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 reviwer 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 the 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

9R1. An Introduction to Linear and Nonlinear Finite Element Analysis: A Computational Approach. - Edited by PK Kythe and Dongming Wei *(Dept of Math, Univ of New Orleans, New Orleans LA 70148-0001).* Birkhauser, Boston. 2004. 445 pp. ISBN 0-8176-4308-7. $79.95.

Reviewed by M Okrouhlik (Dept of Solids, Inst of Thermomech, Acad of Sci, Dolejskova 5, 182 00 Prague 8, Czech Republic).

The book is intended as a textbook for undergraduate and graduate students from engineering, geophysics, and applied mathematics. Very broad spectrum of engineering problems is covered—the examples are taken from structural, mechanical, electrical, and chemical fields. Generally, the book deals with linear and nonlinear problems in radiation, heat transfer, mechanics of elastic and plastic media, continuum mechanics, non-Newtonian fluid flows, and electromagnetics.

The book is composed of 14 chapters, 6 appendices, a bibliography, and subject index. Chapter 1 deals with weak variational formulation of a boundary value problem, Galerkin and Rayleigh-Ritz weighted residual methods. Chapter 2 presents one-dimensional local and global interpolation functions. Chapter 3 explains the Galerkin method and applies it to a one-dimensional second-order equation using liner and quadratic elements. Chapter 4 treats one-dimensional fourth-order equation (beam). Chapter 5 introduces linear triangular and bilinear four-node rectangular elements. Chapter 6 is devoted to two-dimensional problems with a single scalar variable. Stiffness matrix and load vector are derived. In Chapter 7 the two-dimensional boundary value problems as heat exchange, torsion, and seepage are treated. Chapter 8 deals with axisymmetric linear and nonlinear heat transfer problems in solid and fluids. Chapter 9 is devoted to transient problems and numerical time integration. Chapter 10 treats nonlinear problems in one dimension—radiation heat transfer, stress in elastoplastic bars, non-Newtonian fluid flow in between parallel plates, and turbulent flows in tubes. For the numerical solution the Newton method, the method of the steepest descent and conjugate gradient methods are used. Chapter 11 presents the steady-state problems of plane elasticity. Linear triangular and bilinear rectangular elements are treated; stiffness matrices and load vectors are derived. Assembling is clearly described but implementation considerations are not considered. Chapter 12 introduces the penalty method. It is applied to the treatment of both Newtonian and power law non-Newtonian Stokes flow. Chapter 13 deals with vibration analysis—elastic rods, Euler beams, and in-plane vibration of an elastic plate are treated. The last chapter contains the computer codes in Mathematica, Matlab, and Fortran. They form a vivid complement to selected problems appearing in the book. Results of computer runs are presented in the tabular form.

There are six appendices, labeled A to G, in the book. They contain useful complementary information and are subsequently devoted to overview of classical integration formulas, evaluation of stiffness matrices for triangular and rectangular elements for a chosen geometry, time-step marching algorithms (forward and backward difference schemes, Cranck-Nicolson formulas, Newmark method, etc). Also the concept of isoparametric elements is briefly explained, Green identities are shown and Gauss quadrature formulas are derived. In the last appendix the classical minimization methods (method of the steepest gradient and conjugate gradient method) are presented.

There are 87 examples and 148 exercises and 152 figures in the book. Solving the problems both SI and imperial units are used.

The finite element analysis is clearly presented with rigorous mathematical treatment of its background and accompanied by numerous examples. Finite element methodology is covered briefly being saliently combined with a proper computer implementation. Programs and subroutines written in Fortran, Matlab, and Mathematica, treating the examples presented in the book, form a consistent part of the book.

The book is carefully edited and printed. The only misprint I found is on p. 403 where there is a missing zero term in a matrix.

From the reviewer's point of view the book has high educational value stemming from the fact that a very large spectrum of engineering topics is covered. As such the book might well be a good purchase both for university libraries and individuals.

9R2. Beyond Perturbation: Introduction to the Homotopy Analysis Method. - Edited by Shijun Liao *(Shanghai Jiao Tong University, Shanghai, China).* Chapman and Hall/CRC Press, Boca Raton FL. 2004. 322 pp. ISBN 1-58488-407-X.

Reviewed by SA Sherif (Dept of Mech and Aerospace Eng, Univ of Florida, 232 MAE Bldg B, PO Box 116300, Gainesville FL 32611-6300).

This book deals with a very interesting mathematical technique that is rather powerful. While perturbation methods work nicely for slightly nonlinear problems, the homotopy analysis technique addresses nonlinear problems in a more general manner. Through this method, the author demonstrates that a nonlinear problem that normally has a unique solution can have an infinite number of different solution expressions whose convergence region and rate are dependent on an auxiliary parameter. The method provides for ways to control and adjust the convergence region. This makes the method particularly suited for problems with strong nonlinearity.

The book is comprised of two parts. Part I contains Chapters 1 through 5, while Part II contains Chapters 6 through 18. The first part covers the basic ideas and concepts of the method, while the second part focuses on applications of the method to different situations. In addition to introducing the method in Part I, the author discusses the relation of the method to other analytical methods as well as the advantages and limitations of the method. Applications discussed in Part II are varied in scope covering areas such as simple bifurcation of nonlinear problems, nonlinear eigenvalue problems, the Thomas-Fermi atom model, free oscillation systems with both odd and quadratic nonlinearities, Blasius' viscous flow, boundary layer flows with exponential and algebraic properties, von Karman's swirling viscous flow, and nonlinear progressive waves in deep water.

The book should serve as an excellent reference to researchers, engineers, and interested individuals in helping them tackle nonlinear problems in an analytical fashion. It has a good subject index and an outstanding list of bibliography with 136 references cited. The book is very well written and is relatively easy to follow to the mathematically literate person. I highly recommend that it be acquired by interested individuals and libraries throughout.

II. DYNAMICS & VIBRATION

9R3. Bifurcation Theory: An Introduction With Applications to PBEs (Applied Mathematical Sciences 156 Series). - Edited by H Kielhofer *(Inst for Math, Univ of Augsburg, Universitatsstr 14, Raum 2011, Augsburg D-86135 Germany).* Springer-Verlag, New York. 2004. 346 pp. ISBN 0-387-40401-5. $69.95.

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

This unified exposition of the single-parameter bifurcation response of an operator on infinite dimensional space is organized into three sections: an abstract development of local and then global bifurcation and applications to elliptic and parabolic partial differential equations.

The local bifurcation theory, taking up about half the book, depends on the breakdown of the implicit function theorem and is based on the Lyapunov-Schmidt reduction for infinite dimensional spaces. The case that the Fréchet derivative has a one-dimensional kernel includes the saddle-node and the various types of pitchfork bifurcations. A principle of exchange of stability is proved. A Hopf bifurcation theorem for periodic solutions is first proved for ordinary differential equations and then for retarded functional differential equations. A center manifold theorem is used for Hopf bifurcation of Hamiltonian, reversible, and conservative systems. A principle of exchange of stability for Hopf bifurcations is proved, and the stability of global continuation of solutions is examined. A principle of exchange of stability for period-doubling bifurcations is developed. The Newton polygon method is described for problems with a one-dimensional kernel in both the degenerate and nondegenerate cases. Floquet exponents are used to create a principle of exchange of stability for degenerate Hopf bifurcations. Some results are given for higher dimensional kernels of the Fréchet derivative and multiparameter bifurcation.

The global bifurcation theory, subject of the second section, is based on the local index of the operator F, obtained from the Leray-Schauder degree which takes the place of the Brouwer degree of finite-dimensional problems. The crossing number, which is related to a change in Morse index, is defined from the index of the operator. Then if $D_xF(0,\lambda)$ has an odd crossing number for a particular value of the bifurcation parameter λ, that value of the parameter gives a bifurcation point. A degree is defined for a class of Fredholm operators that includes some classes of elliptic operators and for potential operators, and global bifurcation theorems proved, often using Rabinowitz's theorem.

The applications forming the third section begin with results on elliptic operators of second order acting on scalar functions. An example using the degenerate Newton polygon is developed. The particular case of the Cahn-Hilliard energy that describes a binary alloy is solved by taking the mass as the bifurcation parameter and applying a symmetry constraint to obtain a one-dimensional kernel. Then local bifurcations of the free nonlinear vibrations described by the nonlinear wave equation with the period as bifurcation parameter are examined in the one-dimensional case and some extensions are given to higher dimensions. Results are also obtained for the wave equation on the unit sphere. A Hopf bifurcation is analyzed for a nonlinear parabolic problem in which the principle of exchange of stability holds. Finally global bifurcation and continuation results are given for quasilinear elliptic problems and are applied to the Euler-Lagrange equation for the Cahn-Hilliard energy problem.

This mathematics book requires substantial mathematical background. The book is directed to advanced readers rather than beginners so that some basic ideas are not defined. The author has separated the abstract description in the first two sections from the applications with the goal of clarity and allowing the results to be available for any application, but at the risk of making it harder to understand the significance of some of the ideas. In many applications to models of physical behavior, the hypotheses of the various theorems are quite difficult to verify. The book is very useful as a reference because it collects and organizes the bifurcation analysis of infinite-dimensional operators. It could also be used as a text in an advanced course on bifurcation theory with an emphasis on partial differential equations.

9R4. Wave Processes in Solids With Microstructure (Stability, Vibration and Control of Systems, Series A). - Edited by VI Erofeyev *(Russian Academy, Russia).* World Science Publications, Singapore. 2003. 255 pp. ISBN 981-238-227-5.

Reviewed by A Giannakopoulos (Dept of Civil Eng, Univ of Thessaly, Pedion Areos 38334, Volos, Greece).

The book presents a good account of the mathematics of wave processes in solids with microstructure. The Introduction sets the general outline of the book and presents a good historical background on the topic. The Introduction includes the major part of a valuable list of references, especially from the extensive work of the author. The first chapter gives the main constitutive and equilibrium equations for the specific mathematical models of solids with microstructure (Cosserat, Le Roux, and two-solid mixture). The second chapter presents dispersion and dissipation analysis for various types of traveling waves (longitudinal, shear, surface, and noise). The analysis follows from classical assumptions of the traveling waveforms that influence directly the kinematics (displacements and/or rotations). In some cases, nonclassical assumptions are used successfully. The second chapter includes quasi-harmonic wave interactions (nonlinear resonant and high frequency interactions of waves). Chapter 3 introduces the damaged medium and the magnetoelastic medium. The context of this chapter is somehow out of the essential theme of the book. The author should have tried to show more connections of the context of Chapter 3 with the rest of the book (as he has done successfully with Chapter 7). Chapter 4 clarifies the results for the Cosserat continuum, Chapter 5 for the two-components mixture and Chapter 6 for the micromorphic solids in Mindlin's spirit. Chapter 7 makes a successful connection of the medium with dislocations, with Cosserat type of continuum. Finally, Chapter 8 describes wave problems of micropolar fluids. The last chapter seems to be written in a rather uncoordinated way with the co-author mentioned in the Preface. It definitely needs thorough revision. The bibliography is very extensive and very adequate, however, there are also some references that have not been linked to the text. The index suffers also from link problems with the text. It is on the positives of the book the realistic examples that are presented, although it is not always clear why the models do better than traditional models with direct inhomogeneities and anisotropies.

There are numerous typos and occasionally severe language problems in the text, which make the book very difficult to follow in certain cases. Symbols often change meaning, sometimes even in the same chapter, creating confusion. A careful and dedicated reader can overcome these problems. The book is on a topic that has a lot of renewed interest. It can serve as an advanced textbook to complement wave mechanics standard books. The book can also serve as reference, but the reader is advised to read several key papers beforehand, to get a clear picture of the mathematical models of solids with microstructure, especially from the constitutive point of view. The book can be of general interest and should be in libraries that specialize in wave mechanics. It is recommended to researchers that have special interest in topics of mathematical treatment of solids with microstructure, keeping in mind that issues of initial and boundary conditions are not covered in the book.

III. AUTOMATIC CONTROL

9R5. Fundamentals of Robotics: Linking Perception to Action (Series in Machine Perception and Artificial Intelligence). - Edited by Ming Xie *(Singapore–MIT Alliance, Singapore)*. World Science Publications, Singapore. 2003. 692 pp. ISBN 981-238-313-1.

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

This book is probably best described as a contemporary reference describing the state of the art of robotics, at this time. It is a truly impressive volume where the author documents the many significant robotic advances during the last quarter century. He also looks to the future.

The book discusses the broad range of robotics technology ranging from mechanical considerations, to electrical and electronics devices, to control, to vision, to decision making and artificial intelligence. The book is intended for students, for those just getting started in the field, and for experienced practitioners.

The book has three underlying themes: (1) a presentation of the fundamental underlying physics and associated analytical procedures; (2) thinking of robotics from a systems perspective; and (3) treating the entire subject tutorially. Throughout the book the author presents the physical principles, the mathematical analysis, applications, and illustrative examples. In many instances he provides extensive explanations of particular aspects of the technology, including design considerations. At all times, the focus is upon viewing a robot as a complex system incorporating a wide variety of technologies, but principally electro-mechanical-control and decision making.

The book itself is divided into nine chapters spanning approximately 700 pages. The first chapter provides a brief introduction to the subject outlining the various applications of robots ranging from the industrial/manufacturing setting to the household environment. Contained therein is an interesting discussion about humanoid robots. The author also summarizes the principal issues and problems in robotics technology.

The second and third chapters are devoted to mechanical issues such as kinematics (position displacement, rotation, and velocity), mechanisms, joints, and chains. Both forward and inverse kinematics are discussed. The fourth chapter then considers robot dynamics, motors, and drive devices.

Control issues are studied in the fifth chapter. The ensuing topics include automatic feedback systems, control elements, sensing elements, design consideration, algorithms, and joint-, task-, and image-space control.

In the next three chapters the author discusses information systems, visual sensory systems, and visual perception systems of robots. The ninth chapter is then devoted to decision making including issues of planning, mapping, constraints, and control. The book concludes with a very brief chapter on future expectations.

Each chapter contains examples, exercises, and a bibliography.

The author is to be commended for the ambitious undertaking of trying to incorporate all these topics into a single volume. The finished product is impressive. The writing is good and the examples are clear and informative. There are, of course, many places where prior knowledge and expertise are needed to fully benefit from the discussion. On balance, however, the book should be of interest and use to those either working in robotics, hoping to enter the field, or those simply having a curiosity about the subject matter. Purchase is recommended both for individuals and libraries.

IV. MECHANICS OF SOLIDS

9R6. Mechanics of Elastic Composites (CRC Series in Modern Mechanics and Mathematics). - Edited by ND Cristescu *(Dept of Mech and Aerospace Eng, Univ of Florida, Gainesville FL)* E-M Craciun, *(Faculty of Math and Informatics, Univ of Constanta, Romania)*. Chapman and Hall/CRC Press, Boca Raton FL. 2004. 682 pp. ISBN 1-58488-442-8.

Reviewed by GC Gaunaurd (Code AMSRL-SE-RU, Army Res Lab, 2800 Powder Mill Rd, Adelphi MD 20783-1197).

This book is a very enlarged version of the book of the same title published by the first author at the University of Bucharest in 1983. The book comprises eight chapters. The first two are introductory chapters addressing tensor analysis and tensor alegebra in chapter one. The second chapter reviews all the elements of linear elastostatics. This hundred-page introduction provides all the major formulas required for those basic topics. This includes items such as, minimum principles of elastostatics and Eshelby's inclusion theorem and problem. There are over 100 practice problems in this pair of chapters.

The work on elastic composites starts on chapter three, which deals with composite laminates. This is a good point to begin for anyone wishing to learn the basic classical aspects of elastic composites. These include constitutive equations, boundary conditions and variational principles from the micro-mechanical and macro-mechanical points of view. There are over 50 problems at the end to help the student understand these issues better.

Macroscopically homogeneous biphasic linearly elastic composites are covered in Chapter 4. The classical general theory of micro-mechanics is included here and there are over 50 exercise problems here, too.

The three-dimensional linearized theory of elastic body stability begins in Chapter 5. There are sections on small deformations superimposed on large static deformations and on stable and unstable equilibrium configurations. Other topics such as variational principles, bifurcation analysis and dynamic stability criteria are also covered. There are also about 50 problems/exercises at the end.

The last three chapters deal more with recent research topics apparently unavailable until this time in western countries. Chapter 6 addresses the buckling of fiber-reinforced composite strips and bars. It attempts to show the limit of validity of classical plate theory and of Euler's theory for bars. Chapter 7 studies the stability of composite laminates. The eighth and final chapter gives a brief introduction to the fracture mechanics of fiber-reinforced composites. At the start there is a summary of needed elements of complex variable theory as well as the asymptotic behavior of incremental fields. Griffith's criterion is also covered and also cases of crack propagation. The Plemelj-Sohockii formulas are discussed in the text, and expanded in the exercises. Each of the chapters ends with about 50 problems which brings the total for the book to over 400. The answers/solutions to a good portion of these are provided in a large (150 pp) section at the end of the book.

I believe this is an excellent book. It can be used as a textbook for some of the topics it covers and in view of its advanced mathematical level, also as a reference book for researchers and institutional libraries. In general, the book is aimed at the graduate student or professional researcher. The problem collection is excellent. There are very few figures. I know of very few books on this classical topic which cover so much material in such a readable and user-friendly way. The aims of the authors were well reached. It will be quite useful for mechanics students and researchers.

9R7. Design of Plate and Shell Structures. - Edited by MH Jawad *(St. Louis MO)*. ASME Intl, New York. 2004. 476 pp. ISBN 0-7918-0199-3. $96.00.

Reviewed by SN Krivoshapko (Dept of Strength Mat, Peoples Friendship Univ of Russia, 6 Micklukho-Maklaya Str, Moscow 117198 Russia).

The book is printed on good paper. It has a hard cover of nice-looking color and considered design. Text, figures, and tables are well read.

The theories of plates and shells are of great importance in structural engineering, and there is a large number of special literature in this field. Practically all of real constructions and structures with the exception of bars and bar systems are calculated with the application of the theories of plates and shells. It is possible to agree with the author of the book that a book that covers all aspects of plate and shell theory is impractical to write. That is why the author decided to write a book orientating himself primarily toward professional engineers, architects, and post-graduate students interested in designing plate and shell structures. It gave him an opportunity to write in a condensed form the book which embraces all problems of plate and shell theory. More elaborate derivations and more general equations can be found in the literature presented by the author in Appendix ''Reference.''

The book is organized into 16 chapters. The first seven chapters are devoted to plate analysis. The bending of rectangular plates with various boundary conditions is considered in Chapters 1 and 2. Every theme of the chapters is ended with illustrative solutions of problems which can be found in real design. For example, the expressions for the deflections of plates with hydrostatic load, continuous plates, a large plate on multiple supports, plates on an elastic foundation are obtained and the method of the determination of thermal stresses in thin plates is presented.

Plates with constant and variable thickness, subjected to uniform and nonuniform loads in the tangential (circular) direction, are described in Chapter 3. Maan H. Jawad gives classical account of the problem and presents the well known equations. Special attention is given to analysis of tubesheets of heat exchanger as circular plates on an elastic foundation and to the determination of the maximum stress in the flat bottom plate of the tank and its maximum uplift.

Chapter 4 discusses the methods of analysis of elliptic plates with a fixed boundaries, triangular plates, gives a discussion on orthotropic plate theory. Some commonly encountered cases such as analysis of reinforced concrete slabs, corrugated and stiffened plates, box-type bridge decks are presented in this section. But in this chapter, it was necessary to acquaint the readers with principal stresses. The Ritz method, yield line theory, and finite difference method constituting the substance of Chapter 5 considerably expand the sphere of problems on plate analysis having the solution.

After examination of buckling (Chapter 6) and vibration (Chapter 7) of rectangular and circular thin plates the author turns to shell theory.

Chapters 8 and 9 are devoted to membrane theory of shells of revolution. The author presents the basic assumptions of membrane theory but does not point to permissible boundary conditions and permissible loads. The membrane longitudinal and circumferential forces appearing in one-sheet hyperboloids and in spherical, ellipsoidal, conical, cylindrical shells subjected to axisymmetric loads are determined from the analytical equations. The author presents also the formulas for the determination of displacements of shell middle surface. But A. L. Goldenweizer (*The Elastic Thin Shell's Theory*, 1953, 544 pp.) demonstrated that having known the membrane forces and displacements it is necessary also to derive bending moments. If normal stresses depending on bending moments are of no importance in comparison with stresses depending on normal forces then membrane stress state proves its value.

In Chapter 10, the bending of thin round closed cylindrical shells subjected to any axisymmetric pressure is discussed. In presented examples, one determines the normal stresses in long cylinders due to the radial loads such as an edge moment, a concentrated radial load, an internal pressure, and tensile end load. Short round closed cylindrical shells are analyzed due to cylinder loaded by bending moment at one edge. Thermal temperature gradients in cylindrical shells occur either along the axial length or through the thickness of cylinders. The both these cases are discussed in the book.

Chapter 11 is devoted to bending of spherical and conical shells subjected to axisymmetric loads but the basic equations are derived for the whole class of shells of revolution. The special tables presented will facilitate analysis of spherical and conical shells subjected to edge loads.

More difficult cases of shell analysis are discussed in Chapter 12 where shallow shells in the form of hyperbolic paraboloids, elliptic paraboloids, barrel structures, and folded plates are examined. The middle surfaces of these shells are given in the Cartesian coordinates. The chapter does not contain numerical examples.

Great attention in Chapter 13 is paid to buckling of round cylindrical closed shells under external lateral and end pressure and under axial compressive force. Presented figures for the determination of buckling coefficients will give an opportunity to speed up the analyses. Illustrative examples are in general connected with buckling analysis of gasoline tanks, jacketed pressure vessels, support cylinder for a spherical fuel tanks, reactor cylindrical vessels, and the similar constructions.

Problems of buckling of spherical and conical shells constitute the substance of Chapter 14 having placed in 10 pages. The deflected shape is rotationally symmetric. The author uses the minimizing of the total potential energy with respect to the angle of inclination of the deformed middle shell surface and derives formula for the determination of critical normal stress for spherical and stiffened spherical shells under external pressure. For conical shells a critical pressure expression is presented without developing.

The short Chapter 15, ''Vibration of Shells,'' is based, in part, on the equations derived in Chapter 10 which are based on symmetric loading. The resulting three differential equations for the axial, circumferential, and radial displacements of cylindrical shells are assumed as a basis for the subsequent calculations. For shallow spherical shells the resulting equation for the fundamental natural frequency is presented without developing but two examples explain how to use the presented formula.

The final Chapter 16 explains the principles of final element method. The author gives the basic definitions and describes general equations and relationships of the finite element method. In the chapter, the solutions of several problems with using of one-dimensional and linear triangular elements are presented. Having read this chapter any reader will have some idea about possibility of this numerical method.

In summary, *Design of Plate & Shell Structures* is a well-written manual for mechanical engineers and designers working in corresponding fields of industry where the thin-walled spatial constructions are used and for post-graduate students interested in designing plate and shell structures. The book may be used by lecturers as the abstract of lectures on shell theory and on plate theory. The represented photographs of buildings and articles also beatify the book.

The book of Maan H. Jawad can be particularly recommended for individuals.

V. MECHANICS OF FLUIDS

9R8. Statistical Mechanics of Turbulent Flows. - Edited by S Heinz *(Dept of Fluid Mech, Tech Univ of Munich, Boltzmannstrasse 15, Garching 85747 Germany)*. Springer-Verlag, Berlin. 2003. 214 pp. ISBN 3-540-40303-2. $59.95.

Reviewed by AC Buckingham (Center for Adv Fluid Dyn Appl, LLNL, Mail Code L-023, PO Box 808, Livermore CA 94551).

This book is a descriptive monograph with a focus on stochastic probability density function (pdf) procedures and their implementation for turbulent flow. Special emphasis is placed on exposition and adaptation of Lagrangian single-point pdf methods with emphasis on application to chemically reactive turbulent flows. Compressibility considerations enter as a consequence of the temperature and closely associated component species and global mass density changes (and their statistical fluctuations) generated by the component chemical reactions. The stochastic field is treated as a Markov process. The reviewer recommends Pope's (SB Pope (1994)) exposition and review of these methods, their development, potential applications, and physical significance as an informative complement to the author's more concise description, limited, perhaps, by his desire to provide students with a broader survey and comparison of other turbulence closure procedures.

The book is based on the author's upper division and perhaps beginning graduate student level university lectures with stated emphasis given to the instruction of students in environmental sciences and process (chemical) engineering.

Unfortunately the title, statistical mechanics of turbulent flows, perhaps inadvertently, exaggerates the book's content. The term statistical mechanics labels the discipline devoted to study and prediction of average behavior/state of a collection (ensemble) of similarly composed systems. It necessarily includes development of asymptotic predictive formulas for the average behavior where the state of evolution of the individual system members in spacetime is too complex for precise determination. The book certainly describes one such promising entry for predicting the evolution of average turbulence features, and surveys several other existing approaches when viewed relative to the author's perspective and experience with stochastic pdf methods. However, theoretical understanding, experimental definition, and specifically applicable and successful turbulence modeling procedures continue to emerge as more aspects of the turbulence problem become evident. Describing the presently available collection of approaches and procedures as a statistical mechanics of turbulence entity appears premature if not optimistic.

The book includes a usefully extensive reference list, author and subject index. However, for background introduction to statistical turbulence this reviewer feels obliged to add the following references to seminal investigations. The origin of the treatment of turbulence as a statistical phenomenom is usually attributed to Taylor in the early part of the 20th Century (GI Taylor (1921)). Out of a host of important contributions to the growing set of statistical mechanics turbulence contributions by Kraichnan the reviewer is compelled to cite the early work on incompressible hydromagnetic turbulence (RH Kraichnan (1958)), structure of isotropic turbulence at high Reynolds number (RH Kraichnan (1959)), Kolmogorov's hypothesis and eulerian turbulence theory (RH Kraichnan (1964)), and Lagrangian history closure approximation (RH Kraichnan (1965)). In addition, the reader's attention should be drawn to Leslies useful and clear summary of contributions to turbulence theory and statistical mechanics in the very productive years up to the early 1960s (DC Leslie (1973)).

The first three chapters provide a useful, if compact, review of stochastic processes and the mathematical framework used in their analysis. A special flavor in this review is provided with regard to the author's obviously extensive experience with generation of conditional pdf's in Markov processes exploiting the Fokker-Planck equation. The 4th chapter introduces development of the contiuum flow and thermodynamic state equations, multi-component reaction equations, Reynolds averaged Navier-Stokes (RAN) single point closure, and RAN moment closure hierarchies commencing from the underlying molecular statistical collisional field governed by the Boltzmann equation. Turbulence concepts are introduced and identified such as: inherent macro and microscales, energy spectrum, correlations (and their defining pdf's), and inertial range separation of scales. A discussion of direct numerical simulations and their limitations provides a framework for describing the utility, albeit added complexity of combining Lagrangian pdf projection methods with stochastic Lagrangian model differential equations. The Langevin equation is introduced as the prototypical stochastic model differential equation for generation of the large scale directly computable motions and scalar fluctuations. A hierarchy of generalizations to the Langevin model permits simulation of more complex, multidimensional, multi-component flows for chemically reactive flow.

The next to last chapter introduces the combination of specified pdf scalar models with large eddy simulations LES where the large scale flow may be conventionally computed but the convolution filtering includes scalar pdf approximations for the small scale reactive components, and advances to consideration of stochastic subgrid scale models for scalar component reaction distributions with stochastic convolution filter functions and ordered terms in the large (computable) range. Note is made of advances in computing both the large scale range and the filtered sub=grid pdf scalar with stochastic models. The last chapter outlines the practical limitations to utilization of the complex stochastic flow and scalar distribution models for reactive flow in industrial applications. Attention is given to appropriate scaling and parameterization of the appropriate length and time scale coefficients in single point RAN closure methods for practical economical computation. This sought for unification of model approaches for industrial usage is left as a valuable but open, question for discussion.

Among the many topics the author was not able to cover but that must be considered in conjunction with filling out the statistical mechanics of turbulent flows include: multiphase flows, critical phenomena, tracking and appropriate modeling of phase discontinuities, shock wave interaction with turbulence, shock wave enhanced mixing of components and shock-induced critical phase changes, unsteady shockwave turbulence induced motions and resulting heating, turbulent boundary layer separation and reattachment dynamics and the general problems associated with rapidly rotating and swirling combustion flows. The book, within the constraints of size does provide a valuable survey of stochastic turbulent flow procedures supplementary to and in comparison with more conventional closure procedures. Considering the book's relatively modest price it would be a useful addition for personal as well as institutional acquisition.

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