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REVIEW

Frontiers of Computational Fluid Dynamics. Edited by D. A. CAUGHEY and M. M. HAFEZ, Wiley, 1994. 634 pp. ISBN 0471953342. £70.

This book consists of a set of papers presented at a special symposium to honour the 60th birthday of Antony Jameson and held at Cornell in November 1994. As such, it attempts to show something of the current state of CFD and Tony's substantial contribution to it. To those who work with CFD, the book is a useful reference compilation of familiar topics and authors; for those new to the subject the book is a valuable introduction and conveys well the power and excitement of what can now be attempted and what will soon be possible.

CFD is a modern and rather special expression of fluid mechanics. It is an endlessly fascinating, interdisciplinary blend of basic numerical methods, a solid understanding of both experimental and analytical fluid dynamics, software engineering and pragmatism. The rapid development of the subject has mirrored the dramatic growth in computer power – the first two-dimensional, inviscid, transonic airfoil simulations were performed only in the early 1970s (the first three-dimensional simulation in 1974); today the simulation of the viscous flow around a complete aircraft or through a turbomachine can be contemplated. From pure research, CFD has now become a core technology in the aerospace industry.

The book contains chapters on the use of CFD for design and optimization of aerodynamic configurations, unstructured grid techniques, solution of the Euler equations and of the Navier–Stokes equations and applications to aerodynamics and to hydrodynamics – as well as reviews of Tony's own contributions. The numerical techniques covered include advanced meshing issues (unstructured, multi-block and chimera), all the current fashionable range of Total Variation Diminishing methodologies and artificial dissipation strategies, and the usual mix of explicit/implicit iterative solution techniques together with multigrid acceleration. Applications described range from complete aircraft configurations via multi-element airfoils to yacht hulls. There is hardly anything in the book, however, on turbomachinery flow. This is a pity since Tony's teaching has been influential there also and it might be argued that CFD has made much more impact hitherto on the design of turbomachinery than on airframes. Turbulence modelling, perhaps the only remaining limit to our ability to predict flow in a routine manner, is also notable by its absence.

Although much work is presented, the diversity is mostly in terms of the problems attempted. In fact, discarding differing emphases and notation, one is struck by the almost universal commonality in the basics of the numerical methods used by all the authors. These basics owe much to Tony's work both in developing new algorithms and in synthesizing and applying the best ideas from existing algorithms. A common weakness with CFD is to focus too much on endless permutations of the basic numerical methods rather than on application of existing methods to extract new physical understanding from unfamiliar flow fields – this is of course the real objective of CFD.

The book makes clear that the development of a subject as vast as CFD is very much a collaboration between university, government research laboratory and industry. The usual distinction between pure research and application is much less prevalent in CFD than in other engineering subjects. The most successful practitioners of CFD, like

Tony, well understand that the conception of a new algorithm (perhaps developed and tested on only one-dimensional problems) is simply the beginning and that the research is not finished until practical, robust, validated, three-dimensional tools are in use by a designer to actually change metal.

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