Séminaire LaMCoS – mardi 6 décembre 2011, 14h – Amphi Godet INSA Lyon

Signal Processing Techniques for Signal Separation and as an aid to Operational Modal Analysis

R.B. Randall, Emeritus Professor,
School of Mechanical and Manufacturing Engineering
University of New South Wales,
Sydney 2052, Australia

Abstract:

In a number of fields, including machine condition monitoring (MCM) and operational modal analysis (OMA), one only has access to response measurements, which are a compound of forcing function and transfer function components. In the former case, it is of interest to divide the signal between the two components, since a change in condition could be indicated by either. In the latter case, it is the structural properties, as represented by the transfer functions, which are of interest. A first division is often into discrete frequency and random components, and a number of techniques have been devised to achieve this, with different pros and cons. Removal of discrete frequency components from stationary random responses, for example, makes it much easier to apply a number of OMA techniques. The paper compares a number of separation algorithms, including a couple of new ones based on the cepstrum. These have particular advantages when the "periodic" components are not completely periodic, such as blade pass frequencies in fans, turbines etc, where the transmission of periodic pulses to the casing is via a turbulent fluid, giving cyclostationary signals. The cepstrum itself provides a viable technique for operational modal analysis, at least for SIMO systems, where the forcing function and transfer function effects are additive in the cepstrum, and often separable. MIMO systems can be decomposed into a sum of SIMOs by a number of techniques involving blind source separation, and a number of possibilities are briefly discussed.