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BOOK REVIEW

Fluid-Structure Interactions, Vol. 2: Slender Structures and Axial Flow. By M. P. Paidoussis. Academic, 2003. 1040 pp. ISBN 0125 44 3617. £190 or $275.

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With the second volume of *Fluid-Structure Interaction*, Michael Paidoussis has completed a comprehensive and unique two-volume book on fluid–structure interaction in axial flows.

There are theoretical and practical reasons why fluid–structure interaction in axial flow is treated in such detail. Applications are certainly many and varied, from more conventional flows in engineering pipes and external flows around towed arrays and flexible floating slender structures, to novel applications in flows around live fish, and internal biological flows. In addition, there is such a variety of basic flow and structural mechanisms, which lead to complex patterns and responses, linear and nonlinear, that the subject has become one of the paradigms not only of flow–structure interaction, but of mechanics in general. Paidoussis states that his aim is to provide the fundamentals and explain the basic mechanisms of the phenomena involved the result is a great success.

The first volume covered extensively in 6 chapters and several appendices many topics on pipes conveying fluids. The second volume, which is reviewed here, starts where the first volume left off. After a comprehensive chapter (chapter 7) on shells containing or immersed in fluid, which serves both to complete volume one and start off volume two, the rest of the book is dedicated to structures in external axial flow. First, the dynamics of long, solitary cylinders in axial flow are examined in great detail in chapter 8, then clusters of cylinders are studied in chapter 9. Chapter 10 deals with plates in axial flow and finally chapter 11 deals with the dynamics of annular structures. The book is complemented with several very useful appendices. Throughout the book the author provides detailed, well-illustrated applications of the subjects treated, some of which are in traditional areas of engineering and some in the rapidly developing new field of bioengineering.

As stated by the author, throughout the book the emphasis is on physical understanding of the problems, and as a result the treatment is biased towards analytical and semi-analytical methods, but comparison with experiments is extensive and systematically provided, using well-thought-out figures, graphs and photographs. Great care is taken to explain several fine points and resolve apparent paradoxes that have been at the centre of controversy over the years. Also, the physical mechanisms involved in hydroelastic dynamics are discussed in detail.

Chapter 8, on solitary cylindrical structures in axial flow, is typical of the whole volume, demonstrating the author's major contribution to the field with this book: he has re-derived the complete theory and results, developed by himself and several other authors, using a unified nomenclature and presented in a lucid manner. This topic is important because it has served as a paradigm for studying flow instability, including divergence and flutter mechanisms. Theoretical results are always presented side-by-side with detailed and careful comparisons with experiments; this gives great strength to the arguments and derivations. Extensions to compressible and two-phase flows further adds to the value of the chapter. Major subsections of the chapter,

after the theory has been developed, are (1) small-amplitude flow-induced vibration, (2) tapered cylinders, (3) concurrent external and internal flow, (4) parametric resonances, (5) towed and self-propelled cylinders, including fish propulsion, and (6) articulated and pendular systems, which proceed from linear to nonlinear theory, including qualitative system analysis and study of chaotic response. Finally, a subsection with practical applications provides figures and pictures of actual systems. This chapter alone could serve as a unique and valuable monograph, covering in 250 pages this complex subject. The remaining chapters are equally well presented and detailed, with explanations of physical mechanisms and comparison with experiment.

The author possesses an unmatched expertise in the area, and his knowledge of the literature, which spans several decades, and mastery of all developments is impressive. The exposition is very detailed, but at the same time clear, starting from basics and proceeding to the most complex phenomena; the various chapters are self-contained. Thus, despite its size (volume 2 is about 900 pages), this book will be a very valuable source for graduate courses on hydroelasticity, where by necessity only subsets of the book can be covered, while it will be an essential reference for workers in the field. The author states that the book has been written for engineers and applied mathematicians; its uniform and systematic treatment of a vast field does indeed provide invaluable service both to engineers and theoreticians.

In conclusion this is the definitive book on hydroelasticity in axial flow, an essential source for the researcher, but also a valuable textbook for the graduate student a very unusual and valuable book indeed. One must marvel at the amount of work and care that must have been devoted to writing such a book – it is a pleasure to read and a rich source of information. It is highly recommended to libraries and as course material.

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