Eur. J. Mech. B - Fluids 20 (2001) 427–430

Book reviews

S0997-7546(01)01134-7/BRV
Turbulent Combustion by N. Peters (Cambridge University Press, Cambridge, UK, 2000, 304 pp.) £ 45.00, US$ 69.96 hardcover ISBN 0 521 66082 3

Turbulent combustion today is a difficult science. The complexity of the interaction between chemistry and turbulence has lead multiple teams to develop theoretical and modelling approaches in the last thirty years but none of them has proved convincing or efficient enough to be approved by a significant portion of the combustion community. As a result, codes used in industrial applications mostly utilize very crude combustion models proposed thirty years ago, while combustion experts keep developing multiple models of increasing size and complexity. In this framework, the recent book ‘Turbulent Combustion’ by Professor N. Peters is an important contribution because it tries to provide a unified view of turbulent combustion. In the field of combustion monographs, few authors have the necessary background and the courage to concentrate on turbulent combustion and, obviously, Professor Peters was one of the best candidates to do so. Having developed multiple approaches for turbulent combustion in the last twenty years, Professor Peters and his co-workers have established a solid basis which needed to be summarized and presented in a unique book to be used as a reference for the combustion community. This was the objective of this book and it is generally fulfilled; there is no doubt that ‘Turbulent Combustion’ will be used in the future by turbulent combustion experts and provide a simple and complete guide to Professor Peters and co-workers works.

The book is written in an interesting way: the first chapter summarizes the contents and can be used almost as a short version by those who do not wish to get involved in too many details. For the others, Chapter 2 deals with premixed turbulent combustion, 3 with non-premixed flames and 4 with partially premixed flames.

‘Turbulent Combustion’ does try to present an overview of the methods used in the field but naturally, Professor Peters concentrates on the methods developed at Aachen. For premixed flames (Chapter 2), the so called ‘G-equation’ is the centre of the presentation. For non-premixed flames, Chapter 3 concentrates on flamelet models and on the use of the mixture fraction Z while Chapter 4 essentially provides the basis of a Z–G model for partially premixed flames. It is quite useful to have access to synthetic descriptions of these different models even though they constitute only a partial view of the field.

Chapter 2 essentially tries to demonstrate that most (if not all) premixed laminar or turbulent flames can be studied using the G-equation and the level set approach. Even though the G-equation provides an elegant technique to study these flames, the reader sometimes feels that the mathematics required to develop this framework are not necessarily needed. A physically-based interpretation of phenomena would have helped. However, it is also true that there is probably no simple way to present such turbulent combustion models and Chapter 2 is no exception; most models of similar complexity are usually presented in texts which can be read only by a few happy readers. . . .

Chapter 3 is probably of immediate interest to more readers: it provides a simple and complete description of models based on the mixture fraction and on flamelet concepts which are familiar to many scientists and constitute the theoretical basis of multiple models used in practice. Recent extensions of flamelet models to unsteady formulations are also described. ‘Details’ of the implementation of such models in numerical codes are not given and readers interested in coding such models will regret the somewhat abridged presentation.

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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S0997-7546(01)01142-6/BRV

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.