the flapping aircraft is conceptualised as being composed of three rigid bodies (the fuselage and the two wings) which are connected by revolute joints.

Chapter 4 describes how the system identification methodology is successfully used to find the aerodynamic coefficients of the model of the flapping aircraft, based on experimental data. This includes detailed discussion on the experimental setup and instrumentation, which includes an on-board Inertial Measurement Unit (IMU) and a camera-based tracking system. Separate wind tunnel experiments were performed to find parameters related to tail and wing aerodynamics. The nonlinear model contains the full set of modelled dynamics, including the inertial, nonlinear coupling and gravitational effects, as well as nonlinear aerodynamics, from which trim solutions and simplified models can be found.

Chapter 5 uses the fully identified nonlinear flight dynamics model for various purposes, including simulations, the derivation of canonical time invariant models, as well as time periodic models (both are derived for straight and level mean flight), which are suitable for designing practical closed-loop control strategies for different flight conditions. Chapter 6, which is the final chapter, wraps up the work, summarises the modelling assumptions made and discusses the original contributions to knowledge presented by the book.

The book is very clearly written and is quite readable. The authors are clearly leading experts in the field. There is sufficient detail and references in the book for interested readers to perform similar tasks as those reported by the authors. The book is strongly recommended to readers interested in the subject.

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Rotorcraft Aeromechanics

W. Johnson

Cambridge University Press, The Edinburgh Building, Cambridge, CB2 8RU, UK, 2013. 927pp. Illustrated. £95. ISBN 978-1-107-02807-4.

Engineers and scientists, who really enjoy the detailed physics of helicopter flight and have ventured into aerodynamics, dynamics or flight mechanics, will appreciate the wealth of knowledge that the author Wayne Johnson brings to the rotorcraft community. He has published numerous NASA reports and external papers in various journals and conference proceedings and he is also well known for his rotorcraft analysis software CAMRAD (Comprehensive Analytical Model of Rotorcraft Aerodynamics and Dynamics). CAMRAD has been used by many academic and research institutions and helicopter manufacturers throughout the world.

Wayne Johnson's first book *Helicopter Theory* (Princeton University Press) was first published in 1980. More than 30 years on he has written his second major publication *Rotorcraft Aeromechanics*. Given that *Helicopter Theory* was, at the time of publishing, one of the most comprehensive books on the subject, it is difficult not to make some reference to his first book.

Rotorcraft Aeromechanics is one of the more extensive books available on the topic with over 900 pages dedicated to analysis. The book starts with a directive that its main focus is on modelling rather than experimental methods. The assumption is that the reader is conversant with some of the fundamental building blocks such as beam theory and general aerodynamics. The book is certainly full of equations;

https://doi.org/10.1017/S0001924000010393 Published online by Cambridge University Press

however there are also a number of smaller sections that would be appreciated by readers looking for more of a general overview rather than a detailed analysis.

Following a general introduction the essential element to any book majoring on analysis is a comprehensive chapter on notation and definitions. Subsequent chapters cover the analysis of the three major flight regimes and include performance and general design. The remaining chapters address the areas of structural and flight dynamics, aerodynamics including computational methods and noise.

The most important additions to this book are the inclusion of analysis methods covering technological developments in the field of rotorcraft over the last three decades. More complex rotor designs, advanced rotorcraft configurations such as tilt-rotor, coaxial and thrust/lift compounding are covered along with vibration management through individual blade and higher harmonic control. Two areas that could have been mentioned, given the significant levels of research, are advanced blade planform geometries and on-blade flow control such as active flaps.

An extensive list of references is included at the end of most chapters, some of which also include a specific history section. Finally, the layout of this book is a huge improvement over *Helicopter Theory* with a refurbished index and a clearer font.

In conclusion *Rotorcraft Aeromechanics* is an extremely comprehensive book and a welcome update to the author's first book *Helicopter Theory*. The new book covers effectively the intervening developments in technologies and analytical methods used to assess rotorcraft and rotor systems.

Dr Richard Markiewicz, CEng, FRAeS, Principal Rotorcraft Systems Engineer, Dstl

Fundamentals of Helicopter Dynamics

C. Venkatesan

CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL, 33487-2742, USA. 2014. Distributed by Taylor & Francis Group, 2 Park Square, Milton Park, Abingdon, OX14 4RN, UK. 318pp. Illustrated. £89. (20% discount available to RAeS members via www.crcpress.com using AKP32 promotion code). ISBN 978-1-4665-6634-7.

This book is the latest addition to the library of rotorcraft engineering books which has been growing at an increasing rate in recent years. This field, in fact, is now dominated by a number of impressive contributions, spanning from fundamental aerodynamics, to aero-mechanics, structural dynamics, flight dynamics and concise introductory textbooks. Thus, any new addition must find some form of identity in this already crowded niche.

To the reader, it is unclear what the contribution of this book is about, since all the material shown is found in one form or another in the existing literature.

The layout is in the classical style: it starts briefly with a review of the historical development of the helicopter; it introduces fundamental concepts for hovering flight, then moves on to forward flight, rigid blade dynamics, etc. In Chapter 10 'Helicopter Stability and Control' there are plenty of matrices, but few solutions. Simple models (for example Chapter 11 'Ground Resonance – Aeromechanical Instability: a Simple Model') are likewise full of matrices. Physical insight is always preferred ahead of mathematical treatment that reveals very little. Elsewhere, for example in Chapter 9 'Flap Dynamics under General Motion of the Hub', Equation 9·48 runs for nearly five pages for a full 60 lines! Who is