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Book review

Measurement in Fluid Mechanics, S. Tavoularis, Cambridge University Press, New York, 2005 (354pp.).

If you work in the area of fluid mechanics, be it in industry, research, or teaching, buy this book. Even if you don't work in the field, but fluid mechanics has a peripheral impact on your specialty, buy this book. Having read and studied a wide number of books on the various areas of fluid mechanics for over 40 yr, I have never encountered one that the reviewers of novels would call a "page turner." This one is a fluid mechanics page-turner. Not only is it well organized, well written, and thorough, but the author has accomplished his stated objective (and my hopes for all topical books), in that he has written a concise, but thorough, coverage of fluid measurements in a highly interesting manner.

Dr Tavoularis has left no stone unturned in covering the manifold areas of fluid measurement and experimentation, and he has done so in a very readable book. I kept looking for the "holes" that I normally encounter in such works, and I found none. This is a book I wish were available when I was both a graduate student and a young neophyte experimentalist. Dr Tavoularis does a masterful job of presenting the various techniques of experimental fluid mechanics, but he also has the foresight to first review and relate the basic principals which govern, model, facilitate, and constrain the techniques. He covers not only the virtues and benefits of the manifold measurement techniques, but the shortcomings and uncertainties as well. He presents the virtues and capabilities of more modern techniques, such as particle image velocimetry (in a very understandable exposition), and also describes the enduring value of "tried and true" mature techniques (such as the Pitot tube). He does not belabor any technique, but provides clear descriptions, concise assessments, and key references for those seeking more detailed information. The book incorporates key illustrations, where needed, and provides a clear understanding of the physical bases underlying each technique.

The book has two main parts: (1) General Concepts and (2) Measurement Techniques. In the first part, Dr Tavoularis includes two initial chapters covering flow properties and basic principles, and general measurement systems and their static/dynamic characteristics. I found these chapters a good primer for the material to be presented later on measurement techniques. The third chapter beautifully covers one on my pet peeves with experimental measurements—the proper use of and citation of measurement uncertainty. The author does not (as some texts do) pay lip service to this very important area, but he incorporates discussion of relative uncertainties of various instruments throughout the technique sections. The fourth and fifth chapters present the basics of electronic signal conditioning and analysis, and an excellent primer on optics, both of which play critical roles in modern fluid measurements. The final two chapters in the first part discuss the design of experimental fluid flow systems, such as wind tunnels (another excellent job), and a discussion of how to plan a successful experiment. All these chapters are concise, thorough, and pithy. And they are all at a level that a beginning graduate student, and possibly an advanced undergraduate, can read and understand. I believe this initial part of the book provides an excellent overview and reference for even the experienced experimentalist.

The second part of the book is a series of eight chapters reviewing the various types of fluid dynamic measurement techniques, organized by the property to be measured. Six of these chapters provide excellent coverage of the various techniques for measurement of fluid pressure, flow rate, velocity, temperature, (species) composition, and shear stress. The other two chapters examine the elements of flow visualization, and the author's assessment of where advances in fluid measurement are needed. I particularly liked his presentation of Clauser charts and Preston tubes in assessing turbulent shear stress data. His is the best presentation I have read (including the original references) regarding how to effectively employ these tried and true techniques. Another standout is the author's excellent discussion of the impact of marker density in reflecting the true fluid motion for such techniques as flow visualization and PIV (an area not often clarified).

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So, whether you are a teacher seeking a book for an experimental fluid mechanics course, an experimental fluid mechanician seeking an excellent reference book, or an analytical or computation fluid mechanician trying to understand experimental studies, this is your book. As I said at the start of this review, buy it. You will not regret it.

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