Book Reviews

Computational Fluid Dynamics for Engineers

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Cambridge University Press, The Edinburgh Building, Cambridge, CB2 8RU, UK. 2012. 189pp. Illustrated. £65. ISBN 978-1-107-01895-2.

As correctly stated in its Preface, the main aim of *Computational Fluid Dynamics for Engineers* is not to enable the reader to implement a Computational Fluid Dynamics (CFD) computer code or parts thereof, but rather to enable CFD users to understand the fluid dynamics to be modelled at a level adequate to select the best suited modes of the CFD code to be used. This objective is pursued by providing and discussing the main physical models (primarily first principle-based conservation laws and semi-empirical closure models) underlying turbulence, turbulent mixing and reactive flow and multiphase flow CFD modelling capabilities. The book, complemented by three tutorials and one project, is designed for undergraduate Chemical and Mechanical Engineering teaching and is reported to have been used also for PhD-level postgraduate teaching.

Other than the introductory chapter on the general type and structure of CFD simulations input data and the compact concluding chapter devoted to best practice in CFD modelling, the book is structured as follows: Chapter 2 (Modelling) presents the general form of the transport equations solved by CFD codes including required boundary conditions; Chapter 3 (Numerical Aspects of CFD)focuses on aspects of the space-discretisation and numerical integration of the (incompressible flow) governing equations and succinctly discusses a wide number of numerical methods regularly used in CFD. Chapter 4 (Turbulent Flow Modelling) presents a thorough discussion on both turbulence and turbulence modelling, whereas Chapter 5 (Turbulent Mixing and Chemical Reactions) focuses on the physics of turbulence mixing, chemical reactions and the integrated treatment of both in CFD; Chapter 6 (Multiphase Flow Modelling) provides a review of multiphase flow physics and presents several numerical models for the CFD analysis of CFD flows, which are used depending on the type and characteristics of the particular problem at hand.

The main objective of the book, to enable CFD newcomers to better understand the physics solved by the numerous models available in current CFD systems and choose adequate models for their simulations, is very valid, but this objective is also very ambitious in that the book covers a wide range of different areas, from numerical methods to multiphase and reactive flow physics. This objective is achieved to a significant extent. However, the rigour, discussion relevance, proper use of figures and equations to enhance text understanding, quality of the English and overall readability vary significantly throughout the book. For example the chapter on turbulent flow modelling provides clear and complete discussions on the physics of turbulence, the various modelling options available and what are the CFD solution accuracy implications associated with selecting certain models rather than others in the simulation; on the other hand, the more general chapters on modelling and numerical aspects of CFD are slightly cluttered and not very rigorous, possibly due to the wide range of topics discussed in a fairly limited space. Thus, my expectation is that the optimal exploitation of this book would be achieved by readers also possessing sound knowledge of basic CFD concepts and methods, in addition to some prior knowledge on turbulent mixing and chemical kinetics.

Given the wide topic coverage and the sometimes introductory character of the book, it is not helpful that only 21 bibliographic entries are provided for the entire book. The offer of a wider bibliography selection would significantly improve the usefulness of the book, since its topic diversity is likely to require for most readers additional reading on some of the topics.

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High Temperature Materials and Mechanisms

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This book collates the work of fifty able researchers and should appeal to all studying high temperature materials and applications at the highest level. Eight material groups are identified in the Introduction, Chapter 1, preparing the way for further study.

'High-Temperature Materials, Chemistry and Thermodynamics', Chapter 2, reveals much about how high temperature materials respond to all levels of temperature up to three degrees shy of 4,000°C. 'Refractory Metals, Ceramics and Composites for High-Temperature Structural and Functional Applications', Chapter 3, covers eight high temperature groups: 1) Carbon-Carbon composites; 2) Carbon-Silicon Carbide Ceramic Matrix composites; 3) Ceramics; 4) Ceramic Composites; 5) Cermets; 6) Metal Matrix Composites; 7) Refractory Metals; 8) Superalloys. Thermal, electrical, mechanical properties and structures are fully covered.

'High Temperature Adhesives and Bonding', Chapter 4, sheds much light on chemical compositions, bonding preparations and process, epoxy/phenolic, polyimide, bismaleimide, polybenzimidazole, esters and silicon adhesives. Service temperatures rarely above 300°C are considered. 'Oxidation of High-Temperature Aerospace Materials', Chapter 5, begins with a few words on gas turbine engine design, after which the corrosive effect of high temperatures, fuels and reactive products are considered. The authors rightly see validation of materials prior to use as vital and several high tech items of apparatus, enhanced by excellent schematics Figures 5.6 – 5.10, are described. 'High-Temperature Materials Processing', Chapter 6, focuses on tantalum carbide, borides carbides, nitrides and silicides, all of which have very high melting points, lack high temperature stability and are difficult and expensive to process. Many physical and mechanical properties of sintered products are recorded and top down (chemical), bottom up (atomic) and intermediate methods of powder synthesis discussed.

'Characterisation of High-Temperature Materials', Chapter 7, covers all the laboratory scientist needs to know about microscopy, X-Rays and spectroscopy in general. Section 7.3 does in fact contain nine different types of microscopy and section 7.4, thirteen different types of spectroscopy, an excellent guide to high tech laboratory methods. 'Nondestructive Evaluation and Health Monitoring of High-Temperature Materials and Structures', Chapter 8, covers virtually all common approaches: acoustics, ultrasonics,