REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

The numbers in brackets are assigned according to the American Mathematical Society classification scheme. The 1980 Mathematics Subject Classification (1985 Revision) can be found in the December index volumes of Mathematical Reviews.

20[65–01, 65Mxx, 65Nxx].—MYRON B. ALLEN III, ISMAEL HERRERA & GEORGE F. PINDER, *Numerical Modeling in Science and Engineering*, Wiley, New York, 1988, x+418 pp., 24 cm. Price $39.95.

This book seeks to give a unified treatment of numerical modeling by combining material from continuum mechanics, partial differential equations (PDE's) and numerical methods for PDE's. The book is intended to serve as a text for a year-long graduate course for engineers, scientists and applied mathematicians. The basic idea of the book, namely, to first derive the equations from physical principles, then consider fundamental mathematical questions such as existence and qualitative properties of solutions, and finally devise numerical methods (finite difference and finite element methods), is of course sound. It should help the student to gain a better understanding of numerical methods if a proper theoretical background is given, and the theoretical studies are well motivated if the usefulness and importance is shown of numerical modeling in applications. However, such a unified approach requires a very careful selection of material to be successful.

The present book starts with a chapter where the basic PDE's in continuum mechanics (fluid mechanics and elasticity) are derived. Then there follow an introductory chapter on numerical methods and three chapters on steady state (elliptic), dissipative (parabolic) and nondissipative (hyperbolic) problems involving both mathematical and numerical aspects. In the final chapter some nonlinear problems are considered. The style of the book is informal or "nonmathematical"; for example, no theorems with precise assumptions are stated. To my taste, the mathematical level of the text is too low to be really suitable for a graduate course. For instance, variational principles for Poisson's equation and finite elements are discussed without the notions of the H^1-norm and completeness, which seems unnecessarily restrictive, since these concepts are now common also in the engineering literature. Mostly standard material concerning finite difference methods is presented in the chapters on elliptic, parabolic and hyperbolic problems. The book also contains material on finite element methods for these problems, but here the presentation is not adequate. For instance, in Chapter 2, second-order differential operators are applied to piecewise linear functions which are only continuous, and it is stated that the error in the energy norm using piecewise linear basis functions is $O(h^2)$. Such things should be very confusing to the student and defeat the stated ambition of the authors to increase the understanding of the subject.

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Chapter 5 contains a section on finite elements for hyperbolic problems, which is a very active area of research, where rapid progress has been made in the last years, for example on problems in several dimensions and nonlinear problems. However, this development is not touched upon in the present book.

To sum up, I find the basic idea of the book to be very natural but I think it should be possible to give a presentation which would be more precise mathematically and more up-to-date numerically, without becoming more difficult to read.

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21[65–02, 76–02].—OLIVIER PIRONNEAU, *Méthodes des Éléments Finis pour les Fluides*, Collection Recherches en Mathématiques Appliquées, Vol. 7, Masson, Paris, 1988, 199 pp., 24 cm. Price FF 175.00.

This short monograph appears in a relatively new collection edited by P. G. Ciarlet and J.-L. Lions. Although the collection accepts texts in both French and English, most titles are in French. Such an outlet for high-quality research is especially welcome for Ph.D. level teaching where there is a definite lack of this kind of material. In this respect, the book by O. Pironneau is exemplary. It presents an excellent summary of classical problems of fluid mechanics, including a discussion of the physical limitations of models. It also presents a fairly large number of methods for convection-diffusion problems which are probably the most difficult ones in fluid simulation at high Reynolds number. The results are in no way complete, but they leave the reader with a real sense of what the issues are.

The treatment of incompressibility is well done, even if the repertoire of elements is a little short. There is a treatment of less standard boundary conditions, which can also be very useful for beginners; this kind of material is alway very hard to find.

Navier-Stokes equations, both for incompressible and compressible flow, are considered. Again one should not look for complete results but for a broad picture sketching the main facts.

The book contains a collection of information which can nowhere else be found in one place. It should definitely be compulsory reading for beginners in flow simulation. Experienced readers will enjoy the practical presentation and will discover links between facts and methods they may not have thought about before.

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