Book Reviews

Small Unmanned Aircraft: Theory and Practice

R. W. Beard and T. W. McLain

Princeton University Press. 6 Oxford Street, Woodstock, OX20 1TW, UK. 2012. 300pp. Illustrated. £69.95. ISBN 978-0-691-14921-9.

Unmanned aircraft systems (UAS) are no doubt playing an important and increasing role in both civil and military sectors. As demonstrated recently, applications of UAS can be diverse – ranging from military missions such as reconnaissance, surveillance, battlefield damage assessment, communication relays, to civil use in environmental monitoring, fire monitoring, border patrol, aerial mapping, traffic monitoring, precision agriculture, disaster relief, rural search and rescue, as pointed out in the book reviewed authored by Beard and McLain.

In Beard and McLain's book they choose small unmanned aircraft as their main subject. These small unmanned aircraft are typically gas powered, operate on the order of 10 to 12 hours, with wingspan between 5 and 10 feet and payload of approximately 10 to 50 pounds. However, many concepts described in their book should also apply to battery powered fixed-wing micro air vehicles (MAVs) with wingspans less than 5ft.

As an introductory level book, it can be a good choice in understanding the basic challenges in guiding and controlling limited-payload small and miniature aircraft systems. The 13 chapters of the book start from an introductory chapter while the rest cover most of the issues relevant to control and guide MAVs, including co-ordinate frames, kinematics and dynamics, forces and moments, design models for control, autopilot design, sensors for MAVs, state estimation, design models for guidance, line and orbit following, path manager, path planning and vision-guided navigation.

This book is specifically designed for students and beginners with good background knowledge on engineering. It is a good reference book as well, covering many key concepts of MAVs. To engage readers' involvement, this book has an associated design project which has been carefully divided into steps and attached to the end of each chapter. Readers can implement these concepts in Matlab/Simulink to gain further understanding of these concepts and challenges.

Professor Shigang Yue, University of Lincoln

Theory of Lift: Introductory Computational Aerodynamics in MATLAB/ Octave

G. D. McBain

John Wiley and Sons, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK. 2012. 317pp. Illustrated. £64.95. ISBN 978-1-119-95228-2.

Of the many books on the theory of aerodynamics, why would a reader pick up this one? Almost certainly the mention of MATLAB® and (GNU) Octave will be a factor. Increasingly these high level mathematical programs are being used for their easy handling of arrays and complex numbers. The concept is most welcome, but does it live up to expectations?

The motivation for the book is clearer from the Preface than from the publisher's back cover. Dr Geordie McBain taught an introductory aerodynamics course for several years at the University of Sydney. To support the course he compiled a set of notes from the literature and this has become the core of the book. He observed how, as computational analysis developed, models of ideal fluid flow had been dropped from English language textbooks (although not from French). Models of sources, sinks, doublets and so on are elegantly described with complex numbers. Tools such as MATLAB and Octave can handle these with ease and McBain feels that a more traditional theoretical development is again practical and worthwhile.

The book is laid out in three Parts, briefly – Ideal 2D Flow, Ideal 3D Flow and Non-ideal Flow. In the first Part a steady development of ideas leads though the fundamental conservation equations, creation of complex velocity fields and plotting them with Octave, conformal mapping and the imposition of boundary conditions, flat plate and thin wing aerodynamics, then the application of lumped vortex elements, firstly to thin sections and then as panel methods for thick wing section profiles. The second Part works through a similar progression for finite wings including lifting line theory, lumped horseshoe elements and finally vortex lattice calculations. In Part Three the effects of viscosity and compressibility are considered with introductions to boundary-layer theory and to the qualitative changes as the flow increases from subsonic to supersonic. These amply complement the main text.

An appendix provides some notes on Octave programming. Octave is an open source program, freely available on the Internet and compatible with MATLAB; the program listings in this book can be used with either. A reader coming to these programs for the first time will need to look outside for tutorials to gain initial proficiency. Diving straight into the given examples could lead to some frustration, although the listings are quite free of errors.

So, how has the book lived up to its cover? This introduction highlights assumptions with respect to the nature of the fluid flows, draws attention to tricks in the analytical mathematics and to precautions taken in programming the numerical analyses. The book gives a good general introduction to the literature from Lamb, Prandtl and Glauert through to more recent CFD texts. Interesting use has been made of measurements and calculations from the wealth of research material retrievable over the Internet as the basis for numerical examples and verification of results.

The publisher's claim that it starts 'from a basic knowledge of mathematics' is not helpful – this book can not be properly appreciated without some mastery of the supporting (advanced) mathematics and at least some familiarity with the supporting computer program. The author explains 'It was and is envisaged as accompanying a lecture course, either as delivered simultaneously, or perhaps following - even years after - a remembered course, when a trained and practising engineer realises that there are aspects of the theoretical underpinnings that aren't as well understood as they might be'.

This book is a very useful digest of key points from the literature, carefully structured and presented with helpful pointers as to how the successive aerodynamical models can be implemented in the 'now so readily available interactive matrix computation systems'. It would be nice to see a further edition with more of McBain's lecture content to provide a true and gentler introduction for the newcomer.

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