# Preface

The motivation for the second edition stemmed in large part from the rapid pace of change in the fields of numerical simulation and experimental techniques. Despite the changes, our goal remains the same: to provide a reference textbook for graduate students, engineers, and research scientists. English is chosen to permit easy communication between workers in the field.

The contents of the present text book is based on the graduate level course taught at Ecole Centrale de Lyon. Over the years, the high standard students who attended the course largely contributed to improve its content and presentation. For students, it contains the essential results as well as details and demonstrations whose oral transmission is often tedious. At a more advanced level, the text provides numerous references which allow the reader to focus on his specific topics of interest. Some sections and appendices, containing developments on more specific subjects, may be skipped during a first reading, but might appear useful at a second one! We have endeavored to provide a wide array of illustrations throughout the book.

The general structure of the book is as follows. After an introduction in Chap. 1 illustrating the interest of turbulent flows, averaged equations and kinetic energy budgets are provided in Chap. 2. The concept of turbulent viscosity as a closure of the Reynolds stress is also introduced. Wall-bounded flows are presented in Chap. 3, and features specific to boundary layers and channel or pipe flows are pointed out. Free shear flows, namely free jets and wakes, are considered in Chap. 4. Chapter 5 deals with vortex dynamics, vorticity being a key element in turbulent flows. Homogeneous turbulence, isotropy, and dynamics of isotropic turbulence are presented in Chaps. 6 and 7. Turbulence is described both in the physical space and in the wavenumber space. Time-dependent numerical simulations are presented in Chap. 8, where an introduction to large eddy simulation is offered. Statistical models of turbulence are examined in Chap. 9. Major experimental techniques, including hot wire anemometry, laser Doppler anemometry, and particle image velocimetry, are finally introduced in Chap. 10. Numerous additional topics are developed in additional sections marked by a star, such as linear stability, the formulation of different models for compressible flow or the refinement of Kolmogorov theory, to name a few, and references are sorted by topics at the end of the book.

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