one will certainly serve as a useful survey of work of the authors and their collaborators and compatriots, often not easily accessible otherwise.

V.T.

42[65-02, 35L65, 76-08].—RANDALL J. LEVEQUE, *Numerical Methods for Conservation Laws*, Lectures in Mathematics, ETH Zürich, Birkhäuser, Basel, 1990, ix+214 pp., 24cm. Price: Softcover $24.50.

The title seems too general. The book does not cover all the aspects of numerical methods for conservation laws. For example, shock-fitting methods, or finite elements and spectral methods, are not discussed. However, the text does provide an up-to-date coverage on recent developments of shock-capturing finite difference methods, which is one of the most active research areas in numerical solutions for conservation laws.

The first part of this book summarizes the mathematical theory of shock waves. It also covers topics related to gas dynamics equations. Although the material is available in other books listed in the references, a somewhat more elementary approach with the help of graphs is provided here. It should prove helpful to students with a limited background in partial differential equations, but who want to get some feeling about the theory in order to read the second part regarding numerical methods.

Part two of this book is about recent developments of shock-capturing finite difference methods. In the past fifteen years there has been a lot of activity in designing and analyzing stable and accurate shock-capturing finite difference methods for conservation laws whose solutions contain shocks. The developments have been following quite a different path than the traditional linear stability analysis based on smooth solution assumptions. Tools for nonlinear stability such as TVD (total-variation-diminishing) methods have been developed, and high-order nonlinearly stable methods have been designed to resolve shocks and other complicated flow structures. Unfortunately, most of the results have been available only in isolated, sometimes hard-to-read journal articles. Books or Lecture Notes in this area are notably rare. This book is therefore rather unique and should prove to be a valuable reference and textbook in this area.

The text is carefully prepared. I have used a report version of it for a graduate reading course at Brown University, and students feel that it is well written and on the whole easy to understand. Misprints are rare, although the first sentence in the Preface misses an "are" right after the first two words. Another not-so-obvious mistake is in Exercise 17.1 on page 199: the minmod function in (16.51) would have to be changed to a minimum-in-absolute-value function to establish the claimed agreement.

In view of its limited scope, this book is not suitable for a general numerical analysis course for partial differential equations, or for computational fluid dynamics. However, it would serve as an excellent textbook for a graduate seminar course for mathematics or engineering students who are interested in shock calculations, and as a general reference book for researchers. The fact that it contains exercises and is available in relatively inexpensive soft cover is another welcome feature.

One comment on the organization of the material: the first part on theory of conservation laws and gas dynamics equations seems too lengthy, since most of the material can already be found in many good books. It would seem worthwhile to condense the first part and to expand the second part on numerical methods. One gets the impression, when reading through the book, that it is gradually running out of steam: towards the end, the description becomes more and more sketchy.

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43[65M60, 65N30, 65N35].—CLAUDIO CANUTO, M. YOUSSUFF HUSSAINI, ALFIO QUARTERONI & THOMAS ZANG, *Spectral Methods in Fluid Dynamics*, Springer Series in Comput. Phys., Springer, New York, 1988, xv+557 pp., 24 cm. Price $90.50.

The authors present here a comprehensive, up-to-date treatment of spectral methods: "when to use them, how to implement them, and what can be learned from their rigorous theory."

The distinguishing feature of this book is its synthesis between the description of spectral *algorithms* that are successfully implemented in Computational Fluid Dynamics (CFD) problems, and whatever rigorous theory is currently available to support their numerical results.

After the introductory material in Chapter 1, the content of the book can be grouped into three related parts.

The first part outlines the basic ingredients which are involved in spectral solution of PDE's. In includes a bird's eye view on the fundamental concepts of spectral expansions in Chapter 2. Chapter 3 is concerned with accurate spatial differentiation of these spectral expansions in the context of linear and nonlinear PDE's. Temporal discretizations of spectral approximations to time-dependent problems are treated in Chapter 4, and the solution of implicit spectral equations (which arise owing to full spectral differentiation matrices) is studied in Chapter 5.

The second part of the book is devoted to applications of spectral methods for CFD problems. It includes a detailed description of spectral algorithms for unsteady incompressible Navier-Stokes equations in Chapter 7, and for compressible Euler equations in Chapter 8.

The third part of the book deals with the rigorous analysis of spectral methods. Error estimates for spectral expansions are presented in Chapter 9, which is followed by the linear stability and convergence analysis of spectral methods in