BOOK REVIEW

Computational Methods for Fluid Flow

R. Peyret and T. D. Taylor

Among my collection of books on computational fluid mechanics (CFM) and related topics, 'Computational fluid dynamics' by P. J. Roache is, in spite of its relative youth, in poorest shape as far as its physical integrity is concerned. The reason is easily identified: CFM, as an engineering tool, is a relatively young discipline, and the intense wake of its explosive development in the past two decades contains exceedingly few texts providing integral overviews rather than amorphous collections of uncoupled contributions. Roache's book is not only one of these few, but, arguably, is still the premier text among them for reference purposes.

The new book by Peyret and Taylor is a highly welcome addition to this small group, being both a text and a review work of a more general nature. The book, intended for research engineers rather than mathematicians and numerical analysts, is divided into three main chapters, respectively dealing with fundamentals, incompressible flow and compressible flow.

The first chapter opens with a useful presentation of various forms of the Navier-Stokes equations and proceeds to deal in a very concise and readable fashion (ie free from mathematical rigour) with basic approaches to discretisation. The chapter contains sections on conventional finite-difference methods, as well as compact schemes and finite-element and spectral approaches. It further provides very brief summaries on specialised schemes such as the 'discrete-vortex' and the 'cloud-in-cell' methods. The chapter is informative, and the authors deserve a particular compliment for trying hard to provide transparent bridges between, and to identify common features of, finite-difference, finite-element and spectral methods. Unfortunately this fundamental chapter is painfully short for the scope it covers—a mere 130 pages—skirting around a number of major topics. To give an example, splitting methods and generalised ADI methods are each dispensed with in less than two pages.

The second chapter presents fairly extensive summaries of primitive-variable and stream-function-vorticity, finite-difference formulations, and highly condensed sections on the application of finite-element and spectral methods. A number of example solutions are included and discussed. Particularly useful in this chapter is the exposition of various methods for solving for the pressure within the framework of primitive-variable schemes. With over a third of the chapter devoted to stream-function-vorticity based schemes, some would undoubtedly argue that less would have been appropriate in view of the increasing popularity of primitive-variable formulations.

The third and final part, on inviscid and viscous compressible flow, is different in style from the preceding one in that it contains, initially, little introductory information on discretisation techniques, although towards the end of the chapter explicit and implicit schemes for viscous flow (eg MacCormack) are presented. This chapter may represent a useful summary for those wishing to get an inkling of current capabilities on compressible CFM, but is, unlike chapters I and II, not a particularly good vehicle for gaining insight into solution methodologies.

In summary, this lucid, attractively produced book will be a valuable addition to the library of most CFM practitioners and researchers and a good source of references. It will not, however, entirely obviate the need for further glueing operations on my copy of Roache's book.

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