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REVIEW

Computational Fluid Mechanics and Heat Transfer. By D. A. ANDERSON, J. C. TANNEHILL and R. H. PLETCHER. Hemisphere, 1984. 599 pp. $39.95.

My view of computational fluid dynamics is that it is that branch of applied mathematics which concerns the obtaining of numerical solutions to the Navier–Stokes equations, and their derivatives.

Sometimes these derivatives can be very simple; for example, the Laplace equation suffices to describe irrotational flow of an ideal fluid, or the resisted flow of a real fluid in a porous medium. However, these circumstances are non-typical; as a rule one has to solve *coupled* equations simultaneously, the coupling being of that special kind which links the three momentum equations via the continuity equation.

There are many ways of solving the Laplace equation numerically. Some are better and some are worse; and it would be quite useful to have an authoritative textbook which distinguished them. However, that is not what one expects in a CFD textbook; for this has the more serious task of explaining and evaluating methods for solving the *coupled* equations, which are difficult to solve but for which a few good methods have been derived.

The authors of this book do not appear to share the foregoing view; nor, however, do they put forward any alternative unifying notion that I detected. They dwell for most of the book on single differential equations; and it is only in the ninth of their ten chapters that they deal with numerical methods for the Navier–Stokes equations, and then only cursorily. On the way they provide chapters on such topics as the Reynolds equations for turbulent flows, the boundary-layer equations, the method of characteristics, and numerical methods for parabolic and 'parabolized' equations. Each of the corresponding equation sets is coupled in a different way, a fact that, if brought out clearly, can assist the student to distinguish one class of problem from another, and to understand why different solution procedures are used. I would have given this theme more prominence than do the authors.

The authors quote extensively from the literature of their subject; but they do not, in doing so, provide much illumination of their own. The reader seeking guidance as opposed to information will not find it here. For example, when they write of 'the well-known Patankar–Spalding method', they refer to its implicit formulation but fail to mention its use of non-dimensional stream function as a cross-stream coordinate. Yet that is its main distinguishing feature and (I would say) its main merit. More perceptive authors would have drawn the feature to the attention of readers, perhaps in a section which discussed systematically the alternative choices which can be made. The general reader does not care whether the method is well known or not, or even what names are attached to it; but he does need to see options where they exist, and to be helped to make his own choice.

The English style is uneven, as is to be expected when three authors collaborate. The better parts are acceptable; but, in some places, words appear to have been assembled with little thought. The chapter on Grid Generation is particularly slapdash, which the importance of the topic makes especially regrettable. Elsewhere one encounters colloquialisms such as 'let's', and examples of jokiness that will not wear well.

There is little in the book about particular computer programs; and the authors express the view that students should write their own rather than use 'canned' ones.

They obviously do not regard this requirement as very onerous; for one of the homework examples in Chapter 7 starts, offhandedly: 'Write a computer program... to solve the incompressible laminar boundary-layer equations...'. This being their expressed view, it is surprising that they provide two FORTRAN programs in appendices, one for the Thomas algorithm and one for solving block tri-diagonal systems of equations. However consistency of viewpoint is what the book lacks generally.

'Heat transfer' appears in the title; but there is little in the book which will appeal to specialists in that subject. For example, the numerical simulation of heat-exchange equipment is not mentioned; nor is the now significant progress which has been made with the computer simulation of two-phase-flow phenomena.

Of course, much can be learned from study of this 600-page volume, especially about what has been published. Prospective authors of further textbooks on CFD need not fear, however, that the present ones have left them with nothing to do.

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