Chapter 4 addresses partially premixed flames and flame stabilization issues. These questions are recognized today as essential for many recent combustion applications (such as Diesel engines, Direct Injection gasoline engines or lean gas turbines) but research in the field is only beginning. Professor Peters gives a useful summary of the state of the art knowledge for partially premixed flames and shows how the models of Chapters 2 and 3 can be combined to address such problems.

Certain combustion experts will probably feel that ‘Turbulent Combustion’ is somehow incomplete or not accurate enough because it does not present ail existing models and to discuss all controversies which have marked the field in the last twenty years. This can be viewed, however, as a strength of the book; Professor Peters tries (and succeeds in most cases...) to concentrate on a few basic concepts and methods accepted by most turbulent combustion experts and this was certainly a condition for this book to be used as a common reference for the future.

From the first pages of the book, it is also obvious that this monograph is written for combustion specialists. At page 1, the reader must already know what a Reynolds number is and at page 2, he has to be aware of the definition of a Darakohler number because no definition is given for these numbers. Clearly, combustion beginners will have difficulties to make progress in ‘Turbulent Combustion’ if they have not read other textbooks on combustion first. For combustion experts, however, this high presentation speed makes reading interesting and fast even though the text is not fully self-contained and reference to the original publications is needed in many cases. In conclusion, ‘Turbulent Combustion’ is an essential book for all turbulent combustion experts who want an up-to-date summary of the works of N. Peters and his numerous co-workers.

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Fluid Flow Phenomena by Paolo Orlandi (Kluwer Academic Publishers, Dordrecht, The Netherlands, 1999, 368 pp.) € 134.00, US$ 156.00, £ 98.00 hardback ISBN 0 7923-6095 8.

This book by Paolo Orlandi is an interesting addition to the literature on Computational Fluid Dynamics (CFD), as it distinguishes itself markedly from the other books presently available. Indeed, it does not aim at an overview of existing methodologies and numerical schemes, but focuses in very great detail on a limited number of methods developed by the author over the years. A valuable aim of this book, as expressed by the author, is to provide numerical simulation tools in support of experiments, particularly with regard to the complexity of vortex dynamics, which is of particular interest to the author. The most important innovation of this book is the availability of a large variety of source codes for many levels of Navier–Stokes approximations, from 2D laminar models to 3D DNS and LES methods, allowing the reader to reproduce all the results presented and discussed in the book. Large parts of the book are devoted to the detailed description of these codes, under the form of an advanced user guide.

The topics addressed cover incompressible flows exclusively, and ignore the uncertain area of turbulence modelling, as the objective of the author is to provide the reader with a solid numerical basis for direct flow simulations at various levels of complexity.

On the numerical side, the focus of the book is exclusively on finite difference methods. Even there the author does not aim at generality and restricts his presentation to Cartesian and cylindrical coordinates, avoiding the problems related to general curvilinear grids and the important questions related to accuracy involving metric coefficients.

Chapters 2 and 3 are presenting the numerical basis for the following chapters, where applications are presented on 2D vortex dominated flows in 2D Cartesian grids (chapter 4), and their extension to general curvilinear coordinates, restricted however to cases where a conformal transformation to Cartesian coordinates can be defined (chapter 5). Chapter 6 deals with the direct numerical simulation of two-dimensional turbulence and chapter 7 refers to axisymmetric vortex flows, addressing mainly the numerical simulation of vortex rings. Chapter 8 deals with the direct numerical simulation (DNS) of three-dimensional flows with 3 periodic directions base on finite difference methods, mainly oriented at isotropic turbulence. Chapter 9 extends this approach to wall bounded flows in Cartesian coordinates, proposing a set of routines for DNS of turbulent channel flows. The next two chapters deal with flows in cylindrical coordinates with one and two walls. Finally, the last two chapters are devoted to Large Eddy Simulations (LES) in open space and with the presence of a wall, with dedicated software routines.

Chapter 2 provides an original approach to finite difference formulas, with an emphasis on high accuracy requirements, particularly with regard to various clustering schemes and non-uniform grids, in one dimension. Particular attention is given to schemes for parabolic and elliptic equations. For parabolic equations, classical schemes are discussed, as well as Runge–Kutta options. It is unfortunate that the text in the sections 2.3 refer at places to an equation numbering that does not correspond to the one finally selected. Section 2.4 is dedicatedto FFT for elliptic equations and a series of routines for the Poisson equation are described in detail, while a multigrid algorithm is provided in section 2.5.

Chapter 3 applies some of the basics of the previous chapter to the one-dimensional Burgers equation. Of particular interest is the attention given to the spectral analysis and the importance of a conservative formulation. The accompanying routines should be used as a test bed of schemes and of the analysis of the nonlinear effects.

Chapter 4 describes in great detail the discretization of the vorticity-streamfunction approach for 2D Navier–Stokes solutions in Cartesian coordinates, with particular attention to the conservation of energy and the nonlinear generated instabilities. Arakawa's scheme is discussed as well as other approximate factorization schemes. The described method is a combination of the Arakawa scheme and a factorization procedure applied to non-uniform grids. The associated codes are described at length and applied to study the physics of several monopole, dipole and tripole vortices, in presence of solid walls, and of vortex pairing.

The codes described in chapter 5 are applied to the flow of dipole vortices over a hill, or impinging into a cavity.

The first introduction to DNS is provided in chapter 6, dealing with 2D turbulence and based on finite differences, instead of spectral methods, referring to the schemes and codes presented in chapter 4. This short chapter is mainly to be seen as an introduction to the numerical evaluation of turbulent spectra, as chapter 7, mainly oriented at the simulation codes for vortex rings.

One of the most important chapters is number 8, introducing methods and finite difference codes for DNS of isotropic turbulence with 3 periodic directions. This is the first book publication offering the reader and the student the possibility to access and apply a validated DNS code, with the possibility to test for himself various numerical and discretization options and sensitivities. It also provides, through the numerical code presented an analysis of the physics of turbulence, including correlation tensors, PDF's of velocity, pressure and vorticity fields of turbulence, energy spectra and Reynolds stresses.

Chapter 9 extends the DNS codes to wall bounded flows and discusses at length DNS results for boundary layers and channel flows, from the literature and from the authors results. This extensive discussion provides an excellent introduction to the turbulence properties, as derived from DNS results, including PDF's, spectra, cross correlations and input for the evaluation of LES approximations and of current turbulence models. A most inspiring chapter!

The next two chapters are devoted to problems with cylindrical symmetry and are perhaps of more limited application, as they focus on vortex rings and their possible instabilities.

Finally, the last two chapters introduce LES and the author offers a set of routines allowing a complete LES simulation for homogenous turbulence and for channel flows, again based on finite differences. The presentation covers various subgrid models, including thermal flows and the applications are discussed with regard to numerical accuracy issues and grid resolution, including as well comparisons with DNS results. We highly recommend these last 2 chapters to all researchers interested in LES.

This book offers, despite a very personal style, an excellent example of the analysis and application of high accuracy schemes and should be considered as a guideline for new CFD developments, mainly for the description and attention given to all the 'small' details that characterize an advanced and operational code. This is representative of the high level of requirements shown by the author in his constant pursuance of excellence in numerical simulations. This book is therefore to be largely recommended to all researchers in fluid mechanics, in particular for lovers of vortex dynamics, and developers of CFD for DNS and LES simulations, as well as to students engaged in this field at a graduate level. Playing and testing the various subroutines offered by the author should provide a strong and exciting learning base. This compensates largely for the limited generality of the methods and codes presented.

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