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book reviews

Numerical Methods in Fluid Dynamics. By Maurice Holt. Springer-Verlag. 1977. viii-253. Price $31.70.

REVIEWED BY F. G. BLOTTNER[1]

This is the first book of the Springer series in computational physics. The scope and contents are accurately stated on the back cover of the book as follows:

The first part of this monograph is concerned with numerical problems in Gas Dynamics. The discussion of finite-difference methods is concentrated on hyperbolic systems. The author describes the present status of two approaches developed in the USSR, both based on the method of characteristics: The method of Godunov and the BLVR method due to Rusanov and coworkers. Other techniques treated in this volume are due to Butler and Sauer. In later chapters the author describes the Methods of Integral Relations introduced by Dorodnitsyn, Telenin's Method and the Method of Lines—techniques based on polynomial or series representation of the unknowns—all applied to problems in Fluid Dynamics. The presentation is made for graduate students in Mechanical Engineering and Applied Mathematics with basic knowledge of Fluid Mechanics. Many applications and samples of numerical solutions of model problems are presented.

As this summary shows, the title implies a much broader coverage of computational fluid dynamics than is actually provided in this book.

With the significant interest in computational fluid dynamics, there is a need for books which emphasize the techniques developed for solving fluid flow problems. Although there are the very important and useful books such as *Difference Methods for Initial-Value Problems* by R. D. Richtmyer and K. W. Morton and *Numerical Methods for Partial Differential Equations* by W. F. Ames, these books are concerned with more general mathematical problems and contain only a limited amount of material on fluid dynamics. In 1972, *Computational Fluid Dynamics* was published by P. J. Roache; however, the present book being reviewed complements and covers additional subjects not included in this earlier book. The present book makes readily available a description of several important solution procedures developed in Russia. The author has the unique capability necessary to properly work with the Russian authors in order to obtain an accurate interpretation of these techniques. Also, he and his graduate students have utilized and developed some of these techniques further in their research activities. Although much of the Russian literature describing the numerical methods is available as NASA-translated documents, the significant contribution of the author is to provide a lucid development of most of these techniques.

In the Preface the author states that this monograph evolved over a number of years as the result of a graduate course being taught at the University of California-Berkeley. The reviewer would be surprised if this book becomes widely used as a text in a computational fluid dynamics course at many universities. It seems better suited as a supplemental text for course work or as a useful reference book for engineers concerned with developing solution procedures for flow problems.

In my opinion, the weakness of the book is mostly in not placing the numerical techniques described in proper perspective with appropriate credits. For example, in the chapter on the Godunov scheme for solving hyperbolic equations, the well-known Lax-Wendroff and MacCormack schemes are not mentioned. The solution technique for tridiagonal equations is credited to Gelfand and Lokutsievski (1953) while other authors consider Thomas (1949) the originator. The method of integral relations is a special case of the Galerkin procedure in the general method of weighted residuals. Although the historical development of the method of integral relations as applied to fluid mechanics is described, the relationship to the method of weighted residuals is not indicated. The method of lines is indicated to have been developed in the Soviet Union, but earlier in 1930, Rothe, and in 1937 Hartree and Womersley used this technique to solve parabolic partial differential equations. This method and Telenin's method are used to solve elliptic equations but the direct, semidirect, and other marching procedures are not mentioned.

The chapter on the method of characteristics for three-dimensional flows is highly recommended as it provides a comprehensive review and coverage of the various techniques available. This book will be valuable to engineers interested in solving fluid dynamic problems with the computational techniques described.

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Stabilität und Matrizen (in German). By Peter C. Müller. Springer-Verlag, Berlin, Heidelberg, New York. 1977. Pages vii–220. Price $16.80.

REVIEWED BY T. K. CAUGHEY[2]

The author has written an excellent monograph on the subject of matrix methods in stability theory for linear dynamical systems. In many ways this book is similar to the book *Matrix Methods in Stability Theory*,[3] though the emphasis in the present work is on mechanical systems.

The book is organized into six chapters. The first chapter is an introduction and overview of stability in linear systems. Chapter two deals with the general theory of linear dynamical systems with particular emphasis on mechanical systems. The third chapter is devoted to Liapanov stability and instability theory and the role played by quadratic forms as Liapanov functions for linear systems. Chapter four deals with the Liapanov matrix equation, its properties and various solution techniques. The fifth chapter is devoted to a general treatment of stability and instability of linear time invariant systems. Chapter six applies the results of chapters three, four and five to the discussion of stability and instability of linear time invariant mechanical systems. The book is well written and makes enjoyable reading. The reviewer recommends this monograph to anyone in systems theory and dynamics who has a reading knowledge of German.

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[3] *Matrix Methods in Stability Theory*, S. Barnett and C. Storey, Barnes and Noble Inc., New York, 1970.

