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Book review

Large-eddy Simulations of Turbulence. M. Lesieur, O. Métais and P. Comte. Cambridge University Press, New York (2005) (232pp., $ 65.00, Hardcover, ISBN: 0521781248).

The subject of large-eddy simulations (LES for short) of turbulent flows, which started some decades ago through some ground-breaking papers, has grown into a discipline of its own. It has developed its own techniques, diversified to fit the different areas of application, and its own terminology. Because the interest in the subject spans several different areas, like engineering, geophysical flows, and applied mathematics, the need has arisen to develop textbooks for this subject to help graduate students grasp the techniques available, the capabilities offered, and the limitations of LES.

Lesieur, Metais, and Comte have undertaken this endeavour with their new book ‘‘Large-Eddy Simulations of Turbulence’’, complemented by computer animations, available through the Internet. The authors are well-known researchers in this field, have written many research articles, some of them in collaboration with each other, and at least one review article that I am aware of. Lesieur is furthermore the author of a well-known book on turbulence that is supposed, as stated in the Introduction, to supplement the present book.

The book starts with the basic equations of fluid dynamics, and introduces the concept of LES, with the aid of a short history of the subject, from its early days to present time. In Chapter 2 the dynamics of vorticity are discussed, with an emphasis on how to identify vortices in a turbulent flow. In Chapter 3 the basic LES equations in physical space are given, and the main weakness is pointed-out, i.e. poor correlation between the strain field of the resolved flow and the sub-grid stresses. Chapter 4 is dedicated to spectral LES methods, and to the concept of spectral eddy viscosity. Chapter 5 discusses, rather briefly, simulations of inhomogeneous turbulence. In Chapter 6 the current challenges in LES are discussed, and aid to specific problems is made, such as the mixing layer, jet, and flow over a back-step. Chapter 7 covers LES of compressible turbulence. Finally, the last chapter of the book (Chapter 8) has a brief overview of the use of LES in geophysical turbulence.

The choice of contents is very well thought out, and the ordering of the contents helps the reader understand gradually the concept of LES and techniques used. There is also a very extensive list of references. The book is written primarily from the basic science point of view, giving greater emphasis on the concepts of LES. The computer animations are useful in demonstrating the concepts. The current challenges of LES are also discussed well. The authors present a thorough state-of-the-art treatment of the subject of LES. On the other hand, however, there is surprisingly little material on numerical concepts and techniques, which today form an integral part of LES and that will necessarily be addressed in a course on LES. Moreover, although results from real-world problems are described, very little information is given on how to obtain such results. There is very little information, for instance, on how to perform LES in a complex geometry, where one is often forced to work with an unstructured grid. So in engineering-oriented classes on LES the instructor will have to recommend additional reading material besides this book.

Overall however this is a very well-written book, and I have no doubt that anyone involved with LES, whether an experienced researcher or a novice graduate student, will find some parts of the book, or all of it, valuable. The aforementioned criticisms perhaps will be addressed in a future edition of the book, when a much needed subject index may be added too.

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