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Book review

An Introduction to Turbulent Flow by Jean Mathieu and Julian Scott. Cambridge University Press, 2000, ISBN 0521570662

This book is intended as an introduction to the theory of turbulence. The book contains very detailed information on classical topics of turbulence, is clearly written and well presented, giving the reader a solid grounding for understanding the basic phenomena related to turbulence. In particular, Chapters 5, 7 and 8, describing classical models of turbulent jets, wakes and boundary layers, Kolmogorov's theories and numerical simulations of turbulent flows, are very instructive. Moreover, certain topics (e.g., Kolmogorov's theories) are described in such great detail and in depth that can be found in journal papers only. This makes the book a comprehensive source for understanding the fundamentals and classical theories of turbulence and therefore a very useful tool for newcomers to the field.

However, most of the information included in the book is available in numerous monographs on turbulence published over the last 30 years. It is an unfortunate that the book does not challenge the reader with interesting problems to be solved, and the text does not provide a sufficient number of examples and compelling illustrations.

Our main criticism is with regards to the subjects that are not covered (or almost not covered) in the book. Most important, the phenomena of coherent structures in turbulent flows, intensively investigated during the last 20 years by means of rapidly developing optical methods such as particle image velocimetry (PIV) concurrently with direct numerical simulations (DNS). These structures in wall bounded shear flows are discussed briefly at the end of Chapter 5, while the role of coherent structures in free shear flows are mentioned in one paragraph. A separate chapter devoted entirely to these structures would be extremely useful since such information cannot be found in existing books on turbulence. These large structures are associated with turbulent kinetic energy production and transfer and are responsible for the major part of the Reynolds shear stresses. In this respect, the introduction to the topic of transition to turbulence given in the first chapter is insufficient (especially for beginners in the field) because of its strong relations with the development of coherent structures in turbulent flows.

There are also other topics that do not appear in the book, such as turbulence in the presence of stratification, rotation and electromagnetic forces, which can contribute to better understanding of fundamentals of turbulence. When turbulence is subjected to these external forces, its response and modification, in particular, formation of quasi-2D turbulent structures is very instructive and could be used for investigation of many common features in general turbulent flows. In addition, sophisticated experimental methods and instrumentation (e.g., PIV) have become the key tools in modern research of turbulence, therefore, it is somewhat disappointing that a chapter describing this topic was not included in the present book.

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In summary, the book provides a solid background for understanding the fundamentals and classical theories of turbulent flows. As such it would be very useful for graduate students entering the field of turbulence and is recommended for engineers and scientists already working in this field. However, the book falls short in providing the state-of-the-art picture on recent developments in turbulence research.

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