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Book review

S.O. Reza Moheimanip, Dunant Halim, Andrew J. Fleming, Spatial Control of Vibration: Theory and Experiments, World Scientific Press (UK) Ltd., Singapore, ISBN 981-238-337-9, 2003, pp. xii + 223, price £50.

This book discusses the active control of vibration in simple structures such as beams and plates from the perspective of control theory, with particular attention to the effect of control on the spatial distribution of vibration.

After the introduction, Chapter 2 describes the modeling of distributed dynamic systems, including piezoelectric actuators and sensors. Chapter 3 describes the use of spatial norms and model reduction, while Chapter 4 discusses model correction for finite-dimensional modal models. Chapter 5 presents the extension of feedback control theory to incorporate the spatially distributed nature of the disturbances. Chapter 6 discusses optimal placement of actuators and sensors in terms of controllability and observability measures and Chapter 7 discusses system identification.

One of the nicest innovations introduced by the authors is a 3D frequency response plot for the structural response of a beam, which is the magnitude of the frequency response against both frequency and position along the beam. These 3D plots are used to illustrate the effect of model order reduction and control. Model order reduction by modal truncation is compared with the balanced realisations developed in the control community and model correction, which involves including the stiffness of the unmodelled modes and will be more familiar to structural dynamicists.

Another interesting innovation is the use of spatial norms to describe either the space-average mean-square behaviour of a structure, e.g. the total kinetic energy, in the spatial H_2 norm, or the maximum response at any point on a structure, in the spatial H_∞ norm. These definitions allow the standard feedback control formulations to be extended to the control of spatially-varying parameters, as required in active control.

The authors are to be commended for including experimental results to compare with the theoretical models that have been developed, and for the practical implementation of several of their control schemes. One quibble I have, however, is the use of a model with only flexural modes of vibration for the response from collocated piezoceramic actuators and sensors on a beam. Although this is reasonable at low frequencies the coupling due to the in-plane vibration becomes very important at high frequencies and can threaten the stability of controllers designed only taking into account flexural modes. Another problem I had was that a block of 30 pages were bound in the wrong position in the review copy of the book.

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While the material presented in this book is covered in a clear and logical manner, it is restricted to rather idealised structures with idealised actuators and sensors. There is also little discussion of practical application. For a wider or more practically orientated approach, the reader would be better reading *Adaptive Structures* by Clark, Saunders and Gibbs (1998) or *Vibration Control of Structures* by Preumont (2002). For readers with a control background requiring a self contained discussion of active vibration control, however, *Spatial Control of Vibration* would be a good book to read.

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