

Book Review

VIBRATION CONTROL OF ACTIVE STRUCTURES — AN INTRODUCTION Second Edition

André Preumont, Kluwer Academic Publishers, Dordrecht, The Netherlands: 2002, 385 pp, £95 (hardback), £38 (paperback) (ISBN 1 402 00496 6)

There is a growing body of literature in which concepts traditionally associated with mechanical vibrations are integrated with the techniques developed by control engineers. In 1990, modern control theory, notably state-space methods, was linked to structural vibrations by Meirovitch [1]. In 1993, Junkins and Kim [2] provided a tutorial introduction to state-space methods applied to the active control of flexible aerospace structures. Both modern and classical approaches to the development of adaptive structures were provided by Clark and his colleagues [3]. Since 1992, various edited works and collections of research papers have served to emphasize the growing number of applications of both active and semi-active control schemes to structural vibration problems. For applications, the reader is referred to the books by Tzou and Anderson [4], Janocha [5] and Das and Wada [6].

The first edition of Professor Preumont's book appeared in 1997. It provided a predominantly tutorial introduction to classical and modern approaches to active control of structures and also served to inform the practising engineer, who had hitherto thought of mechanical vibrations and feedback control as distinct disciplines. The Second Edition of Preumont's book, the subject of the present review, builds upon the strengths of the First Edition; particularly welcome are the new sections on semi-active control and an extended study based upon the author's investigations into the tendon control of cable structures. In its present form, the book provides a most accessible and balanced treatment of active and semi-active vibration control. As such it provides an excellent introduction for practising engineers and will also be of great help to advanced postgraduate students.

The book begins by making clear the distinction between passive and active schemes for vibration control. Some essential mathematics is then introduced to explain techniques for modal decomposition and to relate these to the transfer function model. Perhaps as an antidote to the mathematics, the hardware of actuators and sensors is then described, making good use of particularly well-designed diagrams.

A detailed discussion of collocated versus non-collocated control leads to a chapter devoted to active damping with collocated sensors and actuators. More specifically, the author discusses direct velocity feedback, acceleration feedback, positive position feedback and integral force feedback. Some of these terms will not be familiar to the traditionally trained control engineer and the author provides lucid descriptions.

He then devotes a chapter to active vibration isolation. This chapter is written entirely in transfer function notation and is therefore accessible to those with only a knowledge of elementary classical control theory.

In the later stages of the book, the author focuses on modern control techniques. The chapter introducing state-space notation links vector-matrix techniques to transfer functions and poles and zeros, before treating pole-placement methods. Linear quadratic regulators and Kalman filters are touched upon briefly, but the interested reader can follow up the cited references. A minor criticism concerns the fact that the following chapter on classical frequency domain analysis comes in between the introduction to state space and the chapter on optimal control. This represents no major problem but may confuse the reader who is relatively new to the subject. Keeping essentially with the modern control focus, subsequent chapters deal with controllability/observability and stability.

Particularly welcome is the new chapter on semi-active control. The chapter is only short but describes magneto-rheological fluids and how these are applied in semi-active schemes. This might perhaps be worthy of expansion in the Third Edition.

As mentioned earlier, the section on applications has been substantially expanded. The First Edition covered applications to structures such as trusses, plates and beams. This new edition also describes in detail the author's work on active tendon control, which serves well to bring the theory to life. The book is warmly recommended as an introduction to the rapidly developing areas of fully active and semi-active vibration control. Not only does the author make the key concepts easily understandable but the balance between classical and modern techniques is just about ideal.

REFERENCES

- 1 Meirovitch, L. *Dynamics and Control of Structures*, 1990 (John Wiley, New York).
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- 3 Clark, R. L., Saunders, W. R. and Gibbs, G. P. *Adaptive Structures: Dynamics and Control*, 1998 (John Wiley, New York).
- 4 Tzou, H. S. and Anderson, G. L. (Eds) *Intelligent Structural Systems*, 1992 (Kluwer, Dordrecht, The Netherlands).
- 5 Janocha, H. (Ed.) *Adaptronics and Smart Structures*, 1999 (Springer-Verlag, Berlin, Germany).
- 6 Das, A. and Wada, B. (Eds) *Selected Papers on Smart Structures for Spacecraft*, 2001, Milestone Series, Vol. MS167 (SPIE, Bellingham, Washington).

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