Smart Composites: Mechanics and Design Edited by R. Elhajjar *et al*

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The term 'smart composite' refers to a multifunctional composite material in which constituents provide unique performance-related functionality by responding in different ways to a combination of mechanical and non-mechanical external stimuli. Smart composites possess attributes beyond the basic strength and stiffness. They can be designed to have integrated electrical, magnetic, optical, sensing, healing and possibly other functionalities that work in synergy to provide advantages that reach beyond that of the sum of the individual capabilities. Materials of this kind have tremendous potential to enhance structural performance by reducing size, weight, cost, power consumption, while improving efficiency, safety and reliability.

With the rapidly rising demand for materials with multiple integrated functionalities comes the need to understand, model and predict behaviour of such materials and structures made of them. This 415-page book presents a valuable and timely contribution to the literature on the subject and is the fifth one in the 'Composite Materials: Analysis and Design' book series edited by Ever J. Barbero, one of the leading authorities in the area of composite materials.

The book comprises 12 chapters written by 25 researchers with significant expertise in the field working at US and UK universities. The chapters present a selection of the latest research on smart composites and are grouped into three sections focusing on Materials, Structures and Sensing, with topics ranging from electrically conductive and magnetostrictive composites to design of morphing wings and structural health monitoring. Most chapters contain examples of practical applications of the discussed concepts and theories, while the chapter on multifunctional layered composite beams contains seven example problems with solutions in the style typically found in textbooks on composites. At the end of the book, there is also a collection of 65 exercises (without solutions) suggested for each chapter, intended to make this edited volume suitable as textbook for a course on smart materials or a follow-up to an introductory composites course.

This book would be useful for senior undergraduate and postgraduate students as well as practicing engineers. It would be suitable for those who already have expertise in working with composites but want to extend their knowledge and understanding to multifunctional composites, with a view to be able to develop new engineering tools for their design and analysis.

Professor Maria Kashtalyan,
University of Aberdeen

Aircraft Systems Integration of Air-Launched Weapons

K. A. Rigby

John Wiley and Sons, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK. 2013. 248pp. Illustrated. £84.50. ISBN 978-0-470-97118-5.

This book is part of the Aerospace Series published by Wiley and edited by Peter Belobaba *et al*, which, based on the quality of this volume should be well

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worth reading. It deals with the integration of air-launched weapons onto air delivery platforms, essentially a process of making the combination work safely and effectively. The process is needed because development programmes for air delivered weapons and airborne delivery platforms are almost always carried out independently. This means that for the effective use of the combination, new weapons have to be made to work on old platforms or old weapons need to be made to work on new platforms. This integration process ensures that the full capability offered by the platform/weapon combination can be achieved. Its importance can be seen by the funding given by UK MoD for a series of studies/investigations over the last decade into the whys and wherefores of such processes and known as WIUK (Weapons Integration United Kingdom).

In spite of the importance of such activities and the significant costs involved, the intricacies of IVVQCA (Integration, Validation, Verification, Qualification, Certification, Acceptance) have few devoted volumes or publications. *Aircraft Systems Integration of Air-Launched Weapons* by Keith Rigby begins to fill this void and although, as its title suggests, it concentrates on the avionic systems and software aspects of the process, it does outline the many other areas of relevance to the integration process. This wider definition is based on a Work Breakdown Structure (WBS) defining all the activities involved in weapon integration, an output I believe from the WIUK studies.

The 15 chapters making up this book start with an introduction to weapon integration outlining the integration process and summarising the contents of the book itself. A description of typical weapons to be air delivered (and hence integrated) continues, followed by an outline of the range of carriage and release systems (generally called S&RE (Suspension and Release Equipment)). Chapter 2 provides a deeper introduction to the integration process using a tabulation of the Work Breakdown Structure, but separating out those areas relevant to the aircraft avionics and systems elements as the main content of the book (shading grey those areas not covered, in figure 2.5). The next chapter deals with requirements, partitioning and aircraft sub-systems and is concluded with descriptions of the safety case and certification aspects of the integration process.

The fourth chapter deals with design issues relating to aircraft armament control systems and the Global Positioning System (GPS). Chapter 5 considers initialisation and targeting of weapons ranging from ballistic bombs to 'smart' air released missiles. Chapter 6, entitled 'Weapon Interface Standards' deals almost exclusively with MIL-STD-1760 with 'Other Weapon Integration Standards' reviewed in Chapter 7 there could be some confusion here between weapon power and data interfaces, weapon interfaces and weapon integration standards, easily resolved by someone familiar with such standards, but possibly confusing to a new reader of the subject. The management of weapon integration activities is considered in Chapter 8 which has the smallest list of further reading, each chapter ending with such a list; useful but not a comprehensive reference section.

A hypothetical weapon is used in Chapters 9 and 10, to paint a scenario and postulate a weapon integration activity with all the steps involved. Since this book deals almost exclusively with the power and data systems aspects of integration, many of the more subtle areas (aircraft self damage from weapon and/or aircraft failures for example) although mentioned, are not considered in any detail. Chapters 11 and 12 introduce 'Plug and play' and 'Open Architecture'

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integration concepts driven by national investigations and NATO ALWI (Aircraft Launcher and Weapons Interoperability) studies, which potentially provide a 'no specific work' route to integration, but again mainly covering the power and data aspects of the process. 'The Universal Armament Interface' (UAI) is covered in Chapter 13. 'Weaponised Unmanned Air Systems' are considered in the next chapter again concentrating on the data requirements – the full coverage of weapon integration onto unmanned air platforms would result in its own dedicated volume.

The final chapter is called 'Reducing the Cost of Weapon Integration' and this can be thought of as the holy grail of integration studies. However, when considering the integration of air delivered weapons onto airborne platforms, safety aspects dominate and ensure that such activities can be highly expensive elements of any weapon integration programme. Trials programmes for qualification can be dominated by the need for safety cases tailored to each trials range or agency involved with much effort required to sign off risk mitigation processes. These complications and complexities of weapon to aircraft integration (and hence providing major contributions to the costs of the process) arise from consideration of the consequences of aircraft and weapon failures, both aero-mechanical and electronic, with the combination and sequencing of such failures providing a branching tree of considerable complexity and hidden detail (evident in Chapter 9). Much of the work in weapon to aircraft integration is being wise before the event.

In conclusion this book provides a comprehensive introduction to the integration aspects of aircraft avionics to weapon interfacing. As a first edition detailing the aircraft systems element of interfacing and integration, it represents a start, which, in later editions, could expand those other areas of the integration process (left shaded grey on the WBS table of activities of Figure 2.5) to eventually become a standard textbook on the subject. A must for all those involved in platform and weapon integration and interfacing activities whether from an aircraft or weapon standpoint.

John R. Pearce, CEng, FIMechE, MRAeS

Powered flight: The engineering of aerospace propulsion

D. R. Greatix

Springer. 2012. 519pp. Illustrated. £63.99. ISBN 978-1-4471-2484-9.

Many textbooks on aircraft propulsion have been published, and it is hard to see how authors can find a way to make their contribution unique. This book covers the evolution range of aerospace propulsion from the earliest times, long before it was 'aerospace'. As with other offerings this aim is challenging for a single, relatively small (519 page), volume. That said I believe that this book largely meets its objective in a number of ways. Where the reader needs more coverage there is usually sufficient extra material to be found with the aid of the Internet.

This book is primarily intended as an aid to teaching and reflects the author's extensive experience in this role, informed by professional engineering and research experience. Naturally the content reflects one man's career path and the environments in which he gained his own personal experience. Following a general

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