.

This book, in a clear presentation, succeeds in establishing a foundation for the mechanics of linear elastic bodies with defects, or mechanics in material space, and in clarifying the parallels with classical linear elastic mechanics. A concise table listing the parallels is given in the Introduction. This fundamental approach in terms of conservation laws is an improvement over dealing with fracture and defects in the classical almost ad hoc manner of defining the path-independent integrals and forces on the defects. *Mechanics in Material Space: With Applications to Defect and Fracture Mechanics* should be useful to those engaged in research on bodies with defects. It could also be a text for a graduate course on this topic or at least used as a supplement. Although no problems are given, many examples are provided of constructing the conservation laws. Engineering research libraries should own this book.

3R3. Theory of Difference Schemes. Pure and Applied Mathematics Series, Vol 240. - AA Samarskii *(Fac of Comput Math and Cybernetics, Moscow MV Lomonosov State Univ, Moscow, Russia)*. Marcel Dekker, New York. 2001. 761 pp. ISBN 0-8247-0468-1. $225.00.

Reviewed by VD Radulescu (Dept of Math, Univ of Craiova, 13, St AI Cuza, Craiova, 1100, Romania).

The study of difference schemes is one of the central subjects in Numerical Analysis. Because of the variety and importance of their applications, in particular to Applied Mathematics, difference schemes caused developments in various areas of mathematics.

This monograph is intended as an introduction to difference schemes at the advanced undergraduate and beginning graduate level. The author aimed at breaching the gap that too often exists between engineering and example-oriented textbooks on the one hand, and needlessly abstract mathematical formulations on the other.

The book is divided into ten chapters, followed by a list of symbols and some concluding remarks. After several necessary prerequisites exposed in the first two chapters, the author develops in Chapters 3–5 concrete difference schemes for equations of elliptic, parabolic, and hyperbolic types. Chapter 3 focuses on homogeneous difference schemes for ordinary differential equations, by means of which the author solves the canonical problem of the theory of difference schemes in which a primary family of difference schemes is specified and schemes of a desired quality should be selected within the primary family.

Chapter 4 is devoted to various difference approximations of second-order elliptic equations. The approximation technique for the Laplace operator and formulations of difference boundary conditions are described for regions of arbitrary shape.

Chapter 5 provides the general theory of difference schemes in which it seems reasonable to eliminate constraints on the structure and implicit form of difference operators. Such a theory treats difference schemes as operator equations and operator-difference equations, which are analogs of difference schemes for time-dependent equations of mathematical physics.

Chapter 6 includes *a priori* estimates expressing stability of two-layer and three-layer schemes in terms of the initial data and the right-hand side of the corresponding equations. This chapter also includes many good examples illustrating the practical use of general stability theory with regard to particular schemes to assist the users in subsequent implementations. The author's strategy is that the stability is the most pressing problem in any algorithm, since it is a necessary rather than a sufficient condition for accuracy.

The main purpose of the next three chapters is to show how the results of the general theory of difference schemes are aimed at starting principles for constructing difference schemes of a prescribed quality. The difference schemes for elliptic equations are viewed as operator equations of the first kind, while the difference schemes relating to analogs of nonstationary equations of mathematical physics are treated as difference equations with operator coefficients in an abstract space of any dimension.

In the last chapter, several economical schemes and iterative methods for multidimensional problems in mathematical physics are developed.

The book is well written and is strongly influenced by the well-known Russian school of Numerical Analysis. The point of view taken here, rigorous presentation without excessive formalism, is however nonstandard.

In conclusion, Samarskii's book *Theory of*

Difference Schemes is original, interesting, and transmits a message in a clear and efficient way. On the whole, this monograph is an excellent contribution to the literature of numerical methods and computer algorithms for solving mathematical-physics problems. The book qualifies to be a reference work that certainly would be a valuable addition to libraries of universities and research laboratories pursuing research in Applied Mathematics.

3R4. Underlying Principles of the Boundary Element Method. - D Cartwright *(Col of Eng, Bucknell Univ PA)*. WIT Press, Southampton, UK. 2001. 276 pp. ISBN 1-85312-839-2. $149.00.

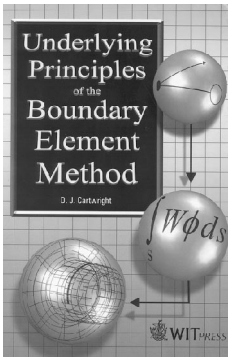
Reviewed by DE Beskos (Dept of Civil Eng, Univ of Patras, Patras, GR-26500, Greece).

This is a very well written introductory textbook on the foundations of the direct Boundary Element Method (BEM). It is very useful to both teachers and their undergraduate students in applied mathematics and engineering, as well as those interested in learning the basics of the method.

The emphasis is on the principles and the mathematical derivations of the BEM and not on its numerical implementation. In that sense, the book is unique since most of the existing books emphasize the numerical implementation of the method. Detailed mathematical derivations are provided and solved problems are presented in detail in each chapter to help the student understand the subject matter of the book. Applications are described for one-, two- and three-dimensional problems of potential theory and elastostatics in a unified manner. Only constant elements are considered here for which the computation of singular integrals can be done analytically (in closed form).

There are two aspects of the book this reviewer considers very important and worth mentioning: *i*) The concepts of the Green's function and the fundamental solution are both discussed in detail. It is further shown how one can obtain the latter as a combination of Green's functions defined for different boundary conditions. In many other books these two concepts are used one for the other and this creates confusion. *ii*) The boundary integral equation for internal points is derived here through the method of weighted residuals, which is a very powerful and general method for formulating boundary element and finite element methods.

The whole book consists of seven chapters, one appendix, a bibliography, and a subject index. More specifically, Chapter 1 deals with a discussion on the derivation of the basic field equations (governing equations) of the scalar or vector type and of the second or fourth order in one or more dimensions. Chapter 2 discusses Green's functions, their properties, derivation, and use in solving boundary value problems. The concept of the fundamental solution, its relation to Green's functions, and its derivation are taken up in Chapter 3. The method of weighted residuals is described in Chapter 4, and its use in the derivation of



the direct boundary integral equation for one-dimensional, potential, and elastostatic problems are described in Chapters 5, 6, and 7, respectively. In those last three chapters, related problems are solved to illustrate the method and demonstrate its advantages. Finally, the last chapter contains various appendices dealing with details of various mathematical derivations, which were presented in Chapters 3 and 5–7. The book concludes with a list of 20 reference books on the BEM and a short subject index.

The author has certainly succeeded in fulfilling his stated aim of providing an introductory textbook emphasizing the underlying principles of the BEM. *Underlying Principles of the Boundary Element Method* should be purchased by teachers, undergraduate and graduate students, researchers who would like to start working in the field, and certainly by libraries.

3N5. Computational Fluid Dynamics for the 21st Century. Proc of Symp, Kyoto, Japan, July 2000. - Edited by M Hafez *(Dept of Mech and Aeronaut Eng, Univ of California, Davis CA 95616)*, K Morinishi *(Dept of Mech and Syst Eng, Kyoto Inst of Tech, Sakyo-ku, Kyoto, 606-8585, Japan)*, J Periaux *(2 Pole Scientifique Dassault-Aviation-UPMC, 78 Quai Marcel Dassault, St Cloud, 92214, France)*. Springer-Verlag, Berlin. 2001. 412 pp. ISBN 3-540-42053-3. $219.00.

This volume contains 24 papers presented at a symposium honoring Prof Nobuyuki Satofuka on the occasion of his 60th birthday. The contributing authors are from Japan as well as from the international community in Asia, Europe, and North America. The topics covered in this volume are Cartesian scheme, gridless scheme, high order and new schemes, optimization techniques, parallel computation, incompressible and compressible flows, multi-phase flows and solid/fluid interactions, magneto-hydrodynamics, and flow visualization techniques.

3N6. Computational Technologies for Fluid/Thermal/Structural/Chemical Systems with Industrial Applications - Volume 1. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta**.** - Edited by V Kudriavtsev and S Kawano. ASME, New York. 2001. 296 pp. ISBN 0-7918-1679-6. ASME Book No G1173A. $110.00. (ASME members $55.00).

This compilation of 29 full-length, peer-reviewed papers covers the following topics: CFD of industrial multiphase flows, CFD of complex 3D flows, and CFD and chemical processes.

3N7. Computational Technologies for Fluid/Thermal/Structural/Chemical Systems with Industrial Applications - Volume II. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta**.** - Edited by CR Kleijn and V Kudriavtsev. ASME, New York. 2001. 300 pp. ISBN 0-7918-1679-6. ASME Book No G1173B. $110.00. (ASME members $55.00).

This compilation of 32 full-length, peer-reviewed papers focuses on the following topics: CFD for the process industry, CFD for fluid-structure interaction, CFD of external flows, and various industrial CFD applications.

3N8. Emerging Technologies: Advanced Topics in Computational Mechanics and Risk Assessment. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta. - Edited by DR Metzger. ASME, New York. 2001. 232 pp. ISBN 0-7918-1672-9. ASME Book No G01166. $100.00. (ASME members $50.00).

This volume of 19 full-length, peer reviewed technical papers focus on computer technology in two areas: computational mechanics with subtopics (nonlinear simulation techniques, algorithms for nonlinear finite element analysis, methods for tubesheet analysis, and meshless methods) and risk assessment, including a multitude of examples on how to assess safety and reliability.

3N9. Fundamentals of Engineering Numerical Analysis. - P Moin *(Center for Turbulence Res, Stanford Univ, Stanford CA 94305)*. Cambridge UP, Cambridge, UK. 2001. 209 pp. Softcover. ISBN 0-521-80526-0. $34.95. (Hardcover ISBN 0-521-80140-0 $95).

This book is an outgrowth of the author's lecture notes for a course in computational mathematics taught to first-year engineering graduate students. The course is the third in a sequence of three quarter-courses in computational mathematics. The students should have already had numerical linear algebra and elementary partial differential equations. Although familiarity with linear algebra in some depth is essential, mastery of the analytical tools for the solution of partial differential equations (PDEs) is not; only familiarity with PDEs as governing equations for physical systems is desirable. It is important for students to be educated about the fundamentals of numerical methods. They should know what factors affect accuracy, stability, and convergence and be able to ask tough questions before accepting the numerical output. The user of numerical methods should not leave all the *thinking* to the computer program and the person who wrote it.

There are six chapters covering Interpolation, Numerical differentiation—Finite differences, Numerical integration, Numerical solution of ordinary differential equations, Numerical solution of partial differential equations, and Discrete transform methods. There is also an appendix, a Review of Linear Algebra, and an index.

3N10. Time Series: Data Analysis and Theory. Classics in Applied Mathematics, Vol 36. - DR Brillinger *(Dept of Stat, Univ of California, Berkeley CA)*. SIAM, Philadelphia. 2001. 540 pp. Softcover. ISBN 0-89871-501-6. $59.00.

This SIAM edition is an unabridged republication of the work first published by Holden Day, Inc., San Francisco (1981). The intention of the first edition was to develop the many important properties and uses of the discrete Fourier transforms of the observed values of time series. The Addendum indicates the extension of the results to continuous series, spatial series, point processes, and random Schwartz distributions. Extensions to higher-order spectra and nonlinear systems are also suggested.

Classical and Computational Solid Mechanics. - YC Fung *(Univ of California, San Diego CA)* and Pin Tong *(Hong Kong Univ of Sci and Tech, Hong Kong, China)*. World Sci Publ Co Pte Ltd, River Edge NJ. 2001. 952 pp. ISBN 981-02-3912-2. $98.00. (Under review)

Finite Element Solution of Boundary Value Problems: Theory and Computation. Classics in Applied Math, Vol 35. - O Axelsson *(Univ of Nijmegen, Nijmegen, Netherlands)* and VA Barker *(Tech Univ, Lyngby, Denmark)*. SIAM, Philadelphia. 2001. 432 pp. Softcover. ISBN 0-89871-499-0. $50.00. (Under review)

Fundamentals of Computational Fluid Dynamics. - H Lomax *(Deceased)*, TH Pulliam *(NASA Ames Res Center, Moffett Field CA 94035)*, DW Zingg *(Inst for Aerospace Stud, Univ of Toronto, 4925 Dufferin St, Toronto, ON, M3H 5T6, Canada)*. Springer-Verlag, Berlin. 2001. 249 pp. ISBN 3-540-41607-2. $49.95. (Under review)

II. DYNAMICS & VIBRATION

3R11. Linear Elastic Waves. - JC Harris *(Theor and Appl Mech Dept, Univ of Illinois, Urbana IL)*. Cambridge UP, New York. 2001. 162 pp. ISBN 0-521-64368-6. $69.95.

Reviewed by L Gaul (Inst A of Mech, Univ of Stuttgart, Pfaffenwaldring 9, Stuttgart, 70550, Germany) and S Hurlebaus (Inst A of Mech, Univ of Stuttgart, Allmandring 5 b, Stuttgart, 70550, Germany).

This work provides, in six chapters, a basic coverage of the science and technology of linear elastic waves. Each chapter contains its own summary, some problem statements, and a list of references.

Chapter 1, *Simple Wave Solutions* summarizes the basic equations of linear elasticity without any derivation. Then, the Laplace and Fourier transforms and their inverses are introduced. For distinguishing between propagation of a wave and vibration of a bounded medium the author introduced the Poisson summation equation. It is unusual to explain the dispersion feature by wave propagation in a one-dimensional discrete lattice. This would be more appropriate in a book on solid state physics.

Chapter 2, *Kinematical Descriptions of Waves* describes the kinematics of time-dependent and time-harmonic plane waves. The latter is also used for explaining the asymptotic ray expansion. The author constructs spherical and cylindrical waves from collections of homogeneous and inhomogeneous plane waves, as opposed to the direct derivation from the solution of the equations of motions in the corresponding coordinate system. From a didactic point of view, the readership, in this case the students, would surely prefer the other, the more obvious way. However, for people working in the area it is nice to obtain an additional view.

Chapter 3, entitled *Reflection, Refraction and Interfacial Waves*, deals with waves at an interface between two materials having different densities and wave velocities. Furthermore, the chapter describes waves that propagate along an interface, while decaying perpendicularly away from it. In this chapter, it becomes obvious that the author does not cover the subject in a complete manner. By considering the reflection, he deals only with an incident longitudinal plane wave, and the refraction is treated only for an incident shear SV plane wave. For a textbook as well as for a reference book, it would be advantageous to deal with the missing cases as well. Obviously, this chapter does not incorporate all possible cases, since the reader is expected to solve the reflection coefficients himself (the solution is given, but the derivation is left to the reader). Furthermore, it would be helpful for a better understanding by the students (the readership in the author's opinion) to show plots of some reflection and refraction coefficients as a function of the angle of incidence. However, the explanation of the phase matching condition is excellent. As a consequence of dealing with reflections, the Rayleigh wave is introduced in this chapter as well. Again some plots presenting the decaying vertical and horizontal amplitudes with depth of the Rayleigh wave, as well as the orientation of the Rayleigh wave particle orbit would be helpful.

Chapter 4, *Green's Tensor and Integral Representation*, discusses the formulation of the integral representations of solutions for rather general problems in elastic wave propagation. In this chapter, the reciprocity identity, the Green's tensor for a full space, the principle of limiting absorption, the integral representation for a source and a scattering problem, and uniqueness of an unbounded region are introduced. The chapter closes with an example that uses the introduced ideas to derive an integral representation for the scattering of an acoustic wave by an elastic inclusion.

According to its title, *Radiation and Diffraction*, Chapter 5 deals with the basic propagation processes that are encountered when studying radiation or edge diffraction. The first problem under consideration consists of calculating the transient, antiplane radiation excited by a line source at the surface of a half-space using the Cagniard-deHoop method to invert the integral transformations. The second one consists of calculating the time-harmonic, inplane radiation from a two-dimensional center of compression buried in a half-space by using plane wave spectral techniques and the method of steepest descent. Finally, the last one treats the calculation of the diffraction of a time harmonic plane antiplane shear wave by a semi-infinite crack using the Wiener-Hopf method and by using matched asymptotic expansions. An appendix describing the relation between the diffraction integral and the Fresnel integral closes the chapter.

The last chapter, *Guided Waves and Dispersion*, treats antiplane shear problems. The guided waves are constructed by using partial waves, and their dispersions are calculated by using the transverse resonance principle. Both harmonic and transient excitations of a closed waveguide are examined by using a mode expansion. The harmonic excitation of an open waveguide by a line source is also studied by using both ray and mode representations. The last problem under consideration deals with the propagation in a closed waveguide with a slowly varying thickness using an asymptotic expansion that combines features of both rays and modes. The chapter ends by examining the propagation of information and energy with the group velocity.

All derivations are carefully developed, however, more illustrations would enhance the mathematical development and understanding. Plenty of textual explanation is provided to clarify the topic under consideration. The book has a detailed table of contents and a rich subject index. However, the reference list could be extended by adding some other basic wave propagation books such as Graff [1], Rose [2], Bedford and Drumheller [3], Doyle [4], Kolsky [5] etc. Due to the incomplete treatment of some problem areas and neglecting some basic topics, the book provides an initiative for the reader to extend the ideas and to solve problems which are not included.

In summary, *Linear Elastic Waves* is a useful work whose major contribution lies in its description and mathematical derivations. Readers may find, however, that the book owes a substantial debt to Achenbach's classic treatment of the subject [6], since Professor Achenbach was the research advisor of the author. However, Achenbach's book is out of print, and therefore, this book, which is only about half of the size of Achenbach's book, would be a welcome replacement to graduate students having started in the subject of wave propagation.

References

1. Graff KF (1991), *Wave Motion in Elastic Solids*, Dover Publications, New York.
2. Rose JL (1999), *Ultrasonic Waves in Solid Media*, Cambridge Univ Press, Cambridge.
3. Bedford A and Drumheller DS (1996), *Introduction to Elastic Wave Propagation*, John Wiley & Son.
4. Doyle JF (1997), *Wave Propagation in Structures*, Springer, New York.
5. Kolsky H (1963), *Stress Waves in Elastic Solids*, Dover Publications, New York.
6. Achenbach JD (1993), *Wave Propagation in Elastic Solids*, Vol 16 of Applied Mathematics and Mechanics, North Holland, Amsterdam.

3R12. Nonlinearity in Structural Dynamics: Detection, Identification and Modeling. - K Worden and GR Tomlinson *(Univ of Sheffield, UK)*. Inst Phys Publ, Bristol, UK. 2001. 659 pp. ISBN 0-7503-0356-5. $130.00.

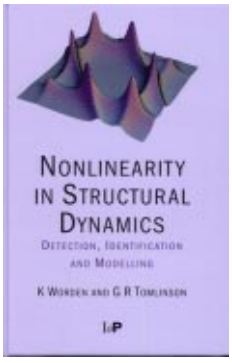
Reviewed by K Yagasaki (Dept of Mech and Syst Eng, Gifu Univ, 1-1 Yanagido, Gifu, 501-1193, Japan).

This book provides backgrounds in some techniques for analyzing nonlinear structural dynamical systems and is intended for

engineers and scientists in the fields of structural dynamics and nonlinear systems. It is also suitable for postgraduate and senior undergraduate students in these disciplines as a textbook and for expert structural dynamicists as a survey. Many engineering examples are given. As for the mathematics of the reader, calculation of vectors and matrices, and basic knowledge of linear differential equations and Fourier analysis are almost sufficient.

The most enthusiastic topics in modern nonlinear dynamics are *chaos* and *bifurcation*. There have also been remarkable advances in the field of nonlinear control. However, these subjects are not treated in this book at all. Instead, it explains useful techniques, which include the frequency response functions (FRFs) and Hilbert transformations, for detection of nonlinearity and system identification (ie, estimation of the governing equations) when the systems do not exhibit very different motions, like chaos, from ones of linear systems. The techniques are especially important from a point of view of structural engineering because really nonlinear behavior like chaos is thought to be rather uncommon in the problems of that field.

The book begins by describing the relevant backgrounds including the frequency response functions (FRFs) in linear dynamics for discrete- and continuous-time systems in Chapter 1. The discussion is first given for single-degree-of-freedom (SDOF) systems and finally generalized to multi-degree-of-freedom (MDOF) systems with an outline of modal analysis. Chapter 2 gives fundamental results and classical approaches to nonlinear systems in structural dynamics. An idea of FRF distortion is also stated there. Chapter 3 discusses FRFs for nonlinear systems in detail and describes how they are used to obtain information about nonlinearity.



In Chapters 4 and 5, the Hilbert transformation, which can not only detect nonlinearity but also solve system identification problems, is explained. A mathematical exposition of the method by complex analysis is also presented. In Chapters 6 and 7, several techniques of system identification for discrete- and continuous-time equations are discussed. In Chapter 8, the concept of FRFs is generalized to higher-order FRFs with the assistance of the Volterra series. The generalization presents a method of system identification for MDOF systems. Finally, three experimental examples of a built-in beam rig, automotive shock absorber, and bilinear beam rig (the last of which is motivated from constructing a system with localized damage in the benchmark of fault detection algorithms) are given, and the techniques of the earlier chapters are applied to demonstrate their effectiveness in Chapter 9. This chapter is especially interesting for the reader from a practical point of view. A substantial set of appendices is also valuable for not only the beginners, but also ordinary researchers in the field.

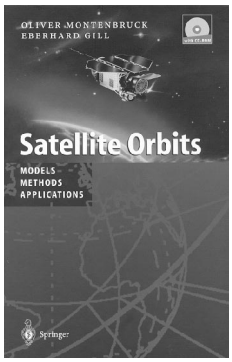
In summary, this reviewer recommends *Nonlinearity in Structural Dynamics: Detection, Identification and Modeling* for students and researchers in structural dynamics who want to study techniques for detection of nonlinearity and system identification in realistic problems.

3R13. Satellite Orbits: Models, Methods, and Applications. - O Montenbruck and E Gill *(Deutsches Zentrum fur Luft- und Raumfahrt, Oberpfaffenhofen, Postfach 1116, Weáling, 82230, Germany)*. Springer-Verlag, Berlin. 2000. 369 pp. CD-ROM included. ISBN 3-540-67280-X. $65.00.

Reviewed by FH Lutze (Dept of Aerospace and Ocean Eng, VPI, Blacksburg VA 24061-0203).

This book is intended to be a ''comprehensive textbook that guides the reader through the theory and practice of satellite orbit prediction and determination.'' This reviewer believes the book does just that. However, it is stated that it is intended for advanced undergraduate or graduate courses, and for professionals on the job. The undergraduate would likely have to struggle with the material presented in the book for two reasons. One is that s/he would not have a sufficient background in all the areas covered, and the other is that a significant amount of material is presented in such a concise form that it does not allow one to pick up the background material from the text. The diligent student, however, could refer to the ample references provided (approximately 320) to fill in the background gaps. The author's focus is on providing material currently being used for orbit prediction and determination. (A good portion of the references are from the 1990s.) There is little, if any, discussion of analytic approaches (such as perturbation techniques) that classically have been applied to such problems. There is an extensive amount of practical information regarding force modeling, measurements and filtering, tracking, reckoning time, and computer algorithms. This information is presented in nine chapters, two appendices, and one CD.

The first chapter, entitled *Around the World in a Hundred Minutes*, summarizes the broad range and types of orbits encountered and has excellent color photos of some recent satellites. The second chapter, *Introductory Astrodynamics*, is approximately 30 pages and reviews the basic two-body theory with its implications on tracking and determining orbit characteristics. Chapter 3 devotes about 60 pages to the modeling of forces, including the higher harmonics of the gravitational field, the gravitational effects of the Sun and the Moon, Solar radiation, and atmospheric drag. In addition, some consideration is paid to precision modeling with GPS satellites in mind. Chapter 4 devotes about 40 pages to the various methods of integration for precise orbit prediction. The emphasis is on comparing accuracy and effort of the different techniques. Chapter 5 is a very nice discussion of the various time and reference systems which takes about 30 pages. Tracking and observation models are discussed in Chapter 6. These include radar and laser tracking, range, range rate, and



the use of GPS signals. Chapter 7 introduces the linearization procedure to supply the required background for Chapter 8 which is *Orbit Determination and Parameter Estimation*. These chapters occupy about 60 pages. In this next to last chapter, the least squares and Kalman filtering methods are presented. Finally, Chapter 9 supplies three application examples using real data, including one demonstrating error analysis, real time orbit determination, and orbit determination using a relay satellite.

If that were the complete book, this reviewer would suggest that it would be a good addition to your library. However, there is more. The authors have provided a CD with some C++ codes that support all the problems at the ends of the chapters, the three application problems in Chapter 9, and in addition, have some generic satellite codes to support problems that the reader might want to attack. In this generic library are mathematical and astronomical constants, integration routines for differential equations, least squares estimation and Kalman filtering, a force model which includes a 20×20 gravitational model, Sun and Moon gravitational effects, appropriate coordinate transformations, calendar-time calculations, and some vector/matrix opera-

tions. The codes that support the problems at the end of each chapter help to improve the understanding of the chapter and aid readers who are doing a self study. In addition, the CD has an extensive list of website links which support most of the topics in the book and more.

Satellite Orbits: Models, Methods, and Applications would be a valuable addition to the library of any engineer or scientist interested in the practical aspects of orbit prediction and determination. There are few books currently available that cover this material under a single cover, the most recent being, *Fundamentals of Astrodynamics and Applications* by DA Vallado, (McGraw Hill, 1997), which would be a good complimentary text to *Satellite Orbits*. The comprehensive reference list along with the CD supplied codes make this book unique in this area.

3N14. Emerging Technologies for Fluids, Structures, and Fluid-Structure Interaction - 2001. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta**.** - Edited by WL Cheng and A Holdo. ASME, New York. 2001. 400 pp. ISBN 0-7918-1686-9. ASME Book No G01180. $130.00. (ASME members $65.00).

This compilation of 47 full-length, peer-reviewed papers covers the following major topics: *fluid, thermal, and fluid-structure systems*, including advances in shock wave and blasts, safety assessment, and structural mechanics and integrity assessment; and *shock wave and blasts, structural mechanics, integrity, and safety assessment*, which contains advances in fluid dynamics, computational fluid dynamics, thermal problems, and full-structure interactions.

3N15. Flow-Induced Vibration - 2001, Volume 1: Cross Flow, Heat Exchangers. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta**.** - Edited by MJ Pettigrew. ASME, New York. 2001. 204 pp. ISBN 0-7918-1675-3. ASME Book No G1169A. $90.00. (ASME members $45.00).

Composed of 25 full-length, peer-reviewed papers, this volume presents information contributing to the understanding of vibration excitation mechanisms with specialization in cross flow, heat exchangers, and attention to cylinder arrays applied to heat exchanger tube bundles.

3N16. Flow-Induced Vibration - 2001, Volume 2: Axial Flow, Piping Systems, Other Topics. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta**.** - Edited by MJ Pettigrew. ASME, New York. 2001. 208 pp. ISBN 0-7918-1675-3. ASME Book No G1169B. $90.00. (ASME members $45.00).

This proceedings is composed of 23 full-length, peer-reviewed papers on vibration excitation mechanisms with specialization in axial flow-induced vibration, piping systems and acoustics, compressors, and cylindrical shells.

3N17. Fluid-Structure Interaction. - Edited by A Dervieux *(INRIA, 2003 Route des Lucioles, Sophia-Antipolis Cedex, F-06902, France)*. Hermes Sci Publ, Paris. 2000. 851 pp. Softcover. ISBN 2-7462-0189-5. $64.95.

This is a special issue of *Revue Européenne des Elements Finis* which is dedicated to mathematical and numerical models for fluid-structure interaction. Fluid-structure interaction concerns the study of mechanical systems involving a fluid and a structure which have mechanical influence on each other. In this special issue, there are two particular focuses: consideration of compressible fluids and concentration on unsteady models.

There are nine individually authored chapters: *Fluid-Structure Interaction: A Theoretical Point of View* (C Grandmont, Y Maday); *Design of Efficient Partitioned Procedures for the Transient Solution of Aeroelastic Problems* (S Piperno, C Farhat); *Deriving Adequate Formulations for Fluid-Structure Interaction Problems: from ALE to Transpiration* (T Fanion, M Fernandez, P Le Tallec); *Sensitivity Analysis and Control in an Elastic CAD-Free Framework for Multi-Model Configurations* (B Mohammadi); *Numerical Study of the Aeroelastic Stability of an Overexpanded Rocket Nozzle* (E Lefrancois, G Dhatt, D Vandromme); *Fully Coupled Fluid-Structure Algorithms for Aeroelasticity and Forced Vibration Induced Flutter: Applications to a Compressor Cascade* (P Leyland, V Carstens, F Blom, T Tefy); *Interaction between a Pulsating Flow and a Perforated Membrane* (R Lardat, R Carpentier, B Koobus, E Schall, A Dervieux, C Farhat, J-F Guery, P Della Pieta); *Analysis of a Possible Coupling in a Thrust Inverter* (R Lardat, B Koobus, E Schall, A Dervieux, C Farhat); and *Aeroelastic Coupling between a Thin Divergent and High Pressure Jets* (E Schall, R Lardat, A Dervieux, B Koobus, G Farhat).

3N18. Guidance and Control 2001. Proc of 24th Annual AAS Conf, February 2001, Breckenridge CO. - Edited by RD Culp *(Univ of Colorado, Boulder CO)* and CN Schira. Am Astronaut Soc, San Diego. 2001. 722 pp. Softcover. ISBN 0-87703-480-X. $100.00. (Hardcover ISBN 0-87703-479-6).

This proceedings is divided into the following six sections: Advances in guidance and control (8 papers); Autonomous and remotely piloted terrestrial landing (8 papers); Landing on planetary bodies (5 papers); Guidance and control storyboard displays (7 papers); Optical control (6 papers); and Recent experiences in guidance and control (7 papers).

3N19. Physics of Direct Hit and Near Miss Warhead Technology. Progress in Astronautics and Aeronautics, Vol 194. - RM Lloyd *(Raytheon Electron Syst, Tewksbury MA)*. AIAA, Reston VA. 2001. 416 pp. ISBN 1-56347-473-5.

This book discusses direct hit technology in conjunction with a new class of warheads coined *near miss* or *direct hit warhead technology*. This book discusses the challenges of designing small lethality enhancement technologies that can be implemented on a direct hit kill vehicle. The book provides designers with a knowledge base of new warhead technologies that can be used in conjunction with direct hit missiles. The ballistic missile and warhead community is provided with new ideas and logic to assess antiballistic missile systems.

3N20. Selected Topics in Nonlinear Wave Mechanics. - Edited by CI Christov *(Dept of Math, Univ of Louisiana, Lafayette LA 70504-1010)* and A Guran *(Inst of Structronics, 275 Slater St, Ottawa, K1P-5H9, Canada)*. Birkhauser Boston, Cambridge MA. 2002. 263 pp. ISBN 0-8176-4059-2. $89.95.

This reference text gives an overview of the current state of nonlinear wave mechanics in both elastic and fluid media. Consisting of self-contained chapters, the book covers new aspects on strong discontinuities (shock waves) and localized self-preserving (permanent) shapes (solitary waves and solitons). Special attention is devoted to the kinematics and dynamics of permanent waves when dissipative effects are added to the original balance between nonlinearity and dispersion.

Key features include survey chapters written in an accessible style by leading specialists; coverage of emerging topics in the field; interdisciplinary approach integrating mathematical theory and physical applications of nonlinear waves in elastic and fluid media; treatment of the intrinsic mechanisms of propagation of different types of nonlinear waves; presentation of analytical methods for solving wave propagation problems in elastic and fluid media; and a user-friendly index.

3N21. Thermal Hydraulics, Liquid Sloshing, Extreme Loads, and Structure Response. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta. - Edited by FJ Moody. ASME, New York. 2001. 264 pp. ISBN 0-7918-1676-1. ASME Book No G01170. $110.00. (ASME members $55.00).

This volume of 31 full-length, peer-reviewed papers is devoted to exploring how materials interact under extreme loading conditions. The following topics are covered: sloshing and fluid-structure interaction; thermal hydraulic phenomena in vessels, piping, and components; and explosive loading and damages to projectiles and automobiles.

Vibration of Strongly Nonlinear Discontinuous Systems. Foundations of Engineering Mechanics. - VI Babitsky *(Dept of Mech Eng, Louborough Univ, Louborough, Leicestershire, LE11 3TU, UK)* and VL Krupenin *(Inst of Machine Stud, Russian Acad of Sci, Moscow, 101830, Russia)*. Springer-Verlag, Berlin. 2001. 399 pp. ISBN 3-540-41447-9. $99.00. (Under review)

Virtual Testing of Mechanical Systems: Theories and Techniques. Advances in Engineering, Vol 4. - OI Sivertsen *(Norwegian Univ of Sci and Tech, Trondheim, Norway)*. Swets and Zeitlinger Publ, Lisse, Netherlands. 2001. 189 pp. ISBN 90-265-1811-0. $87.00. (Under review)

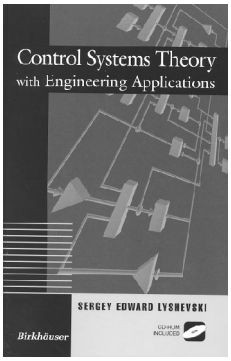
III. AUTOMATIC CONTROL

3R22. Control Systems Theory with Engineering Applications. - SE Lyshevski *(Dept of Elec and Comput Eng, Purdue Univ, Indianapolis IN 46202-5132)*. Birkhauser Boston, Cambridge MA. 2001. 416 pp. CD-ROM included. ISBN 0-8176-4203-X. $79.95.

Reviewed by PJ Eagle (Exp and Comput Mech, DaimlerChrysler Corp, 800 Chrysler Dr, Auburn Hill MI 48326-2757).

This book is a monograph devoted to methods for analyzing linear and nonlinear multivariate control system problems. The stated aim of the text is to be ''used to teach undergraduate and graduate classes in automatic control at electrical, mechanical and aerospace engineering departments.'' While this text has several problems achieving this aim (as described below), it is a unique resource that should not be overlooked as an addition to a library of books on control systems. The book is geared toward using the popular MATLAB® and SIMULINK™ software as tools for analysis and data presentation. The book is not at a very fundamental level and does not contain practice problems. As such, it would not be a good choice as an undergraduate text. However, it is a resource of a large quantity of solved example problems (including a CD-ROM of MATLAB/SIMULINK source code) related to multivariate control and nonlinear systems that is not found in many similar texts. For this reason, this book would be a valuable resource for upper-level graduate students pursuing research topics in control systems.

The book consists of five main sections divided into numerous subsections. There is no list of nomenclature and symbols, but the notation is consistent with those used in standard control system practice. There is a brief index as well as a list of references which is simply a list of publications that are not necessarily related to the content of the book. The reference list is divided into topical sections. For reasons that are not clear, the list of ''Papers in Control'' is largely populated by the author's publications. The book was well reviewed for typesetting irregularities and typographic errors. There is an abundance of figures, most of which are graphs and other screen output from MATLAB. The line art does not appear to be professionally executed, but it is clear and consistent.



The book contains an introduction to MATLAB that begins as being overly simple, but covers a wide range of the fundamentals necessary to apply this tool to solving controls problems. The level of detail is useful for readers who are teaching themselves MATLAB for use in these types of applications. The coverage of MATLAB examples is so extensive that some diagrams and output figures are too complex for a book of this type. Nonetheless, the author has taken great care to painstakingly document the examples in text and figure. Some editorial oversight is the coverage of state space theory after MATLAB has already been applied to some state space analysis.

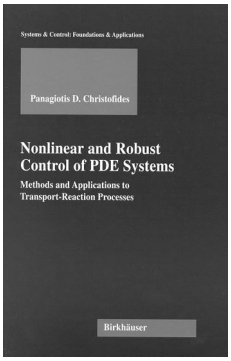
One of the best features of this book is its clear presentation of Hamilton-Jacobi and Lyapunov methods coupled with numerous examples, complete with simulation data and MATLAB files on CD-ROM. Graduate students and researchers in optimal control will benefit from this level of detail. It should be noted that while these examples are detailed enough to run simulations and verify output, they expect the reader to be familiar with a fairly high level of domain-specific knowledge (such as aircraft dynamics). Some examples are flush with irrelevant details like how long the simulation took to run using a particular computer. Other examples suffer from poor practices in significant figures and the lack of appropriate diagrams (a complex dynamic model of a robot is presented with no supporting diagram). In contrast, there is a well-documented and laboriously complete example on induction motor control that would be invaluable to students struggling with the practices in nonlinear control. Even with the above criticisms, this book would be an excellent starting point for a graduate student pursuing problems in discrete-time systems with optimal control.

In summary, this reviewer would definitely recommend *Control Systems Theory with Engineering Applications* to students or libraries seeking control system and MATLAB/SIMULINK reference texts. This is a very complete and practical resource. It is not a teaching textbook, but it would be an outstanding supplement to an advanced graduate course in nonlinear control.

3R23. Nonlinear and Robust Control of PDE Systems: Methods and Applications to Transport-Reaction Processes. - PD Christofides *(Dept of Chem Eng, UCLA, Los Angeles CA 90095-1592)*. Birkhauser Boston, Cambridge MA. 2001. 248 pp. ISBN 0-8176-4156-4. $69.95.

Reviewed by J Chow (Adv Tech Center, Org L9-24, Lockheed Martin, 3251 Hanover St, Palo Alto CA 94304-1191).

The author has written a book that seeks to present practical, general nonlinear, and robust control methods for hyperbolic and parabolic PDE systems, and to illustrate their application to transport-reaction processes that are found in the chemical industry. There is also an attempt to compare their effectiveness with respect to traditional control methods for PDE systems. This book is written for process control engineers, researchers, and students at the graduate level.



The field of chemical engineering contains many different examples of hyperbolic and parabolic PDE systems. As the author rightly states in his preface, ''The interest in control of nonlinear partial differential equation (PDE) systems has been triggered by the need to achieve tight distributed control of transport-reaction processes that exhibit highly nonlinear behavior and strong spatial variations.'' As a result, there is a requirement to provide the chemical process community with an overview of the most recent advances in nonlinear PDE control theory.

In this book, general and practical methods for synthesizing nonlinear controllers for hyperbolic and parabolic PDE systems are systematically developed, and then extended to include robustness. Geometric and Lyapunov-based control techniques are used to synthesize nonlinear and robust controllers that use a finite number of measurement sensors and control actuators to achieve a stable closed-loop system in the face of model uncertainty. All the PDE systems considered in this text are assumed to have unique solutions that are sufficiently smooth. Readers are assumed to have a basic knowledge about PDE systems and control theories.

The first two chapters focus first on quasi-linear, first-order hyperbolic PDE systems, and then on the same type of hyperbolic PDE systems, but those which include time-varying uncertain variables and unmodeled dynamics. These control methods are based on geometric control concepts and are applied to nonisothermal plug-flow reactor examples. The next two chapters focus on developing general methods for quasi-linear parabolic PDE systems using Galerkin's method and approximate inertial manifolds, both with and without time-varying uncertain variables. Examples of the methodology's successful application to the control of temperature profiles for catalytic rods and nonisothermal reactors are presented for illustration. The following chapter deals with the nonlinear and robust control of parabolic PDE systems with moving boundaries, ie, time-dependent spatial domains. General methods for synthesizing nonlinear and robust time-varying output feedback controllers are presented, again using a combination of Galerkin's method and the approximate inertial manifold. The final chapter presents case studies in which the control methods derived in earlier chapters for parabolic PDE systems are applied. In particular, the control of a rapid thermal chemical vapor deposition process and a Czochralski crystal growth process are illustrated and simulated. The book ends with an extensive set of mathematical proofs to support the results developed in the preceding chapters. It also has an extensive bibliography and is sprinkled throughout with clear figures and examples.

Nonlinear and Robust Control of PDE Systems is a well-written book that succeeds in its objectives and is possibly the first one to do so. The control theories and synthesis methodologies are described in exhaustive mathematical detail. This book can also be recommended to researchers and engineers in other fields who are faced with the task of developing nonlinear feedback and robust controllers for hyperbolic and parabolic PDE systems. They will find this book to be very useful because it provides the reader with the general framework for nonlinear feedback control based on detailed mathematical models.

3N24. Romansy 13: Theory and Practice of

Robots and Manipulators. Proc of 13th CISM-IFToMM Symposium. - Edited by A Morecki *(Warsaw Univ of Tech, Warsaw, Poland)*, G Bianchi *(Polytechnic of Milan, Milan, Italy)*, C Rzymkowski *(Warsaw Univ of Tech, Warsaw, Poland)*. Springer-Verlag, New York. 2000. 511 pp. ISBN 3-211-83333-1. $81.90.

This proceedings focuses mainly on problems of mechanical engineering and control. The opening lecture, by B Roth, presents an overview of the theoretical basis for the mechanical aspects of robot design. The general lecture, by M Vukobratovic, discusses the theory and practice of new frontiers of robotics.

The 50 regular papers included in this volume illustrate significant contributions in mechanics (13 papers), motion control (7), synthesis and design (8), legged locomotion (11), sensing and machine intelligence (2), applications (5), and biomechanical aspects of robots and manipulators (4).

Practical Methods for Optimal Control using Nonlinear Programming. - JT Betts *(Res and Tech Div, Boeing Co, Seattle WA)*. SIAM, Philadelphia. 2001. 190 pp. ISBN 0-89871-488-5. $51.00. (Under review)

Strategies for Collective Minimalist Mobile Robots. Engineering Research Series No 6. - C Melhuish *(Fac of Eng, Univ of the West of England, UK)*. Professional Eng Publ, Suffolk, UK. 2001. 222 pp. ISBN 1-86058-318-0. $150.00. (Under review)

IV. MECHANICS OF SOLIDS

3R25. Engineering Rock Mechanics: An Introduction to the Principles. - JA Hudson and JP Harrison *(Huxley Sch of Env, Earth Sci, and Eng, Imperial Col of Sci, Tech and Med, Univ of London, London, UK)*. Pergamon, Oxford UK. 2000. 444 pp. ISBN 0-08-041912-7.

Reviewed by ME Popescu (Dept of Civil and Architec Eng, Illinois Inst of Tech, 3201 S Dearborn St, Chicago IL 60616).

The US National Committee on Rock Mechanics defined rock mechanics as ''the theoretical and applied science of the mechanical behavior of rock and rock masses; it is that branch of mechanics concerned with the response of rock and rock masses to the force fields of their physical environment.'' Rock engineering is concerned with the investigation, design, construction, and performance of engineered structures built on, in, or of rock. It involves engineering applications of the science of rock mechanics.

Rock mechanics and rock engineering are not synonymous although the terms are sometimes used as if they were interchangeable. The Statutes of the International Society for Rock Mechanics say that ''the field of rock mechanics is taken to include all studies relative to the physical and mechanical behavior of rocks and rock masses and the applications of this knowledge for the better understanding of geological processes and in the fields of engineering.'' Thus, rock mechanics is seen as having a major input into rock engineering, but as having application in other areas as well.

Despite the long history of the use of rock as a construction material, the development of the science of rock mechanics and of a mechanics-based rock engineering design methodology occurred only relatively recently. The initial development of these design approaches appears to have been associated largely with civil engineering projects and especially with hydro-electric power schemes. An early manifestation of the emergence of rock engineering was the publication in Vienna in 1929 of the first volume of the journal *Geologie und Bauwesen* (Geology and Construction) edited by Josef Stini. In 1962, the journal's name was changed to Felsmechanik and Ingenieurgeologie (Rock Mechanics and Engineering Geology) under the editorship of Leopold Müller. The other major journal in the field, the International Journal of Rock Mechanics and Mining Sciences, which was founded in the United Kingdom in 1964, had an initial mining emphasis.

Annual colloquia on rock mechanics have been held in Austria since 1950 and annual symposia in the United States of America since 1956. Under the leadership of Leopold Müller, the International Society for Rock Mechanics was formed in 1962. The Society's first International Congress was held in Lisbon, Portugal in 1966.

This book, *Engineering Rock Mechanics: An Introduction to the Principles* by Hudson and Harrison, and its companion volume *Engineering Rock Mechanics: Part 2: Illustrative Worked Examples* by JP Harrison and JA Hudson (see next Review, **3R26**), represent authoritative references on engineering rock mechanics, consolidating into one handy source information once widely scattered throughout the literature. They include new, previously unpublished material; present the fundamental concepts of rock mechanics; and appraise their practical application in industrial projects such as tunneling and mining.

Engineering Rock Mechanics: An Introduction to the Principles is based on the content of the integrated engineering rock mechanics course given at Imperial College by the authors. As stated in the book preface the authors made a special attempt to present the principles of rock mechanics and then to place them in the engineering context. The layout follows a logical course. Chapters 1–13 cover the basic subjects of rock mechanics such as stress, strain, permeability, discontinuities, anisotropy and inhomogeneity, testing techniques, rock mass classification, rock dynamics and time dependent aspects. Chapter 14, entitled *Rock mechanics interactions and rock engineering systems*, discusses the principles of rock engineering systems and interaction matrix as the basic device used in rock engineering systems. Soft systems approach is used if the state variables are conceptual in nature while the fully-coupled model or the hard systems approach is used if the state variables are physical variables. Chapters 15–20 cover major applications in rock engineering including instability and stabilization of surface and underground excavations. There are two appendices at the end of the book on stress and strain analysis and hemispherical projection methods, respectively.

Concluding with an exhaustive bibliography of significant references and a very well-organized index, the book addresses the principles of engineering rock mechanics and is not intended to be truly comprehensive in the sense of including all information on the rock engineering subject. Readers requiring more information are referred to the five-volume compendium *Comprehensive Rock Engineering*, edited by the first author and also published by Pergamon.

Engineering Rock Mechanics: An Introduction to the Principles and its companion volume, *Engineering Rock Mechanics. Part 2. Illustrative Worked Examples*, deftly and elegantly bring together timely and in-depth information on one of the most active fields of applied mechanics. The books are written by authors with long standing teaching, research, and consulting experience in rock mechanics engineering.

These books are clearly written and the text, figures, and tables are produced to a high quality. These two books represent a significant contribution to the challenging field of rock mechanics and should be recommended as a reference for university libraries serving civil engineering, mining engineering, and geological engineering programs, as well as for research corporations, and engineering consulting firms.

3R26. Engineering Rock Mechanics: Part 2. Illustrative Worked Examples. - JP Harrison and JA Hudson *(Huxley Sch of Env, Earth Sci, and Eng, Imperial Col of Sci, Tech, and Med, Univ of London, London, UK)*. Pergamon, Oxford UK. 2000. 506 pp. ISBN 0-08-043010-4. $128.50.

Reviewed by ME Popescu (Dept of Civil and Architec Eng, Illinois Inst of Tech, 3201 S Dearborn St, Chicago IL 60616).

This book reviewed here is a companion book to *Engineering Rock Mechanics: An Introduction to the Principles* by Hudson and Harrison (see previous Review, **3R25**). This companion book contains worked examples of engineering rock mechanics in action as the subject applies to civil, mining, petroleum, and environmental engineering. This book can be used as a standalone textbook or as a complement to the introductory book. The book covers the necessary understanding and the key techniques supporting the rock engineering design of structural foundations, dams, rock slopes, tunnels, caverns, hydroelectric schemes, and mines.

The authors adopted a question-and-worked-answer presentation—the question and answer sets have been collated into 20 chapters which match the subject matter of

Engineering Rock Mechanics: An Introduction to the Principles: Chapters 1–13 on rock mechanics principles and Chapters 14–20 on applications in rock engineering. Part A entitled ''Illustrative worked examples–Questions and answers'' can be read as a narrative consisting of sequences of text, questions, and answers, while in Part B entitled ''Questions only'' the same questions can be tackled without the answers being visible.

Each chapter of Part A has the same format: Section 1–Introductory aide-memoire to the chapter subject; Section 2–Questions with worked answers that illustrate the principles of the rock mechanics subject and the associated rock engineering design issues; and Section 3–Additional points, often reinforcing the most important aspect of the subject. Part B includes question sets that give examples of the procedures often encountered in practice. It emphasizes that a good designer needs not only knowledge *for* designing (technical knowledge), but also must have knowledge *about* designing (an appropriate process to follow).

There are three appendices. Appendix A contains a 3D stress cube cut-out which can be copied and made into a model as an aide-memoire. Appendix B contains a hemispherical projection sheet which can be also copied and used. Appendix C contains RMR and Q rock mass classification tables. Exhaustive references, lists of units and symbols, and a subject index add very much to the value of the book.

Engineering Rock Mechanics: An Introduction to the Principles and its companion volume, *Engineering Rock Mechanics. Part 2. Illustrative Worked Examples*, deftly and elegantly bring together timely and in-depth information on one of the most active fields of applied mechanics. The books are written by authors with long standing teaching, research, and consulting experience in rock mechanics engineering.

These books are clearly written and the text, figures, and tables are produced to a high quality. These two books represent a significant contribution to the challenging field of rock mechanics and should be recommended as a reference for university libraries serving civil engineering, mining engineering, and geological engineering programs, as well as for research corporations, and engineering consulting firms.

3R27. Probabilistic Assessment of Structures using Monte Carlo Simulations. - Edited by P Marek, J Brozzetti, M Gustar. Academy Sci Czech Rep, Prague, Czech Rep. 471 pp. CD-ROM included.

Reviewed by I Elishakoff (Dept of Mech Eng, Florida Atlantic Univ, Boca Raton FL 33431-0991).

This is a textbook, which was completed with the support of the European Commission under the Leonardo da Vinci program. It is an unusual book. It is composed by 33 authors, 11 of whom may be characterized as students. This reminds me of a Talmudic dictum stating that one can learn a lot from his teachers, even more from his colleagues, and the most from one's students. This cooperation between the editors, university professors, and the PhD students is a most welcome one. The authors pose a rightful and timely question: ''What is needed to be done in order to improve and to make progress in the use of full probabilistic reliability assessment?''

Indeed, there are many research papers in this area by now (possibly several thousand), with attendant monographs, specialized regional and international conferences with multi-volume proceedings, contributed and keynote lectures. Yet the above-mentioned problem is seldom being addressed. This unfortunate situation makes an impression that the methods treating uncertainty constitute a second-order effect, or a curiosity that is unconnected with reality, for the designers and the deterministically minded engineers want to get some simple tools from the researchers engaged in the probabilistic mechanics.

Returning to the authors' question, their reply is as follows: ''The attention should be focused to the qualitatively new reliability assessment methods considering the rapidly increasing potential of the computer and information technology.'' Further that ''The formation from the 'pre-computer' reliability assessment concepts to the new generation of 'computer era technology' which makes workable a fully probabilistic concept, will require education of designers and a 're-engineering' of the whole assessment procedure of structural reliability.''

The authors suggest massive utilization of the Monte Carlo method. The book has an attachment form of the software (CD-ROM) to demonstrate the feasibility of probabilistic reliability assessment.

The textbook comprises 16 chapters and three appendices. Chapter 2 explains the Monte Carlo simulation technique. The authors explain: ''Simulation is an experiment performed on a model rather than on a real system.'' They note wisely that ''There is not a generally accepted exact definition of the concept of randomness.'' They discuss basic notions of probability theory and statistics, including random variables, histograms, and the Monte Carlo method, along with uncertainty of results, variance reduction techniques, and typical problems illustrating what can be calculated using Monte Carlo simulation. Then they proceed to the random number and pseudorandom generators, including testing of their quality, and a transformation method. They have developed simulation based reliability assessment (SBRA) programs. The load combination program (LoadCom) is a tool for loads effect combination analysis according to allowable stress design, partial safety factor design, and limit states design according to Canadian National Standards. They also describe response combination (ResCom) damage accumulation (DamAc), and an AntHill program allowing evaluation and display of multi-dimensional random variables. This permits a direct reliability assessment, as well as an iteration procedure for model parameter estimation.

In Chapter 3, the authors present a problem of interpretation of the limit state philosophy, including serviceability limit states, static and dynamic models, and load effects. Chapter 4 is devoted to single component, load combinations; dead load effects for single-story buildings; analysis of principal stress at a point of a beam; combined dead, live, and snow load effects; and dependent load effects. Chapter 5 treats examples associated with resistance of structural elements and components. Ultimate bearing capacity of reinforced concrete cross-section subjected to bending and compression, resistance of short composite columns, variability of the strength of steel-concrete composite beams, post buckling resistance of compressed rectangular plates, tension resistance of a bolted beam to a beam connection, and shear resistance of a better beam are treated.

Structural elements are discussed in the sixth chapter. The material includes pipes under internal pressure, nailed timber-to-timber joint, dowelled steel-to-timber joint, stability of a portion of a continuous girder exposed to several variable loads and to a moving variable load as many others. Chapters 7 and 8 are dedicated, respectively, to the first-order and second-order theories. The ninth chapter discusses reliability of retaining walls and slopes, whereas Chapter 10 deals with prestressed concrete examples. Accumulation of damage is discussed in Chapter 11; serviceability is treated in Chapter 12; and Chapter 13 deals with special situations. The title of Chapter 14 is ''From Components to Systems.'' It includes assessment of coupled steel beams, determination of the safety of a bolted lap joint, as well as that of the bolted web plate joint. Eurocodes are discussed in Chapter 15. Chapter 16 deals with the Bayesian approach.

Numerous examples included in the text allow for a multifaceted education in a unified reliability context. It is an indispensable reference to those who want to see

probabilistic methods in action. The Monte Carlo method is shown as a powerful technique for dealing with a large variety of engineering problems. Engineers may use it in order to contrast their own methodologies with the ones presented in the book in view of bringing some new aspects of the topics discussed. This reviewer would want to see the discussion of dependent random variables, correlations, as well as the sources of the assumptions of the adopted probabilistic densities.

Probabilistic Assessment of Structures using Monte Carlo Simulations is an excellent text for educating practicing engineers. Some of the examples could also be adopted in various courses that have a deterministic flavor in order to demonstrate the philosophy of probabilistic design. This book, therefore, is a welcome new bird, telling us that possibly the probabilistic spring may still arrive for design purposes, not only for research.

3R28. Stability of Elastic Structures. Foundations of Engineering Mechanics. - NA Alfutov *(M-1 Dept, Moscow State Univ of Tech, 2-nd Baumanskaya Str 5, Moscow, 107005, Russia).* Springer-Verlag, Berlin. 2000. 337 pp. ISBN 3-540-65700-2. $99.00.

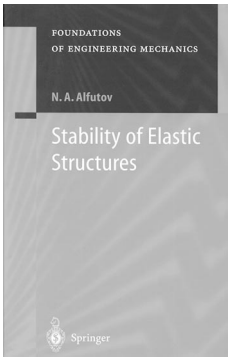
Reviewed by J Wauer (Inst fur Tech Mec, Univ Karlsruhe, Kaiserstr 12, Karlsruhe, D-76128, Germany).

The stability loss of slender structural systems under loading is still an actual field of research in mechanics. Every engineer nowadays has to know the occurring phenomena and the analytical methods to explain them. In general, such stability investigations have to be based on a dynamic approach. However, in many practical applications, a static approach can be applied, and this is the objective of the present book. It is clearly pointed out by the author that only the static stability of elastic systems is considered, and that the complete mathematical framework is explained for classical structural members such as columns, plates, and (cylindrical) shells. The drawback of this restriction is being compensated for by the demand to give a very clear and straightforward introduction into the basics of this part of an important field.

The book is arranged in seven chapters (and an appendix) together with a list of references and a subject index both covering the complete content of the book.

Chapter 1 deals with the basic theory of elastic stability. It stresses the equilibrium paths for deformed systems, stable or unstable equilibrium states and bifurcation points as well as limit points and critical loads, including energy criteria for bifurcational stability loss and a corresponding method using homogeneous linearized equations. It also discusses the supercritical behavior and the stability of elastic structures under combined loading. A summarizing statement on stability problems for slender structures concludes the chapter.

Chapter 2 discusses the energy method more in detail starting with the principle of virtual displacements and variational approaches in the linear theory of elasticity. Two basic forms of the presented energy criterion for bifurcational stability loss are introduced and generalized as the Bryan and the Timoshenko form. The significance of the Rayleigh-Ritz method in the stability analysis is addressed, and the Galerkin method and its relationship to the Rayleigh-Ritz method is explained.



Chapter 3 covers the stability of straight columns, essentially under axial forces. Elastic foundations and elastic supports are included in the analysis, and the stability of self-gravitating column is examined. In addition, the problem of lateral-torsional beam buckling is dealt with, and the influence of transverse shear strains is also addressed.

Chapters 4 and 5 concern the stability of plates. Chapter 4 discusses the differential equation approach while Chapter 5 is focused on the energy method. Both rectangular and circular plates under mid-plane distributed force-loading are considered. Transverse shear effects, thermoelastic buckling, and plates under local loads are supplementing topics.

Chapter 6 is devoted to the stability of (cylindrical) shells starting with corresponding considerations on circular rings. Axial compression and external radial pressure are the preferred load cases, but shells under torsion and transverse bending also find attention. Finally, stiffened shells (by elastic frames) are addressed.

Chapter 7 gives an outlook to nonlinear problems starting with a discussion of the supercritical behavior of a compressed bar after stability loss and extending the examination to plates and shells including initial imperfections.

The appendix gives a compact introduction into eigenvalue problems, stationary values, and extrema of functions and functionals.

The restriction mentioned at the beginning detracts from the value of the book for all persons interested in receiving a general view of the whole field of structural stability. On the other hand, to find a clear introduction about the static stability and to understand the peculiar phenomena in this area, it might be better to concentrate on the basics for simple structural members. In this sense, *Stability of Elastic Structures* can be recommended for all undergraduate and also graduate courses in engineering science, in particular civil and aeronautic engineering. Also, for practical engineers in these fields, it is a good reference. The book is well written with good quality figures and illustrations. It is worth being purchased by every engineering library.

3R29. Theory of Porous Media: Highlights in Historical Development and Current State. - R de Boer *(Inst fur Mechanik, Univ Essen, Fachbereich 10 Bauwesen, Essen, D-45117, Germany).* Springer-Verlag, Berlin. 2000. 618 pp. ISBN 3-540-65982-X. $95.00.

Reviewed by N Katsube (Dept of Mech Eng, Ohio State Univ, 206 W 18th Ave, Columbus OH 43210).

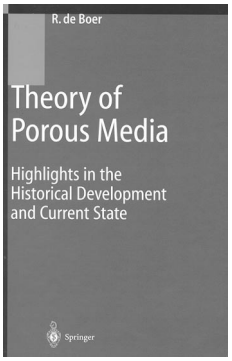
This book consists of historical and recent development of porous material theory, can be used as a reference book in this area. In the early and classical era, general development of continuum mechanics such as Cauchy's formulation of the stress concept, the development of linear elasticity theory, and the foundation of thermodynamics are summarized. At the end of each chapter, biographical notes of the important contributors are outlined. There the readers could learn about the lives of these prominent researchers, including their characters, and the nature of scholarly debates. The readers can also learn about how the lives of these researchers were influenced by the historical events, and how failure in one event had led to success in another.

In the modern era, the emphasis is placed on the porous materials. The historical review includes the controversy between Fillunger and von Terzaghi and the subsequent development of the theory by Biot and others. Further development of elasticity and plasticity theories and a more modern framework of continuum mechanics and mixture theory are also discussed.

The current state of porous material theory reflects the author's work as well as the related work developed mostly in Europe. It is based on the assumption that the deformation gradient of the constituent can be separated into the part due to the real material and the part due to the change of the pores in size and shape through a multiplicative decomposition process. In developing constitutive theories, the principle of material objectivity as well as entropy inequality is employed. An extensive development of a porous material theory is presented based on these theoretical frameworks.

Theory of Porous Media: Highlights in Historical Development and Current State is a great book to have if you would like to know about the historical development of

porous material theory since many of the letters and articles written by the researchers in early days are not available in English. In addition, if you would like to follow the recent development of porous material theory, which is consistent with the above stated assumptions, this book will



provide an extensive review. However, the reader should be aware that this is not the only approach available in the area of porous materials. There are a number of different approaches available for the development of constitutive behavior of porous materials. These other approaches are more phenomenologically based and often motivated by experimental observations. The developed models are verified by experimental data and used to solve important practical problems.

3N30. Analysis of Bolted Joints - 2001. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta**.** - Edited by KH Hsu and T Sawa. ASME, New York. 2001. 200 pp. ISBN 0-7918-1671-0. ASME Book No G01165. $90.00. (ASME members $45.00).

This collection of 19 full-length, peer-reviewed technical papers discusses the following topics: analysis of spiral and graphite gaskets and considerations for a non-asbestos gasket, sealing of box-shaped and metal-to-metal joints, and gaskets under internal pressure. This volume also contains one student-written paper on gasket stress levels.

3N31. Deformation and Fracture Behaviour of Polymers. - Edited by W Grellmann *(Dept of Eng Sci, Martin-Luther-Univ of Halle-Wittenberg, Halle, D-06099, Germany)* and S Seidler *(Inst of Mat Sci and Testing, Vienna Univ of Tech, Favoritenstr 9-11, Vienna, A-1040, Austria)*. Springer-Verlag, Berlin. 2001. 599 pp. ISBN 3-540-41247-6. $99.00.

This book gives an overview of recent advances in fracture mechanics of polymers (experimental and alternative methods), morphology-property correlations (homopolymers, copolymers, blends), hybrid methods of polymer testing and polymer diagnostics, technological test methods, biocompatible materials and medical prostheses, as well as application examples and limits. The investigations of deformation and fracture behavior with experimental methods of fracture mechanics have been subject to intense research during the last decade. In a systematic manner, each chapter of this book gives a review of the particular aspects.

3N32. Design Methodologies for Space Transportation Systems. Education Series. - WE Hammond *(NASA Marshall Space Flight Center, Huntsville AL)*. AIAA, Reston VA. 2001. 866 pp. CD-ROM included. ISBN 1-56347-472-7.

This is a sequel to the author's earlier text on *Space Transportation: A Systems Approach to Analysis and Design*, published in 1999. Both texts represent a comprehensive exposition of the existing knowledge and practice in the design and project management of space transportation systems. This present book is intended as a reference companion to the first book. The text discusses new conceptual changes in the design philosophy away from multistage expendable vehicles to winged, reusable launch vehicles and presents an overview of the systems engineering and vehicle design process as well as the trade-off analysis. Several chapters are devoted to specific disciplines such as aerodynamics, aerothermal analysis, structures, materials, propulsion, flight mechanics and trajectories, avionics, computers, and control systems. The final chapters deal with human factors, payload, launch and mission operations, and safety.

3N33. Fracture and Fitness. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta. - Edited by D Lidbury. ASME, New York. 2001. 216 pp. ISBN 0-7918-1678-8. ASME Book No G01172. $100.00. (ASME members $50.00).

Including 23 full-length, peer-reviewed papers, this volume explains the issues and current developments in the assignment of fatigue, and brittle and ductile fracture. Topics covered include application of fracture mechanics in failure assessment; fatigue and fracture of nuclear components; and using the master curve method to determine fracture toughness.

3N34. High Pressure Technology - 2001: At the Dawn of the New Millenium. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta**.** - Edited by L Antalffy and L Picqueur. ASME, New York. 2001. 100 pp. ISBN 0-7918-1673-7. ASME Book No G01167. $80.00. (ASME members $40.00).

This is a compilation of 12 full-length, peer-reviewed papers. The volume is divided into the following four sections: effects on autofrettaged vessels—experimentation with the machining and diameter of a cross-bore, as well as with cracks in cylindrical vessels; analysis of methods used for vessel design; flaw evaluation and creep crack growth; and a panel discussion with members, Japan, Europe, and the US, to compare high pressure vessel codes.

3N35. Pressure Vessel and Piping Codes and Standards. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta. - Edited by MD Rana. ASME, New York. 2001. 240 pp. ISBN 0-7918-1674-5. ASME Book No G01168. $100.00. (ASME members $50.00).

This volume includes 33 full-length, peer-reviewed papers which fit into three broad categories: plastic analysis in pressure vessel design; environmental fatigue issues; and structural integrity of pressure components. Three panel sessions describe new developments in the ASME code and compliance with PED regulations.

3N36. Pressure Vessel and Piping Design and Analysis - 2001. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta**.** - Edited by DH Martens. ASME, New York. 2001. 412 pp. ISBN 0-7918-1685-0. ASME Book No G01179. $130.00. (ASME members $65.00).

This is a compilation of 48 full-length, peer-reviewed technical papers designed to advance current theory and practice of pressure vessels and components. The volume is divided into two sections:

Design and analysis of pressure vessels, heat exchangers and components, and piping and components, including limit load analysis; and

Fatigue and fracture: applications on components, new developments, simplified methods, reactor vessel assessment. This section also includes *Fitness for service*: life extension, remediation, and repair.

3N37. Residual Stress Measurement and General Nondestructive Evaluation. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta. - Edited by DE Bray. ASME, New York. 2001. 128 pp. ISBN 0-7918-1684-2. ASME Book No G01178. $80.00. (ASME members $40.00).

This volume of 13 full-length, peer-reviewed technical papers covers measuring residual stress without the destruction of pressure vessels and piping. A sampling of contents includes stress measurement using x-ray diffraction and ultrasound techniques; electromagnetic and holographic techniques; speckle correlation interferometry and local heat treating for low levels of stress; and testing of key mechanical properties of oil and gas pipelines.

3N38. Service Experience, Fabrication, Residual Stresses and Performance. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta. - Edited by RW Warke. ASME, New York. 2001. 148 pp. ISBN 0-7918-1682-6. ASME Book No G01176. $90.00. (ASME members $45.00).

This volume of 15 full-length, peer-reviewed papers covers the following topics: service experience in operating nuclear plants; service experience in fossil fuel plants containing strategies for assessing the degree of degradation in several critical components; weld residual stresses and fracture, and new cost-cutting weld models employing pre-machining and weld sequence design; and fabrication and performance.

Cosserat Theories: Shells, Rods and Points. Solid Mechanics and its Applications, Vol 79. - MB Rubin *(Fac of Mech Eng, Technion-Israel Inst of Tech, Haifa, Israel)*. Kluwer Acad Publ, Dordrecht, Netherlands. 2000. 480 pp. ISBN 0-7923-6489-9. $205.00. (Under review)

Digital Photoelasticity: Advanced Techniques and Applications. - K Ramesh *(Dept of Mech Eng, Indian Inst of Tech, Kanpur, 208016, India)*. Springer-Verlag, Berlin. 2000. 410 pp. CD-ROM included. ISBN 3-540-66795-4. $116.00. (Under review)

Fracture Mechanics of Metals, Composites, Welds, and Bolted Joints: Application of LEFM, EPFM, and FMDM Theory. - B Farahmand. Kluwer Acad Publ, Dordrecht, Netherlands. 2001. 408 pp. ISBN 0-7923-7239-5. $140.00. (Under review)

Metal Failures: Mechanisms, Analysis, Prevention. - AJ McEvily *(Dept of Metall and Mat Eng, Univ of Connecticut CT)*. Wiley, New York. 2002. 336 pp. ISBN 0-471-41436-0. $90.00. (Under review)

Thin Plates and Shells: Theory, Analysis, and Applications. - E Ventsel *(Eng Sci and Mech Dept, Penn State, Univ Park PA 16802)* and T Krauthammer (Protective Tech Center, Penn State, Univ Park PA 16802). Marcel Dekker, New York. 2001. 666 pp. ISBN 0-8247-0575-0. $175.00. (Under review)

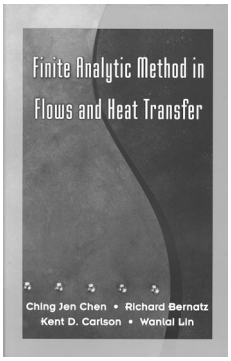
Three-Dimensional Contact Problems. Solid Mechanics and its Applications, Vol 93. - VM Alexandrov *(Dept of Mech and Math, Moscow State Univ, Moscow, Russia)* and DA Pozharskii *(Mech and Appl Math Inst, Rostov-on-Don State Univ, Rostov-on-Don, Russia)*. Kluwer Acad Publ, Dordrecht, Netherlands. 2001. 406 pp. ISBN 0-7923-7165-8. $131.00. (Under review)

V. MECHANICS OF FLUIDS

3R39. Finite Analytic Method in Flows and Heat Transfer. - Ching Jen Chen *(Col of Eng, Florida A&M Univ)*, RA Bernatz *(Luther Col)*, KD Carlson *(Univ of Iowa)*, Wanlai Lin *(Tech Dev of Next Generation Prod, Emerson Elec Corp)*. Taylor & Francis Publ, New York NY. 2000. 332 pp. ISBN 1-56032-898-3. $69.95.

Reviewed by G de Vahl Davis (Sch of Mech and Manuf Eng, Univ of New South Wales, Sydney 2052, NSW, Australia).

The finite analytic (FA) method is an Eulerian method that solves the differential equations for CFD/HT by representing the solution domain as a series of homogeneous, constant parameter elements. Within each of these elements an algebraic form of the analytic solution of a linearized form of the equations is constructed. The solution at a nodal value in the interior of each element is expressed as the sum of neighboring nodal values weighted by finite analytic coefficients. A system of these finite analytic algebraic equations is then solved to provide a numerical solution for the dependent variable at prescribed discrete locations within the domain.



The method was conceived by CJ Chen (one of the authors of this book) and his then student, Peter Li, in 1977. It was first published in 1981 and has since been developed, extended, and implemented by Chen, his students and others. A global web search for ''finite analytic method'' yielded about 200 hits, while ScienceDirect® (for Elsevier publications) yielded 96 references between 1980 and 2001. The method has been successfully applied to a range of problems in two- and three-dimensional flow and heat transfer, both laminar and turbulent, in regular and irregular domains. The authors claim that, compared to traditional finite difference (FD) methods, the method is stable and accurate over a much broader range of flow and computational parameters such as Reynolds number and grid spacing. Nevertheless, it has not yet been widely adopted, and several well-known texts on CFD/HT published in recent years do not mention it.

This book is aimed at graduate students and practitioners of CFD/HT. It is presented in five parts totaling 310 pages, comprising 25 chapters and two appendices. Some knowledge of differential equations and of some analytic methods are assumed.

Part I is entitled *Introduction to Computational Fluid Dynamics* and contains an introduction followed by chapters on Governing Equations (the N-S and energy equations and turbulence modeling); Classification of PDEs; Well-Posed Problems (including existence and uniqueness); Numerical Methods (a brief survey of FD, finite element (FE) and FA methods); and a more extensive chapter on The Finite Difference Method. In the chapter on numerical methods, the authors briefly compare FA with FD and FE, highlighting the advantages and disadvantages of each; they conclude, not surprisingly, that FA wins out.

In Part II, *The Finite Analytic Method*, the method is explained in detail. The seven chapters cover Basic Principles; One-, Two-, and Three-Dimensional Cases; Stability and Convergence; Hyperbolic PDEs; and what is called the Explicit Finite Analytic Method for the 2D transport equation for convection dominated flows, which is less complex than the implicit formulations developed in the preceding four chapters.

Part III, *Numerical Grid Generation*, contains an introduction covering algebraic transformations and a summary of differential methods, followed by chapters on Elliptic Grid Generation; Equations in ξ and η Coordinates; Diagonal Cartesian (DC) Method; and FA Method on DC Coordinates.

In Part IV, several *Computational Considerations* are discussed: Velocity, Pressure and Staggered Grids; Nonstaggered Grid Methods; and Boundary Conditions.

Finally, Part V describes some *Applications of the FA Method* to Turbulent Flows; Turbulent Heat Transfer; Complex Domain Flows; and Conjugate Heat Transfer. It is this section, more than any other, which will allow teachers and practitioners to decide whether to adopt the method. The examples include turbulent flow past disc valves; the sea breeze phenomena (sic), a turbulent atmospheric boundary layer circulation driven by surface temperature gradients; groundwater flow and solute transport; and the design of a compact heat exchanger.

The authors say that a 2D laminar Fortran code is available at www.finiteanalytic-.com. However, when this reviewer went there, he got the message ''This site is currently under construction; please check back at a later time'' in several languages.

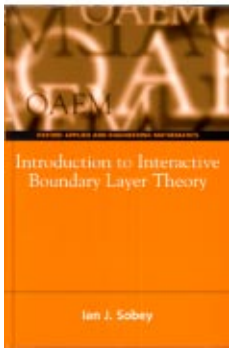
This book should certainly be seriously considered by teachers of CFD/HT, and graduate students should have some exposure to the ideas presented. Time will tell whether the finite analytic method will take a place alongside—or perhaps even surpass—finite difference and finite element methods.

3R40. Introduction to Interactive Boundary Layer Theory. - IJ Sobey *(Comput Lab, Oxford Univ, UK)*. Oxford UP, Oxford, UK. 2000. 332 pp. ISBN 0-19-850675-9. $80.00.

Reviewed by JH Lienhard V (Dept of Mech Eng, MIT, Rm 3-162, Cambridge MA 02139-4307).

Laminar boundary layer theory, as taught in most introductory fluid mechanics courses, involves asymptotic expansion of the Navier-Stokes equations to leading order in a small parameter equal to the minus one-half power of the Reynolds number. An inner viscous region (the boundary layer) and an outer inviscid region are matched to one another to fix the unknown terms in the expansions. Boundary layer theory at this order works very well for many engineering applications; it is, however, inadequate for the prediction of some very important phenomena, particularly in relation to flow separation.

If the asymptotic expansions are carried to higher order, difficulties arise in the form of singularities and an inability to match the higher-order terms. These problems were explored in detail by Goldstein and others, beginning in the 1930s. Only in 1969 was a resolution found, in the form of *interactive* boundary layer theory. To what interaction does this name refer? Specifically, it is an interaction between the pressure field and the streamline displacement, which is accommodated by a three layer, or *triple deck*, analysis of the boundary layer.



Sobey's new monograph, *Introduction to Interactive Boundary Layer Theory*, is an effort to collect and summarize the fundamental developments in this very abstruse area of fluid dynamics. His approach is initially historical. After a short chapter recapitulating the equations of fluid dynamics, Sobey begins serious work with a 50-page summary of theoretical efforts to take boundary layer theory to higher order. These efforts focused on the simple situations of semi-infinite and finite length flat plates. Sobey thoroughly illustrates problems encountered by Goldstein and others as they attempted to complete a second-order theory, and he shows how a severe singularity in transverse velocity arises at the trailing edge of a plate.

The third chapter gives an account of the triple-deck theory, through which Stewart-

son and Messiter independently resolved the trailing edge singularity in about 1969. Their work introduced a three-layered structure near the trailing edge of a plate, each layer of which scales with a different power of the Reynolds number. The analysis is executed through multiple matched asymptotic expansions. The numerical solution of the resulting equations is described in Sobey's next chapter. The triple-deck model successfully resolves the trailing-edge singularity found in the classical two-layer theory, and, in the author's estimation, is ''one of the outstanding achievements in theoretical fluid mechanics.''

In Part II of the text, Sobey turns to the problem of separated flow. After a brief introductory chapter, he devotes Chapter 6 to a historical survey of efforts to predict separation in crossflow over a cylinder. Free streamline theories, boundary layer theories for adverse pressure gradients, and combinations thereof are summarized through the year 1969. Chapter 7 describes efforts to use triple-deck ideas for this problem and outlines some of the continuing difficulties with the theory.

The final part of the book, in three chapters, applies interactive boundary layer theory to two-dimensional channel flows in which the walls are perturbed by indentations. Upstream influence and the Coanda effect are each considered at length. An Appendix provides problems and numerical exercises.

This book is not for the faint of heart. A working knowledge of asymptotics is essential, as is a thorough acquaintance with classical boundary layers and potential flow theory. For those having such a background, the mathematics will still demand careful reading. Of course, one of the rewards of having learned the classical theory is that a book like this one is both accessible and rewarding. On the other hand, despite the hopeful statement in the preface that readers with little background in fluid mechanics should be able to absorb the text, nonspecialists will find this material challenging.

The major flaw of the book is a lack of careful copy editing, as in the following passage from page 30:

''The factors of $\sqrt{2}$ which appear in (2.25) are somewhat arbitrary, different authors have used slightly differing notation, in this case we are following Van Dyke (1964).''

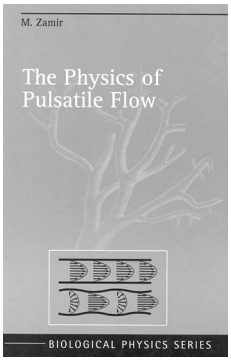
Such phrasing permeates the text and poses an ongoing distraction. Sobey often moves to an imperative voice when introducing equations or procedures (''Now expand...,'' ''Define parabolic coordinates by...''), which creates the sensation of notes copied onto a chalkboard. Finally, although the book is typeset in LaTEX, the latter has not been used to its full potential. The delimiters in many equations are not sized properly, and the frequently-used symbol for ''much less than'' is set as $< <$, rather than via the glyph $\ll$ (obtained with the LaTEX command \ll).

These concerns are, of course, minor; *Introduction to Interactive Boundary Layer Theory* will stand as a unique and valuable contribution to the literature. Students of theoretical fluid mechanics have much to gain from this book.

3R41. Physics of Pulsatile Flow. Biological Physics Series. - M Zamir *(Dept of Appl Math, Univ of W Toronto, London ON, N6A 5B7, Canada)*. Springer-Verlag, Wien, Austria. 2000. 220 pp. ISBN 0-387-98925-0. $69.95.

Reviewed by RS Budwig (Mech Eng Dept, Univ of Idaho, Moscow ID 83844-0902).

This is the first book, to my knowledge, to give a detailed description of the basic physics and mathematics of pulsatile flow in a tube. While the focus of the monograph is the physics and mathematics of pulsatile flow, the author does refer often to the application of this knowledge to the subject of blood flow in the conduits of the mammalian circulatory system. There are two monographs that write on this subject from a medical perspective (*Hemodynamics*, by WR Milnor, and *Blood Flow in Arteries*, by DA McDonald) and two monographs that give a broader view of the physics of circulation (*The Fluid Mechanics of the Large Blood Vessels*, by TJ Pedley, and *Biodynamics–Circulation*, by YC Fung). Finally, there is a non-mathematical, but highly descriptive monograph on this subject (*Vital Circuits*, by S Vogel).



The six chapters of the present book may be divided into two categories: Chapters 1 and 2 focus on fundamental concepts and Chapters 3 through 6 describe four cases of tube flows. The first chapter of the book provides a presentation of the background concepts that are required to study tube flows. This reviewer was pleased to find that, in addition to the required basic concepts, the author has included a section on whether or not blood may be treated as a Newtonian fluid. He also provides a brief discussion on when blood flow might be turbulent. The second chapter is a standard development of the equations of motion for fluid flow—the author derives the equations in polar cylindrical coordinates so they may be readily applied to tube flow.

Chapter 3 focuses on the subject of steady tube flow. The Hagen-Poiseuille solution is developed and discussed. The author goes on to discuss entry length of a tube flow and then devotes the remainder of the chapter to the application of modeling flow in the arterial tree. The chapter has an insightful discussion of the concept of the energy expenditure that is required to move a fluid through a tube and the implications of this on the diameter of blood vessels in the arterial tree. One area for improvement in this chapter and throughout the book would be the addition of a few examples with realistic numerical values for viscosity, diameter, etc. The reader would then get an idea of the order of magnitude of quantities that are being discussed (for example, does it require 1 watt or 100 watts to pump blood through the human aorta at typical conditions?).

Chapter 4 goes on to consider the case of pulsatile flow in a rigid tube. The author presents a detailed development of the solution for the case of a flow driven by a purely sinusoidal pressure waveform. He includes a section on how Fourier analysis can be used to represent waveforms that are more complicated than a simple sine wave (such as the waveforms that occur in the flow of blood in the arteries). The author presents graphical results of the velocity profiles. This reviewer was surprised that the author did not present and discuss the near-wall velocity overshoot (Richardson's annular effect) that is a hallmark of oscillatory tube flow. On the other hand, this reviewer compliments the author for his unique contribution in writing an entire section on the power required to drive a pulsatile flow. Chapter 5 gives a clear and unique presentation of the analysis and results for pulsatile flow in an elastic tube. Chapter 6 presents the theory of wave reflection for pulsatile flow in a system of elastic tubes. Both Chapters 5 and 6 include a level of detail that is not found in other books.

On the whole, this reviewer found the topics in this book to be presented with clarity. The unique features of the monograph include the presentations on pumping power and the level of detail in the presentations on flow in an elastic tube and on the theory of wave reflections. The author has chosen to limit the book's scope—he does not address the secondary flow patterns that develop at bends, bifurcations, constrictions, or other morphologies that exist in the cardiovascular system. The author has included excellent problems at the end of each chapter, solution summaries at the end of the book, and a valuable list of references with each chapter. This reviewer is pleased to recommend *Physics of Pulsatile Flow* for the library of anyone involved in the study or teaching of internal pulsatile flows.

3R42. Principles of Fluid Mechanics. - AN Alexandrou *(Dept of Mech Eng, Worcester Polytechnic Inst)*. Prentice Hall, Upper Saddle River NJ. 2001. 573 pp. ISBN 0-13-801762-X. $100.00.

Reviewed by R Verzicco (Dept di Ingegneria Meccanica e Gestionale, Politecnico di Bari, Via Re David 200, Bari, 70125, Italy).

This book is an introductory text for fluid dynamics which contains enough material for two semesters of undergraduate courses. The organization of the material reflects the particular point of view of the author, and this gives the opportunity to have a look at standard concepts from a different perspective. The book contains also some material from experimental and computational fluid dynamics which have become of fundamental importance in modern courses.

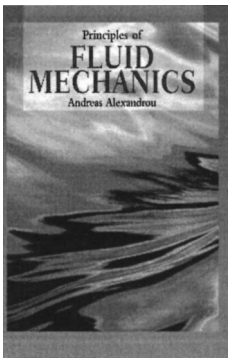
The text contains 13 chapters and five appendices. Each chapter is focused on a particular topic and contains its own references and exercises. In the appendices, some complementary material is provided which is very useful for the application of theory to practical examples. The book closes with a subject index.

Chapter 1 opens the book with an introduction to fluid dynamics and its impact to design. Some solution methods are mentioned thus anticipating successive concepts. Standard fluid properties and system of units are then introduced. Chapter 2 is devoted to conservation laws for closed systems including the basic thermodynamics principles. In this chapter, a particular view of the hydrostatics is given in contrast to the standard approach which considers hydrostatics as a separate topic.

Chapter 3 derives the conservation laws for open systems starting from the Reynolds transport theorem. The successive chapter gives the concepts of position, velocity, and acceleration vectors thus introducing the Lagrangian and Eulerian perspectives and the deformation of a fluid element. Using these results, Chapter 5 reconsiders the conservation laws in differential form. The chapter is completed with a description of boundary conditions, constitutive relations, Navier-Stokes equations, and non-isothermal flows. Chapter 6 is concerned with non-dimensional analysis and similitude, including the Buckingham theorem and the distorted- or incomplete-similarity. Chapter 7 deals with the exact analytical solutions of the Navier-Stokes equations; there are some unusual solutions like the film drawing of the fully developed non-Newtonian channel flow even if the Couette plane channel is not considered; this solution, however, can be easily derived since the basic principles are described with enough details.

The concepts of boundary layer and separation together with exact and approximate solutions are given in Chapter 8. Turbulent boundary layers are analyzed using empirical laws and giving quantitative correlations. This chapter has a very broad content; it includes external flows, force coefficients (for wings and general shape objects), internal flow with a particular attention to viscous flows in pipes.

Chapter 9 considers ideal inviscid flows. In the first part, the Euler equations along streamline coordinates and the Bernoulli equations are discussed, while in the second part, the basic theory for two-dimensional potential flow is introduced. No mention is made of the three-dimensional potential flows.



The successive four chapters present additional material which could be taught as complementary material in a course. Chapter 10 deals with the dynamics of rotating fluids and turbo-machineries starting from the conservation of angular momentum for closed and open systems. Particular examples are then illustrated showing pumps, turbines, and propellers.

Chapter 11 describes compressible flows starting from the speed of sound up to normal and oblique shocks and expansions. At the end of the chapter, Rayleigh and Fanno flows are described. In Chapter 12, some basic concepts of experimental fluid dynamics are given by describing the main components of a data acquisition system and the main measurement techniques. The last chapter provides the fundamentals of computational fluid dynamics with solution schemes for algebraic, ordinary differential, and partial differential equations. Finally, simple techniques for the solution of viscous and inviscid flows are yielded.

The five appendices contain, respectively, fluid properties, compressible flow tables, differential form of the equations in Cartesian, cylindrical-polar and spherical coordinates, and some simple computer programs and background material (such as vector and tensor algebra and elementary calculus) for a better comprehension of the material in the book.

This reviewer believes that the quality of the book is adequate for the intended scope. The presented material is well explained and completed with a lot of examples whose solution can be used as a guideline for the numerous exercises at the end of each chapter. Many good-quality pictures contribute to make the exposition clear and pleasant.

In conclusion, *Principles of Fluid Mechanics* is suitable for adoption as a text for the undergraduate level. Concerning libraries, it could complete the existing literature for undergraduates providing an additional viewpoint.

3N43. Aerodynamic Drag Reduction Technologies. Proc of CEAS/DragNet European Drag Reduction Conf, June 2000, Potsdam, Germany. - Edited by P Thiede *(EADS Airbus GmbH, Bremen, 28183, Germany)*. Springer-Verlag, Berlin. 2001. 390 pp. ISBN 3-540-41911-0. $199.00.

This proceedings volume, like the conference, aims at providing a comprehensive survey of the current status of research, development, and application in all disciplines of aerodynamic drag reduction including laminar flow technology, adaptive wing concepts, turbulence and separation control, induced drag reduction, and supersonic flow aspects. Most of the papers presented at the conference are included in this volume.

3N44. Granular Gases. - Edited by T Poschel *(Inst fur Biochemie, Humboldt-Universitat, Monbijustr 2, Berlin, 10117, Germany)* and S Luding *(Inst fur Computeranwendungen, Abt I Physik, Univ Stuttgart, Pfaffenwaldring 27, Stuttgart, 70569, Germany)*. Springer-Verlag, Berlin. 2001. 457 pp. ISBN 3-540-41458-4. $98.00.

''Granular gases'' are dilute granular systems, ie, many-particle systems, in which the mean free path of the particles is much larger than the typical particle size. This condition implies that the duration of particle contacts is much shorter than the mean flight time. In contrast to molecular gases, in granular gases the particle collisions occur dissipatively, ie, in each binary collision the particles lose part of the kinetic energy of their relative motion. The dissipation of kinetic energy causes a series of non-trivial effects, such as the formation of clusters and other spatial structures, non-Maxwellian velocity distributions, anomalous diffusion, correlations in the velocity field, characteristic shock waves, and others.

This book is divided into five sections on the following topics: Kinetic theory and hydrodynamics, Collisions and one-dimensional models, Vibrated granular media, Granular astrophysics, and Towards dense granular systems. Each section contains four to seven individually-authored investigation results. An author index is also provided.

3N45. International Symposium on Multi-Phase Flow and Transport Phenomena. Held in Antalya, Turkey, November 2000. - Edited by DM Maron *(Holon Acad Inst of Tech, PO Box 305, Holon, 58102, Israel)*. Begell House, New York. 2001. 621 pp. Softcover. ISBN 1-56700-162-9. $75.00.

This proceedings includes seven Keynote Lectures, 47 papers, and 17 poster session papers from the 2^{nd} International Conference on this topic. It covers the area of two-phase flow and transport phenomena.

3N46. Rarefied Gas Dynamics. Proc of 22nd Int Symp, Sydney, Australia, July 2000. - Edited by TJ Bartel and MA Gallis *(Sandia Natl Labs, Albuquerque NM 87185)*. AIP, Melville NY. 2001. 979 pp. CD-ROM included. ISBN 0-7354-0025-3. $295.00.

This proceedings contains 7 invited and 118 contributed papers divided into the following 13 chapters: Kinetic theory and transport phenomena; Rarefield flow studies; Plasma flows and processing; Numerical methods; Gas-surface interactions; Particle models and procedures; Microscale flows; Multiphase flows; Chemical reactions and thermal radiation; Low density aerodynamics; Jets, plumes, and propulsion; Clusters, aerosols, and granular gases; and Internal flows and vacuum systems.

3N47. River, Coastal and Estuarine Morphodynamics. Proc of IAHR Symp, Sept 1999, Genova, Italy. - Edited by G Seminara and P Blondeaux *(Dept of Env Eng, Univ of Genova, Via Montallegro 1, Genova, 16145, Italy)*. Springer-Verlag, Berlin. 2001. 211 pp. ISBN 3-540-41839-3. $84.95.

This book is a collection of review papers by most of the invited lecturers at the symposium. Along with the proceedings of the symposium, the present volume represents one of the outcomes of the activities of the Italian research group *Morfodinamica Fluviale e Costiera*, coordinated by G Seminara and co-funded by the Italian Ministry of Scientific Research and by various Italian universities.

The following nine papers are included in this volume: Perspectives in morphodynamics (G Seminara and P Blondeaux); Sediment entrainment and transport in complex flows (JM Nelson, MW Schmeeckle, RL Shreve, SR McLean); Alluvial roughness in streams with dunes: A boundary-layer approach (JJ Fedele and MH Garcia); Use of numerical models in coastal hydrodynamics and morphology (R Deigaard and J Fredsoe); Process of occurrence, flow and deposition of viscous debris flow (T Takahashi); Transverse slope of bed and turbid-clear water interface of channelized turbidity currents flowing around bends (G Parker, J Imran, C Pirmez); Pattern formation in the nearshore (R Holman); Long-term morphological prediction (H De Vriend); and River and tidal networks (A Rinaldo, S Lanzoni, M Marani.

3N48. Rotating Fluids in Engineering and Science. - JP Vanyo *(Dept of Mech and Env Eng, and Geol Sci, Univ of California, Santa Barbara CA)*. Dover Publ, Mineola NY. 1993. 429 pp. Softcover. ISBN 0-486-41704-2. $21.95.

This Dover edition, published in 2001, is an unabridged reprint of the work originally published by Butterworth-Heineman in 1993. It presents the basic principles and applications of rotating fluid theory. The book has 22 chapters which are divided into three parts: Fluid Mechanics Review, Rotating Fluid Theory, and Rotating Fluid Applications.

Energy Methods for Free Boundary Problems: Applications to Nonlinear PDEs and Fluid Mechanics. Progress in Nonlinear Differential Equations and Their Applications. - SN Antontsev *(Dept de Matematica, Univ de Beira Interior, Covilha, 6201-001, Portugal)*, JI Diaz *(Dept de Matematica Aplicada, Univ Complutenese, Madrid, 28040, Spain)*, S Shmarev *(Dept de Matematicas, Univ de Oviedo, Oviedo, 33007, Spain)*. Birkhauser Boston, Cambridge MA. 2002. 329 pp. ISBN 0-8176-4123-8. $79.95. (Under review)

Hydrodynamics: Examples and Problems: A Textbook. - YA Buyevich *(Deceased)*, DV Alexandrov *(Dept of Math Phys, Ural State Univ, Lenin Ave 51, Ekaterinburg, 620083, Russia)*, SV Zakharov *(Inst of Math and Mech, Russian Acad of Sci, Ural Branch, S Kovalevskaja St 16, Ekaterinburg, 620219 GSP-384, Russia)*. Begell House, New York. 2001. 331 pp. ISBN 1-56700-159-9. $67.50. (Under review)

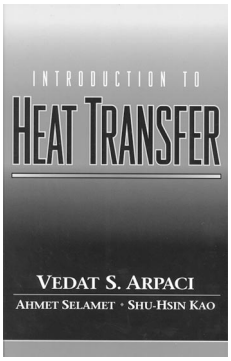
Schlieren and Shadowgraph Techniques: Visualizing Phenomena in Transport Media. - GS Settles *(Gas Dyn Lab, Penn State Univ, 301 D Reber Bldg, Univ Park PA 16802)*. Springer-Verlag, Berlin. 2001. 376 pp. ISBN 3-540-66155-7. $89.95. (Under review)

VI. HEAT TRANSFER

3R49. Introduction to Heat Transfer. - VS Arpaci *(Univ of Michigan, Ann Arbor MI)*, A Salamet, Shu-Hsin Kao. Prentice Hall, Upper Saddle River NJ. 2000. 611 pp. ISBN 0-13-391061-X. $93.33.

Reviewed by Y Jaluria (Mech Eng Dept, Rutgers Univ, 98 Brett Rd, Piscataway NJ 08854-8058).

This well-written book is a useful addition to the large number of textbooks available for heat transfer courses that are taught at the undergraduate level in engineering. It is written as an introductory book for a one-semester course, though the material included is more than what can easily be covered in a semester. It is written in a clear and easy-to-understand style, with a focus on the basic principles of heat transfer. Consequently, advanced topics, solution methods, and applications are generally not covered, since the basic concepts can be brought out by considering relatively simpler problems. Though the emphasis is on analysis, some discussion is devoted to numerical methods, and a few selected computer programs are included. The book stresses problem formulation on the basis of the fundamental principles of thermodynamics and mechanics.



The book starts with the foundations of the subject and discusses the basic concepts that are used for formulating a problem in heat transfer. The basic laws such as Fourier's law of conduction and Stefan-Boltzmann's law of radiation are presented. Methods of formulation are discussed, with the inductive formulation approach being adopted for the text. The five steps included in the formulation, involving defining the system, stating the general and particular laws, and obtaining the governing equations and the initial and boundary conditions, are presented in detail. Conduction heat transfer is covered in the next three chapters, starting with steady one-dimensional conduction and progressing through multidimensional to transient conduction. Problems in different coordinate systems and with different boundary conditions are considered. The basic methodology is again stressed and many well-known, classical, and useful solutions are given. Computational methods for conduction follow this treatment, and both steady and unsteady problems are considered for a numerical solution. This chapter shows the importance and usefulness of numerical methods and presents some standard solution strategies.

The basic concepts in convection, including boundary layer flow, dimensional analysis, scales, dimensionless parameters, and governing equations, are presented in Chapter 5. The integral analysis approach is used for obtaining the solutions. Thus, the treatment is somewhat elementary, but it does bring out the basic features of the transport processes. The discussion is mainly directed at the physical nature of the problem and underlying principles, as done earlier for conduction. This is followed, in the next chapter, by empirical correlations for both forced and natural convection. Many important results, with some presented in terms of dimensionless numbers proposed by the first author, are given. The use of these correlations is also demonstrated. The analysis and selection of heat exchangers are discussed in detail in Chapter 7, considering different types of heat exchangers and methods of analysis. Important and well-known results are included.

Radiation heat transfer is covered in the next three chapters. The basic concepts are introduced in Chapter 8, including the quantum mechanics basis for transport and properties of radiation. This is followed by a chapter on radiative exchange in enclosures using view factors, electrical analogy, and the radiosity method of analysis. Gas radiation is presented in the next chapter considering radiation properties of gases, optical thickness, and simple methods to account for gas radiation. This chapter presents several useful results that can be used in practical problems. Finally, phase-change problems are considered in the last chapter. Several interesting results in boiling and condensation are given. Some important material properties, units, charts, and correlations are included in the appendices making it easy to find relevant data for solving exercises in the book.

The presentation is clear, and the treatment is quite satisfactory for an introductory course. It will be a useful textbook for engineering students who have not studied heat transfer, though they have been exposed to courses in thermodynamics and fluid mechanics. Most other textbooks in heat transfer at this level tend to focus on solution methods and results, while also discussing various practical problems to bring out the importance of heat transfer in different fields. The present book is clearly directed at the fundamental aspects and on the formulation of the problem. It serves a very useful and worthwhile role in this capacity. The examples and exercises given in the book help in the presentation and in the understanding of the material, as well as in pointing out the application of these methods to more complicated problems. *Intro-*

duction to Heat Transfer can certainly be recommended as a textbook for introductory courses in heat transfer.

3N50. Compact Heat Exchangers and Enhancement Technology for the Process Industries - 2001. Proc of 3rd Int Conf, Davos, Switzerland, July 2001**.** - Edited by RK Shah *(Delphi Harrison Thermal Syst, Lockport NY)*. Begell House, New York. 2001. 576 pp. ISBN 1-56700-164-5. $99.50.

This proceedings includes most of the papers presented at the conference. A total of 72 papers from 18 countries are divided into the following sections: Single-phase heat transfer fundamental studies; Single-phase augmentation techniques; Single-phase design data and methods; Single-phase heat exchanger development and applications; Phase-change heat transfer fundamental studies; Vaporization, condensation, and absorption augmentation techniques; Vaporization and condensation design data and methods; Phase-change heat exchanger development and applications; and Fouling in heat exchangers.

These papers represent a focused attention to the use of CHEs and Enhancement Technology in the process industries and indicate opportunities in the process industries.

3N51. Smart Control of Turbulent Combustion. From Int Workshop on Turbulent Combustion, Sept 2000, Nagoya Univ, Japan. - Edited by A Yoshida *(Dept of Mech Eng, Tokyo Denki Univ, 2-2 Kanda-Nishikicho, Chiyoda-ku, Tokyo, 101-8457, Japan)*. Springer-Verlag, New York. 2001. 98 pp. ISBN 4-431-70308-X. $44.95.

This volume includes most of the contributions at the workshop which was designed to review the present status of turbulent combustion studies. Ten papers describe the latest findings of Japanese studies in this field.

Principles of Heat Transfer. - M Kaviany *(Dept of Mech Eng, Univ of Michigan, Ann Arbor MI)*. Wiley, New York. 2002. 973 pp. CD-ROM included. ISBN 0-471-43463-9. $125.00. (Under review)

VII. EARTH SCIENCES

3N52. IUTAM Symposium on Theoretical and Numerical Methods in Continuum Mechanics of Porous Materials. Held at the University of Stuttgart, Germany, Sept 1999. - Edited by W Ehlers *(Inst of Appl Mech, Univ of Stuttgart, Stuttgart, Germany)*. Kluwer Acad Publ, Dordrecht, Netherlands. 2001. ISBN 0-7923-6766-9.

This volume contains 57 articles showing the state of the art in the field of porous media research. It provides the whole range of modeling empty, partially-saturated, and fully-saturated porous materials, such as soil, concrete, sinter materials, metallic and polymeric foams, glacier and rock ice, living tissues, etc. In addition to the macroscopic continuum mechanical view of porous materials and the numerical computations of fully coupled solid-fluid problems, micro-to-macro homogenization strategies are presented and material parameters are compared to experimental data to optimize the geometrically linear and finite approaches for the description of the elastic, viscous, and plastic properties of the solid matrix and the viscous properties of the pore-fluids. In addition to these general topics, several contributions are included concerning the fields of wave propagation, localization phenomena, Biot's approach to porous media, fracture and damage, swelling, drying and shrinkage, as well as composite materials.

This book allows researchers and engineers to get an overview of the theoretical and numerical description of porous materials, including various applications to practical engineering problems.

3N53. Seismic Engineering - 2001, Volume 1. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta**.** - Edited by G Roussel. ASME, New York. 2001. 292 pp. ISBN 0-7918-1683-4. ASME Book No G1177A. $110.00. (ASME members $55.00).

This is a collection of 35 full-length, peer reviewed technical papers covering the following broad topics: high-level seismic response of piping; seismic evaluation of systems, structures, and components; seismic structure response and interaction effects; seismic, shock, and vibration isolation; and seismic testing and analysis verification.

3N54. Seismic Engineering - 2001, Volume 2. Proc of ASME Pressure Vessels and Piping Conf, July 2001, Atlanta**.** - Edited by G Roussel. ASME, New York. 2001. 180 pp. ISBN 0-7918-1683-4. ASME Book No G1177B. $90.00. (ASME members $45.00).

This collection of 16 full-length, peer-reviewed technical papers covers earthquake damages and earthquake ground motions, control with active and passive damping, and innovative anti-seismic techniques. The winning paper from this Student Paper Competition is also published in this book.

VIII. ENERGY & ENVIRONMENT

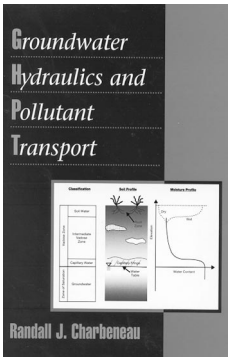
3R55. Groundwater Hydraulics and Pollutant Transport. - RJ Charbeneau *(Dept of Civil Eng, Env and Water Resources Eng Program, Univ of Texas, Austin TX)*. Prentice Hall, Upper Saddle River NJ. 2000. 593 pp. ISBN 0-13-975616-7. $105.00.

Reviewed by SA Sherif (Dept of Mech Eng, Univ of Florida, 228 MEB, PO Box 116300, Gainesville FL 32611-6300).

This book is intended for use as a textbook for upper level undergraduate and graduate courses in groundwater hydrology, groundwater hydraulics, and mass transport of subsurface contaminants. It is also intended to serve as a reference for practicing hydrologists, hydrogeologists, and environmental engineers. The book contains nine chapters, nine appendices, 460 references grouped at the end of the book, and an index.

Chapter 1 is an introduction to groundwater hydrology with topics dealing with porous media, distribution of subsurface water, porosity and related properties of soil, subsurface hydrologic cycle, and hydrogeologic formations. Chapter 2 presents a discussion of Darcy's Law, continuity relations for flow in porous media, and groundwater management models. Chapter 3, entitled *Groundwater and Well Hydraulics*, addresses topics such as steady and transient flow to a well in an ideal confined aquifer, pumping tests, slug tests, well tests, multiple well problems, potential flow for stratified aquifers, the interface in coastal aquifers, and other transient flow problems. Chapter 4, entitled *The Vadose Zone and Groundwater Recharge*, presents detailed discussions of soil water in the vadose zone, soil water characteristic curve, Darcy's Law and Richard's Equation, measurement of soil properties, infiltration models, redistribution of soil water, evaporation and desorption models, evaporation from a shallow water table, and water balance and groundwater recharge.

Chapter 5 deals with sources of subsurface contamination, mass transport processes, the general continuity equation, solute partitioning, degradation losses of soil and groundwater contaminants, and simplified forms of the continuity equation. Chapter 6 entitled *Solute Transport by Advection*, includes topics such as advection transport, potential theory, potential and stream functions, some applications of potential theory, residence time distribution theory, standard flow patterns, and evaluating the environmental consequences of groundwater contamination. Chapter 7 is entitled *Solute Transport by Diffusion* and deals with Fick's laws, molecular diffusion coefficients, diffusion in porous media, diffusion in multiphase systems, some applications of the diffusion equation, and volatilization losses of soil contaminants. Chapter 8 presents detailed discussions of one-dimensional flow and column experiments,



radial flow from a well, transverse dispersion, the mechanical dispersion tensor, moments of the transport equation, analytical models of chemical spills and contaminant plumes, numerical simulation of solute transport, nonideal flow in porous media, and subsurface mass transport through the vadose zone. Chapter 9 deals with multiphase flow and hydrocarbon recovery. This includes topics such as capillary trapping and residual saturation, NAPL behavior in fractured media, monitoring of free-product petroleum hydrocarbon, NAPL infiltration in the vadose zone, screening models for fate/transport of organic chemicals in soil and groundwater, soil-vapor extraction systems, and free product recovery of petroleum hydrocarbon liquids. Many of the appendices have spreadsheet modules for topics discussed in the book. Examples include modules for calculating well functions, slug test well function, LNAPL distribution, and LNAPL recovery analysis.

Groundwater Hydraulics and Pollutant Transport is very well written and organized, contains topics appropriate for its

stated title and objectives, has numerous examples and chapter problems, and has very clear illustrations and diagrams. The author is obviously very knowledgeable in the subject matter and is able to use his skills in teaching the subject over many years to convey his ideas clearly to the reader. This reviewer recommends that the book be acquired by academic and research libraries as well as practicing hydrologists, hydrogeologists, and environmental engineers.

IX. BIOENGINEERING

3R56. Introduction to Bioengineering. - Edited by YC Fung *(Univ of California, San Diego CA)*. World Sci Publ, Singapore. 2001. 292 pp. Softcover. ISBN 981-02-4398-7. $28.00.

Reviewed by RL Huston (Dept of Mech, Indust, and Nucl Eng, Univ of Cincinnati, PO Box 210072, Cincinnati OH 45221-0072).

This is a tutorial intended for beginning students who are considering careers in bioengineering. The objective is to provide readers with a view of contemporary studies in bioengineering and to thereby create an inventive/design motivation for further studies. As a course text, however, this book is quite different from traditional textbooks: It is written by 12 authors (mostly from the University of California at San Diego) and divided into 11 chapters on a variety of topics. In each chapter, the author (or authors) provide a relatively informal or conversational perspective on the chapter topic which is then followed by a contemporary archival research paper (or papers). The pedagogic is to give the readers a broad introduction followed by detailed in-depth analyses. A series of assignments and special projects are also provided.

The text spans approximately 285 pages. The chapter topics and authors are:Roles of flow mechanics in vascular cell biology in health and disease, by Shu Chien; Perspectives of biomechanics, by Yuan Cheng Fung; Implantable glucose censor: An example of bioengineering design, by David A Gough; Design and development of artificial blood, by Marcos Intalietta; Analysis of coronary circulation: A bioengineering approach, by Ghassan S Kassab; What lies beyond bioinformatics, by Bernhard Palsson; Tissue engineering of articular cartilage, by Robert L Sah; Cell activation in the circulation, by Geert W Schmid-Schonbein; Molecular basis of cell membrane mechanics, by Lanping Amy Sung; Biomechanics of injury and healing, by Pin Tong and Yuan Cheng Fung; and Pulsatile blood flow in the lung studied as an engineering system, by Michael RT Yen and Wei Huang.

The editor has successfully kept the contributions relatively uniform in style and in level of content. The subject areas, however, are less well distributed, but instead they tend to emphasize fluid mechanics and microbiomechanics as opposed to solid mechanics (skeletal biomechanics) and dynamics (kinesiology). Interestingly the authors admit this imbalance, but they nevertheless seek to meet the stated tutorial objectives. They appear to be successful. Indeed, in this reviewer's experience, the approach taken here seems to be very effective in both introducing students to the subject and for motivating further study in a field which encompasses all of applied mechanics and much more.

This reviewer finds *Introduction to Bioengineering* to be a new and refreshing text on this increasingly evolving subject. Critically, it would be easy to identify some chapters as being more interesting and more attuned to the objectives than others. But this would not make the book any less attractive. The only serious criticism is that the book has no index, glossary, or bibliography.

Adoption consideration by introductory bioengineering course instructors is strongly recommended.

3R57. Mechanics of Motor Proteins and the Cytoskeleton. - J Howard *(Dept of Physiology and Biophys, Univ of Washington, Seattle WA)*. Sinauer Assoc Inc, Sunderland MA. 2001. 367 pp. ISBN 0-87893-334-4. $59.95.

Reviewed by RL Clark (Dept of Mech Eng and Mat Sci, Duke Univ, 301 Hudson Eng Center, PO Box 90300, Durham NC 27708).

The introduction of this text is timely with regard to current interest in nanoscience and nanoengineering. A recent article, ''The Little Engines That Couldn't,'' (Peter Weiss, *Science News*, July 22, 2000), reveals that ''early enthusiasts didn't anticipate the powerful forces that arise at the surfaces of micromachines.'' In particular, components of such devices intended to move, such as miniature gears in micro-electro-mechanical systems (MEMS), tend to stick together because of van der Waals and other molecular forces. This problem results from attempts made to ''miniaturize'' conventional engineering systems without consideration of changes in forces that dominate at these different scales (inertial versus viscous for example). In contrast, nature scales up when ''engineering'' systems and works within an aqueous environment for the most part. This textbook provides a wonderful perspective for mechanics at the scale of a single protein molecule where dimensions are measured in nanometers and forces are measured in picoNewtons.

The author of this text does an outstanding job in developing a book for a broad audience, inclusive of biologists, physicists, and engineers. The book is aimed at an introduction to the mechanics of molecules and the application of this knowledge to the morphology and motility of cells. This aim is readily achieved within this text, which is well suited as an introductory graduate course for the intended audience.

The book is well organized into three primary parts: Physical Principles, Cytoskeleton, and Motor Proteins. If an engineer is interested in nothing more than gaining insight into the relevant physics at the molecular level, then the book is worth purchasing simply for the well-written section devoted to Part I: Physical Principles. Within this section, mechanical forces; mass, stiffness, and damping of proteins; thermal forces and diffusion; chemical forces; and polymer mechanics are all discussed. The mathematical treatment within the chapters is sufficient to provide perspective; however the specifics of the mathematical developments are detailed for the reader with more inclination for such in the appendices.

The author does an outstanding job in providing figures that readily convey the pertinent concepts. Furthermore, there are numerous examples which succeed in conveying insight into the mechanics at the molecular scale as well as perspective of dimensional units. These examples provide a much needed bridge between the terminology used in biology and that used in engineering.

Part II and Part III of the text provide context for the structure, mechanics, and polymerization of cytoskeleton filaments and also provide specifics of force generation and active polymerization. This is essential background for detailing the structure of the motor proteins, including parameters such as speed, steps, and forces. The operation of these nanomachines, manufactured by nature, provides much motivation and insight for engineers.

Mechanics of Motor Proteins and the Cytoskeleton will take permanent residence on this reviewer's shelf due to a personal interest in mechanics at this scale, and this reviewer would highly recommend it to those with interest in or currently involved in the analysis or development of micro-electro-mechanical systems or nano-electro-mechanical systems.

X. GENERAL & MISCELLANEOUS

3N58. Mechanical Engineer's Handbook. - Edited by DB Marghitu *(Dept of Mech Eng, Auburn Univ, Auburn AL)*. Academic Press, San Diego. 2001. 864 pp. Softcover. ISBN 0-12-471370-X. $69.95.

The purpose of this handbook is to present the reader with a teachable text that includes theory and examples. Useful analytical techniques provide tools for mechanical design. The book may also serve as a reference for the designer, a source book for the researcher, and a guide for the mechanical engineer. It covers a broad spectrum of critical engineering topics.

This handbook contains the fundamental laws and theories of science basic to mechanical engineering including controls and mathematics and provides suggestions for more specific literature.

Author Index for March 2002

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