

# Preface

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In the fall of 2009, Elsevier approached me about possibly taking over as the lead author of this textbook. After some consideration and receipt of encouragement from faculty colleagues here at the University of Michigan and beyond, I agreed. The ensuing revision effort then tenaciously pulled all the slack out of my life for the next 18 months. Unfortunately, I did not have the honor or pleasure of meeting or knowing either prior author, and have therefore missed the opportunity to receive their advice and guidance. Thus, the revisions made for this *5th Edition* of *Fluid Mechanics* have been driven primarily by my experience teaching and interacting with undergraduate and graduate students during the last two decades.

Overall, the structure, topics, and technical level of the *4th Edition* have been largely retained, so instructors who have made prior use of this text should recognize much in the *5th Edition*. This textbook should still be suitable for advanced-undergraduate or beginning-graduate courses in fluid mechanics. However, I have tried to make the subject of fluid mechanics more accessible to students who may have only studied the subject during one prior semester, or who may need fluid mechanics knowledge to pursue research in a related field.

Given the long history of this important subject, this textbook (at best) reflects one evolving instructional approach. In my experience as a student, teacher, and faculty member, a textbook is most effective when used as a supporting pedagogical tool for an effective lecturer. Thus my primary

revision objective has been to improve the text's overall utility to students and instructors by adding introductory material and references to the first few chapters, by increasing the prominence of engineering applications of fluid mechanics, and by providing a variety of new exercises (more than 200) and figures (more than 100). For the chapters receiving the most attention (1–9, 11–12, and 14) this has meant approximately doubling, tripling, or quadrupling the number of exercises. Some of the new exercises have been built from derivations that previously had appeared in the body of the text, and some involve simple kitchen or bathroom experiments. My hope for a future edition is that there will be time to further expand the exercise offerings, especially in Chapters 10, 13, 15, and 16.

In preparing this *5th Edition*, some reorganization, addition, and deletion of material has also taken place. Dimensional analysis has been moved to Chapter 1. The stream function's introduction and the dynamic-similarity topic have been moved to Chapter 4. Reynolds transport theorem now occupies the final section of Chapter 3. The discussion of the wave equation has been placed in the acoustics section of Chapter 15. Major topical additions are: apparent mass (Chapter 6), elementary lubrication theory (Chapter 8), and Thwaites method (Chapter 9). The sections covering the laminar shear layer, and boundary-layer theory from a purely mathematical perspective, and coherent structures in wall-bounded turbulent flow have

been removed. The specialty chapters (10, 13, and 16) have been left largely untouched except for a few language changes and appropriate renumbering of equations. In addition, some sections have been combined to save space, but this has been offset by an expansion of nearly every figure caption and the introduction of a nomenclature section with more than 200 entries.

Only a few notation changes have been made. Index and vector notation predominate throughout the text. The comma notation for derivatives now only appears in Section 5.6. The notation for unit vectors has been changed from bold  $\mathbf{i}$  to bold  $\mathbf{e}$  to conform to other texts in physics and engineering. In addition, a serious effort was made to denote two- and three-dimensional coordinate systems in a consistent manner from chapter to chapter. However, the completion of this task, which involves retyping literally hundreds of equations, was not possible in the time available. Thus, cylindrical coordinates  $(R, \varphi, z)$  predominate, but  $(r, \theta, x)$  still appear in Table 12.1, Chapter 16, and a few other places.

And, as a final note, the origins of many of the new exercises are referenced to

individuals and other sources via footnotes. However, I am sure that such referencing is incomplete because of my imperfect memory and record keeping. Therefore, I stand ready to correctly attribute the origins of any problem contained herein. Furthermore, I welcome the opportunity to correct any errors you find, to hear your opinion of how this book might be improved, and to include exercises you might suggest; just contact me at [drd@umich.edu](mailto:drd@umich.edu).

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April 2011

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