Book Reviews

Fundamentals of Modern Unsteady Aerodynamics

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Springer, Tiergartenstrasse 17, D-69121 Heidelberg, Germany. 2010. 341pp. £117. ISBN 978-3-642-14760-9.

This book is meant as a graduate textbook for aerospace engineers. The first five chapters are on the classical topics whereas the penultimate chapter covers the modern topics on unsteady aerodynamics. The classical chapters mostly refer to the aerodynamic of flows past thin or slender objects in small angle-of-attack. The latter chapters cover vortex lift, different sorts of wing rock and flapping wing aerodynamics. The so-called classical topics can be found in many other fluid dynamics books such as John Anderson's *Fundamental of Aerodynamics*.

There are some grammatical mistakes which reduces the effectiveness of the book. The diagrams need considerable improvements. For example, in the Fig. 1.2 comparison of the experimental and theoretical pressure coefficients, dotted lines are used both for axis, chord positions and experimental values – highly confusing to detect which one refers to the actual experimental values. This style has been repeated throughout the book.

Examples and questions provided at the end of each chapter are useful for the readers to understand the subject matter in more depth. A number of theoretical equations are given in the Introduction chapter, i.e. Chapter 1 which defines the lift, drag and pitching moments for special cases e.g. for thin aerofoil, in subsonic, transonic and hypersonic cases. However, the equations are not derived. This leaves the readers puzzled about the validity of the equations. However, these make a good exercise for the students to provide the proof for themselves.

Some explanations are also too brief and superficial in this introductory chapter, e.g. real gas effects associated with hypersonic flows are referred due to the high skin friction omitting the heating associated with strong shock wave. Hence, for special topics such as this readers are better of referring to specialist books such as provided by Shapiro. Towards the end of the classical section, i.e. at Chapter 7, a large chapter is devoted to the hypersonic flows, where special cases such as the Newtonian theory and hypersonic similarity concept are introduced in detail. A major shortcoming of this chapter is the validity of the analytical equations to practical real cases, the unsteady issues, and modern CFD cross-validation. The CFD simulation presented for the double ellipse test case at M = 8 at 30° angle-of-attack should have been compared with the available experimental data which has been the subject of many ESA workshops.

Chapter 2 provides a summary of most equations encountered in modern fluid dynamics, from potential flows, to Navier-Stokes (NS), with linearised versions, such as thin-layer and Parabolised NS and a short section on algebraic turbulence models. However, the CFD techniques and the turbulence modelling are out of date and not described in detail.

General description of the incompressible flow past aerofoil is presented in Chapter 3, concepts such as the circulation, Kutta condition and vorticity distribution around the aerofoil and the wake. Simple harmonic motion, heaving and pitching moments are introduced first leading to the arbitrary motion using the Wagner function and the gust problem.

Chapter 4 provides a description of flow about thin wings and finite aspect ratio wings based on the Prandtl lifting line theory, its modification by Weissinger for high sweep delta wings and R. T. Jones's theory for low aspect ratio wings. Unsteady consideration and the arbitrary motion of thin wings are also presented.

and holographic systems, amongst other methods.

Chapter 10 provides a practical approach to the design of a PIV experiment; it also explains how to validate and postprocess the results and offers some guidelines to help improve the accuracy of the measurements.

Readers interested in obtaining a deeper insight into PIV methods will find more detailed information on particle dynamics, seeding and light scattering in Chapter 2. Further details on imaging and pixelisation can be found respectively in Chapters 3 and 4. Chapters 6, 7 and 8 contain the theory of PIV and Chapter 9 presents different methods to use in the analysis of data. Finally, details on the theory behind geometric imaging, stereoscopic reconstruction and FFT algorithms are provided in the appendices.

To conclude, this book – part of the Cambridge Aerospace Series – comprises without a doubt the most comprehensive and unified description and analysis of PIV methods existing to date and should be on the shelves of any library that covers the subject of experimental fluid mechanics.

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Mechanical Vibration: Analysis, Uncertainties and Control – Third edition

H. Benaroya, H. and M. L. Nagurka

CRC Press, Taylor and Francis Group, 2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN, UK. 2010. 960pp. Illustrated. £44.99. ISBN 978-1-4200-8056-8.

This substantial text – this third edition runs to some 992 pages – is aimed at both undergraduate and postgraduate engineering courses in vibrations. It will also provide a useful reference for practicing engineers. There are many texts for this audience, of course, but this book stands out in a number of ways. These arise from the authors desire to stamp their individuality on the book.

First is the material covered. Apart from the fundamentals of vibration of single degree of freedom (SDOF), multiple degree of freedom (MDOF) and continuous systems, there are substantial additional chapters and sections on the responses of such systems to random excitation and on active vibration control. These – graduate topics perhaps – are written with an appropriate length and depth so that the majority of vibration engineers will get all they require without the need to refer to specialist texts. Secondly, the book is more enjoyable to read than most. It contains numerous biographical summaries of the lives and achievements of famous people in the field, footnotes providing background information, sometimes from quite diverse branches of science, and material describing the practical problems faced by the engineer, with descriptions and pictures of applications. All these make the text readable. Finally the prose is written in a somewhat informal and often amusing style, in the first person, which also improves its readability, although perhaps a bit verbose in places.

After an introduction, chapters 2 to 4 cover traditional material concerning the fundamentals of SDOF systems: free and forced vibration, including damping. Chapter 5 concerns random excitation. As with other chapters, it starts with motivation and applications, then covers random variables and the response of SDOF systems. Chapter 6 concerns control, and specifically active vibration control using classical and modern techniques. Both of these last chapters are of substantial length and cover the material to an adequate depth to be useful.

Chapter 7 gives an overview of analytical dynamics, Lagrange's equation and Hamilton's principle. Chapters 8 and 9 concern MDOF systems – the fundamentals of vibration and, again, random excitation and (multivariable)

control. There is a short section on Monte Carlo Simulation which again gives a good introduction for the reader. Chapters 10 and 11 concern continuous systems while Chapter 12 concerns nonlinear vibration.

For the lecturer, the book is structured in such a way that specific chapters would be suitable for an undergraduate course, while giving a taste of more advanced topics, while the other chapters could form the basis of a postgraduate course. For the student or the practicing engineer, the book is readable and there is a good selection of material, so that it will have some lasting value.

Of course, no book is perfect – for example, in my opinion some description of the finite element method would be desirable, too little emphasis is placed on modal analysis and modal decomposition and there is an unappealing mixture of both SI and US systems of units – but these are also perhaps a reflection of the authors' individuality.

In summary, there is a good selection of material, including topics that are not often adequately covered in a single text, the engineering context is clear and the material is presented in an interesting and readable manner. This is a lot of book for the money and it is recommended.

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The Micro-Doppler Effect in Radar

V. C. Chen

Artech House, 16 Sussex Street, London, SW1V 4RW, UK. 2011. 290pp + diskette. Illustrated. £90. ISBN 978-1-60807-057-2.

Over the last decade the author has become one of the most authorative experts in the main effects of target micro-motions on received radar echoes. His experience and indepth knowledge of the micro-Doppler effect is reflected in the textbook.

The book is well written, easy to read with the author providing a complete and self-contained study of the micro-Doppler effect in many different cases of interest. The contents of the book itself not only provides a useful tool for the radar expert that is interested in the micro-Doppler phenomenon but will also be easy to understand for a reader with a general signal processing background.

The 300 page book starts with an introduction to the fundamentals of the Doppler effect and related time frequency analysis. This is followed by the basics of the Micro-Doppler effect in radar that includes the analysis of a canonical case study that involves micro-Doppler induced by vibrating and rotating targets in different configurations. The analysis of the micro-Doppler effect from rigid and non-rigid body motion is comprehensively analysed with examples from real life cases including wind turbines and human walking. One of the most interesting parts of the book describes how to analyse, extract and provide an interpretation of the micro-Doppler signatures where particular attention is given to the case of the human behaviour. The book concludes with an analysis of the open challenges in the micro-Doppler domain along with a view into its future prespectives.

A DVD containing MatLab codes accompanies the book. This includes simulations of the different cases analysed in the book. Furthermore this can be also used to generate new simulations with different parameters and configurations.

In summary, the book is a complete handbook and it will be of great value for the researcher and industrialist who are interested in the study of the micro-Doppler effect in radar.

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