Care and Repair of Advanced Composites – Second edition.

K.B. Armstrong *et al*

SAE International, 400 Commonwealth Drive, Warrendale, PA, USA. 15096-0001. 2005. 639pp. Illustrated. $89.95. ISBN 0-7680-1062-4.

Serious consideration of repair and maintenance is vital to full and economic utilisation of advanced structures, so this book of over 600 pages will be of great use and interest to everyone involved in such aspects of high performance fibre-reinforced plastics. Parts of it should also be required reading for all practising and budding designers of structures fabricated from such materials; if repair is not considered at the initial design stage then an irreparable structure could easily be produced. It is unlikely to be of direct interest to research workers, but could be useful background reading for students studying advanced composites.

The book is a considerable improvement on the first edition, of which it is an enlarged and updated version. It is well illustrated and replete with relevant data and, give or take the occasional confusion with units and typographical error, is an excellent text. The contents are based on the many years of practical experience of the authors and members of an IATA Task Force, and the Commercial Aircraft Composite Repair Committee which followed it.

There are 17 chapters, each with a comprehensive bibliography, and a full index. Following an Introductory chapter, there follows background chapters on materials, handling and storage, manufacturing techniques, and design criteria. The core issue of repair is treated in the remaining chapters. Safety measures and the working environment are dealt with, then damage and repair assessment, source documents, repair method selection and repair techniques. After these come chapters on mechanical fastening, documentation, equipment and hand tools, tooling and mould making and metal bonding.

The penultimate chapter describes many generic damage/repair problems, based on actual cases, which have been brought about by poor initial design. This chapter is a "must" for all designers of advanced composite structures. The final chapter, of over 100 pages, presents a wide ranging treatment of the design of repairs, and includes appropriate stress analysis methods for both bonded and mechanically fastened repairs. The book is strongly recommended.

Professor Frank L. Matthews, CEng, FRAeS

A Modern Course in Aeroelasticity – Fourth edition

Edited by E.H. Dowell *et al*

Kluwer Academic Publishers, Dordrecht. 2004. Distributed by Springer-Verlag, Tiergartenstrasse 17, D-69121 Heidelberg, Germany. 746pp. Illustrated. £105.50. ISBN 1-4020-2039-2.

A Modern Course in Aeroelasticity is a classic text on many aspects of the subject of aeroelasticity. In recent years it was impossible to obtain this book so it is great to see it back on sale in its fourth revised and enlarged edition. As the work is well known in the aeroelastic community, this review will concentrate on the new material. There are four completely new chapters dealing with the most recent advances in the field.

Chapter 9 discusses modern methods for the modelling of fluid-structure interaction, mostly computational fluid dynamics techniques. The chapter is essentially a review paper. Some key methodologies are introduced and sample results are reported, mostly for aerofoils and a delta wing. The chapter is of most value when seen as a snapshot of research in this field.

Chapter 11 deals with nonlinear aeroelasticity and is based on a review paper. It contains some good general discussion of phenomena such as limit cycle oscillations. Sources of nonlinearity are explored and examples are given. The chapter is a very good introduction and a substantial bibliographical source.

Chapter 12 is on aeroservoelasticity and concentrates on active flutter suppression, a field of research that has seen substantial activity in recent. This chapter is the best of the new material in the book because it combines a presentation of the state of the art with two very detailed examples. Theoretical modelling and control law design is validated by experimental results for both examples.

Chapter 13 deals with aeroelasticity in turbomachinery in the presence of nonlinear flows. Linearization approaches are presented and the handling of unsteady flows in the frequency domain is discussed. As the aerodynamic forces are calculated from CFD methods, there are no paradigmatic examples here but the general methodology is well presented.

Finally, Chapter 6 on aeroelasticity in civil engineering has been substantially revised. While the established parts of the book are suitable for readers of all levels, the new material is mostly addressed to research engineers, both in academia and in industry. It will serve as a good introduction to the selected areas of research and as an extensive source of bibliographical information.

Dr G. Dimitriadis

Aircraft Design – a Conceptual Approach – Fourth edition; and RDS-Student: Software for Aircraft Design, Sizing and Performance

D.P. Raymer

American Institute of Aeronautics and Astronautics, 1801 Alexander Bell Drive, Suite 500, Reston, VA 20191-4344, USA. 2006. 838pp; 72pp. Illustrated. $109.95 (AIAA members), $148.95 (non-members). ISBN 1-56347-829-3; ISBN 1-56347-831-5.

The Education Series of textbooks produced by 'the cousins' – the American Institute of Aeronautics and Astronautics (AIAA) – is renowned for products of high quality. The present book is the latest edition of *Aircraft Design* by Daniel Raymer who, formerly of Lockheed Aeronautical Systems, Burbank, California, is now with the Conceptual Research Corporation, Playa del Rey, California. The first edition appeared in 1989.

The fourth edition has substantially the same format but has been expanded, and is usefully accompanied by an RDS-Student software package and disk, comprising what is described as a "sophisticated yet friendly" aircraft design and analysis computer program. The aim is the analysis of both new and derivative aircraft, making it a flexible tool, not only for teaching students, but also as a compendium for those with more experience.

The author has provided a broad range of designs. It includes a homebuilt light racing aeroplane with design calculations set out as one might on the back of an envelope, showing the more traditional fundamental technique of the design process. He also casts his net wide to more advanced civil and military multi-engine layouts, including tailless and three surface, and forward-swept.

The author discusses the relative merits of different arrangements and types of powerplant, including also rocket and hydrogen propulsion. He considers various configurations for extremes of flight, with a brief introduction to helicopters, and hybrid air-

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ships, like the Ohio 'Dynalifter'; required performance and flight mechanics in modern tactical manoeuvres (dynamic turning and supermanoeuvres), stability, control, handling qualities and vertical flight (both jet and propeller). There is too a section on unique aircraft concepts: flying and blended wings, lifting fuselages – multi fuselages, asymmetric configurations, joined wings (explored long ago by the late Norman Hall-Warren). This section ends with flight in ground (or surface-) effect; unmanned and uninhabited aircraft (pilotless). The book has a number of conceptual design examples, six appendices, questions, references and index.

All told with this conceptual approach, Raymer has produced a first class compendium of the art and science of aircraft design, displaying methods which are entirely relevant, both ancient and modern. The reviewer had his heart stopped by the publisher's price of $148.95, but one must expect specialised textbooks to be expensive.

Dr Darrol Stinton, CEng, FRAeS

Hypersonic and High-Temperature Gas Dynamics – Second edition

J.D. Anderson

American Institute of Aeronautics and Astronautics, 1801 Alexander Bell Drive, Suite 500, Reston, VA, USA. 20191-4344. 2006. 811pp. Illustrated. $64.95 (AIAA members), $90.95 (non-members). ISBN 1-56347-780-7.

In 1989 the first edition of John Anderson's book was published by McGraw-Hill. In the UK it cost £37.95 for 690 pages and was a very good buy. Now, after an interval of 27 years comes the second edition weighing in at 811 pages for $90.95. Recognising that the RPI has nearly doubled during this period, and with a favourable exchange rate, this second edition is, in real terms, substantially cheaper than the first.

The most noticeable change had been the addition of a preview to each chapter. These unashamedly chatty introductions are to whet the readers appetite before starting the main course. There are no completely new chapters but an extensive new section on shock-shock interactions has been added and seven pages on hypersonic waveriders are now included as a design example.

This book is about the fundamentals of hypersonic aerodynamics, not an essay on the state of the art. Nevertheless the new edition draws on modern literature to illustrate the fundamentals and is very up-to-date. Thus the real X-43 is shown in place of previous paper concept vehicles and the list of references includes some dated 2006.

After an extensive introduction, Part 1 deals with inviscid flow, covering both approximate and exact methods. Viscous flow is covered in Part 2 together with hypersonic viscous interactions and a chapter on CFD solutions of viscous flows. In Part 3 the problems of high-temperature gas dynamics are dealt with. Real gas effects, kinetic theory, statistical thermodynamics, viscous high temperature flows and radiative gas dynamics are all examined in a section occupying over 300 pages.

What isn't covered? The author admits that a Part 4 was to have included low density flows, experimental hypersonics and applied aerodynamics (vehicle design) but space prevented this. To be fair there are whole texts now available dealing with some of these missed topics. There are very few errors (e.g. an incorrect sign in equation 2·39 on page 46, which is happily printed correctly in the Summary two pages later). My only slight criticism is the poor index, no mention of the X-43 or of cones or cone flow, yet all are there in the text.

These are minor flaws. In summary John Anderson has updated and enlarged an excellent book to provide an even better one. It is also very good value for money, buy it!

Professor J.L. Stollery, CBE, FREng, HonFRAeS

Applied Cartesian Tensors for Aerospace Simulations

D.M. Henderson

American Institute of Aeronautics and Astronautics, 1801 Alexander Bell Drive, Suite 500, Reston, VA, USA. 20191-4344, 2006. 215pp. Illustrated. $64.95 (AIAA members), $89.95 (non-members). ISBN 1-56347-793-9.

The author declares that he wrote this book for 'aerospace students who have special interests in the mathematical description of the motion of flight vehicles'. Appropriately then a very large proportion of the book is concerned mainly with the description and uses of the transformation matrix defining a change of axis system in a variety of aeronautical and astronautical applications. If this sounds somewhat simplistic to the potential reader then he or she would be very much mistaken – so fundamental is an understanding of these transformations that the author has constructed an interesting and useful text very largely around this basic concept.

The first chapter develops fundamental geometrical relationships which include an extended understanding of the concept of Euler angles generalising the common astrodynamic and aerodynamic definitions of these angles. The author also introduces the Hamilton quaternion and explains its utility and how this theory relates to transformation matrices. As the various theoretical techniques are developed, sections describing aerospace applications are introduced. In this first chapter these include such topics as computational star navigation and the solution of guidance, navigation and control problems using data from sensors in rotating frames of reference.

Chapter Two deals with the motion of a point mass in a gravitational field, deriving first of all the Keplerian orbital results. This leads on to such topics as the development of the relative motion equations used during spacecraft rendezvous and docking operations.

The third chapter deals with rigid body motion and n-body problems in astrodynamics. From this the author develops the motion of a rigid body subject to gravity gradient torques in a non-uniform gravitational field. The final chapter introduces some material on the description of non-uniform, non-spherical gravitational field and an extended consideration of the modelling of forces on flight vehicles in the context of flight simulation.

The author stipulates in the preface that "The reader should have an understanding of differential and integral calculus, differential equations, and the fundamentals of vector analysis" as a prerequisite to this text. Despite the author's assertion to the contrary, I do not feel that this is a text from which one could learn the fundamentals of Cartesian tensors and so I would add a basic understanding of tensors to the list of prerequisites. But that does not detract from the book's utility in describing quite lucidly the application of transformations to the description of the motion and the formulation of guidance, control and navigation algorithms for spacecraft and air vehicles. The generality of the treatment makes it applicable to a wide variety of problems.

Unsurprisingly, given the mathematical nature of the material, there are a significant number of typographical errors. These would probably lead to difficulties for readers not already familiar with the material. It is to be hoped that these will be eliminated in any future editions.

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