is extremely important in augmented aircraft development and this chapter provides a good introductory level overview of Bode frequency response analysis and its interpretation in aircraft control applications. The material on State Space mathematics is new to this edition. It is rather too brief, it looks like an afterthought and is not tied explicitly to the earlier material in the book to which it is most relevant. Chapter 11 is entirely new, it gives a historical design overview of the A-10 aircraft and obviously capitalises on the authors' experience. It provides an interesting summary description of the flight mechanics aspects of this novel aircraft design. As a conclusion, this is a powerful 'real world' illustration of the importance of flight mechanics in the general aircraft design process.

In terms of technical content, the coverage of the book is not very much different from the First edition. However, it is significant that the opportunity has been missed to integrate the use of State Space methods in the many mathematical applications throughout the book and not to reference the universally used computational tools, such as MATLAB, in the many worked examples. It also remains an inconvenience that the Second edition does not include a comprehensive list of notation – an important omission in a work dealing with this subject matter. Each chapter concludes with a collection of examples for students, which is a useful addition to a book intended for the undergraduate market. The numerical examples use American Imperial units throughout, which is not surprising given the authors' experience and the fact that the content is based on a course given at the US Air Force Academy.

The enthusiasm of the author and his contributors for the subject is abundantly clear, and since all have been 'practitioners of the art' as well as educators gives the material a strong sense of relevance. The inclusion of many 'real world' examples throughout makes the book interesting to read and easy to assimilate – an important attribute in a book intended for undergraduate students. Although it has some short comings, it is evident that the Second edition should continue to appeal to students and teachers alike.

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Smart Structures Theory

I. Chopra and J. Sirohi

Cambridge University Press, The Edinburgh Building, Cambridge, CB2 8RU, UK. 2014. 905pp. Illustrated. £85. ISBN 978-0-521-86657-6.

Inderjit Chopra and Jayant Sirohi are quite prominent figures in the field of smart materials and structures. Dr. Chopra in particular has been at the forefront of US Army Research Office and MURI programs in the US on smart and adaptive structures, with special emphasis on rotorcraft applications. The book they have written draws out of their experience and provides one of the most comprehensive and extensive treatises on smart materials and structures published in the last two decades.

An example of the thoroughness and scale of effort undertaken by the two authors is Chapter 1, which is dedicated to the historical developments and a general review of the applications of smart and adaptive structures. With 112 pages and 406 references, this chapter provides the most comprehensive historical perspective and overview on current application of smart structures I have had the pleasure to read. Sixty pages alone are dedicated to a review of the R&D programmes conducted in the last

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two decades in the transport, construction and biomedical fields.

The rest of the book covers classical smart materials and structures technologies, like piezoelectric actuators, shape memory alloys (SMA), magnetorestrictive and electrorestrictive materials, together with electrorheological and magnetorheological fluids. What makes this book special is the strong focus on the theoretical foundations of sensing and actuation principles when using smart materials, with several worked examples for the practitioner. The narrative used by the authors is always very clear and the mathematical derivations are easy to follow for everybody with an undergraduate degree in physics or engineering. Quite importantly, the authors provide in a very clear and exhaustive manner design principles and formulas to evaluate the performance of smart structures and sensors. Chapters 4 and 5 in particular provide an extensive guide on how to design and model beams and plates with induced-strain actuation. Those two Chapters account for 250 pages, with clear derivations of the formulas and several worked examples.

Electro/magneto-restrictive materials and fluids are also described from a designer perspective, with derivations of performance formulas from simplified equations of state, nevertheless useful for the initial design of devices based on these smart solids. Shape memory alloys are also described in a concise and clear manner, with a presentation of different micromechanical models that characterise the 1-way and 2-ways shape memory behaviour in wires. A feature that I particularly liked is the extensive description about the training of the SMA wires and their application and embedding in composite laminates. This whole part is quite detailed, and provides very useful information to the researcher and practitioner who want to engage in this field. The final Chapter 8 is dedicated to provide detailed examples of solid-state actuation and energy harvesting in integrated systems. The examples shown in this chapter are again drawn from the previous work of the two authors and are very useful to identify the effects of actuator stiffness, topology of the piezo-stacks and hybrid hydraulic actuation concepts, for example. A significant part of the chapter is dedicated to actuation concepts for smart rotors, which can be however considered in other morphing wing application.

No book is perfect and some topics which are timely in the field of smart materials are somehow missing (like shape memory polymers, EAPs and nano-based smart materials). The strongest parts of this book are related mainly to piezoelectric-related actuation and sensing systems, something which is well expected considering the expertise of the authors. In terms of applications, the book is also perhaps too much US focused and somehow neglects important contributions done in Europe and Japan. However, almost all chapters offer a very exhaustive and clear description of the physics underpinning the behaviour of smart materials and structures and provide an excellent source of information and design principles to students and engineers that want to approach the smart structures field.

With 905 pages and over thousands of references, this is one of the most authoritative books on smart materials and structures produced so far. This is a book that I strongly recommend.

Fabrizio Scarpa, Laurea, PhD, FRAeS, Professor of Smart Materials and Structures, Queens School of Engineering, University of Bristol

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