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Book Reviews

The Symmetric Eigenvalue Problem. By Beresford N. Partlett. Prentice-Hall, Englewood Cliffs, N.J. 07632. 1980. Pages xix–348. Price $25.

REVIEWED BY S. H. CRANDALL[1]

Eigenvalue problems are ubiquitous in engineering analysis. A generation ago the same engineer would formulate the physical problem, set up the associated eigenvalue problem, obtain a partial solution graphically or numerically, and interpret the result in terms of the physical system. Today thanks mostly to the great development of computers there is a considerable division of labor involved in accomplishing similar but more extensive goals. A numerical analyst designs an algorithm, a software specialist then creates a program which is eventually made accessible to the engineer with the eigenvalue problem. The present book is directed narrowly toward the numerical analysis underlying algorithms for the symmetric matrix eigenvalue problem. Only passing allusions are made to the physical problems from which eigenvalue problems arise or to the software developments which are required to implement the algorithms. The main feature of the book is the lucid description of the developments in numerical analysis of eigenvalue problems which have occurred during the past thirty years. These topics include triangular factorization, reduction to tridiagonal form, Jacobi rotations, QL and QR algorithms, Lanczos algorithms, Rayleigh quotient iteration, and subspace iteration. Matrices are called small if they can be stored and worked on entirely in the high-speed memory. It is claimed that the understanding of the methods for small matrices is now essentially complete. The problem for tomorrow is to reach a similar plateau for cost-effective methods applicable to very large matrices. Each chapter contains exercises for the reader. Material in the first nine chapters has been used in a senior level course in numerical analysis while later material has been used in a graduate seminar. The first 14 chapters deal with the problem $Ax = \lambda x$ for a single real symmetric matrix A while the final chapter extends most of the results to the generalized problem $Ax = \lambda Mx$ for two symmetric matrices A and M. Within the limits imposed the author has produced a carefully crafted exposition of the present state of understanding of algorithms for eigenvalue problems.

Nonlinear Oscillations. By Peter Hagedorn. Translated and edited from German to English by Wolfram Stadler. Oxford University Press, New York. 1981. Pages x–289. Price $85.

REVIEWED BY C. S. HSU[2]

It is a pleasure to call the reader's attention to the appearance of an English version of Professor Hagedorn's book on nonlinear oscillations. While there are several outstanding introductory mathematical books on nonlinear ordinary differential equations available, there is a dearth of modern textbooks which introduce the theory of nonlinear oscillations from the point of view of mechanics. In this respect this book fulfills a need and is a most welcome addition to the literature. The adoption of the book for classroom use may, however, be hindered by the cost factor.

For a review of the technical contents of the book the reader is referred to a review prepared by Professor Rosenberg and published in the March, 1979, issue of this JOURNAL, Vol. 46, p. 238.

Turbulence in the Free Atmosphere. By N. K. Vinnichenko, N. Z. Pinus, S. M. Shmeter, and G. N. Shur, (F. L. Sinclair, Trans.) Second Edition. Plenum Publishing Corp., New York. Pages xiii–310. Price $49.50.

REVIEWED BY J. L. LUMLEY[3]

This book, like the first edition published in 1968 in the USSR and in 1973 in the USA, is devoted mainly to the results of experimental, rather than theoretical, investigations of atmospheric turbulence affecting the flight of aircraft. The book does not deal with the microscale turbulence that affects the propagation of radio waves, light and sound in the atmosphere. The authors constitute the staff responsible for work of this nature at the Central Aerological Observatory at Dolgoprudnyi, the leading such group in the USSR.

The revised and enlarged second edition greatly expands on the original coverage of methods and apparatus for measurements of fluctuations of velocity and temperature, and has been updated to include the results of new experimental investigations of turbulence in clouds and in the tropopause. In particular, the section devoted to radar and laser methods has been enlarged, and an aircraft instrument for measurement of temperature fluctuations is described. Chapters 6–8 dealing with atmospheric convection, thermal turbulence, turbulence in clouds, and wave/turbulence interaction, have been radically revised and enlarged, bringing in much new experimental data, and reflecting the increase in understanding of the mechanisms responsible that has taken place in the time since publication of the first edition.

Injection and Mixing in Turbulent Flow. By J. A. Schetz. M. Summerfield, editor. Progress in Astronautics and Aeronautics, AIAA. New York. Vol. 68. Pages xvii–200. Price $17; Member, $27 List.

REVIEWED BY J. L. LUMLEY[3]

This useful book collects in one place a great deal of data on jets with/without coflowing streams, axial pressure gradients, net mo-

[1] Ford Professor of Engineering, Massachusetts Institute of Technology, Cambridge, Mass. 02139.

[2] Professor of Applied Mechanics, Department of Mechanical Engineering, University of California, Berkeley, Calif. 49720.

[3] Willis H. Carrier Professor of Engineering, Sibley School of Mechanical and Aerospace Engineering, Cornell University, Ithaca, New York 14853.

mentum defect, swirl, multiple phases, three-dimensional effects, crossflow, buoyancy, compressibility, and viscous effects. In nearly every case results are presented of attempts to model the flow by the use of mean flow models, one-equation models, two-equation models, and Reynolds stress models; often, comparisons of several or all of these models are presented. The evaluation of the data and of the model performance is from an engineering point of view, with very little discussion of the basic physics; this is consequently not a book that could be recommended for a student beginning a study of turbulence. It is really more appropriate for an engineer who will be called upon to compute complex mixing flows, or as a supplement to a book which emphasizes the basic physics.