Shock and Vibration

Hindawi

Special Issue on

Mathematical Models in Condition Monitoring of Mechanical Complex Systems

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Vibration-based condition monitoring (CM) usually consists of several sequential steps: (i) observation based initial understanding of the physical test requirements and setup, (i) measurement and processing of the important physical parameters, (iii) feature extraction and mathematical model building, (iv) analyzing diagnostic data, and (v) making final decision regarding further test and results oriented actions.

Nowadays, especially for complex industrial systems, each of these steps is supported by advanced mathematical models to assure appropriate effectiveness of CM techniques.

Advanced mathematical methods are also commonly used for vibration time series processing, modelling and analysis, and detection of damage often bases on statistical or stochastic modelling of vibration-based features. In case of multidimensional data set (multichannel vibrations or extra auxiliary physical data for context based diagnostics) methods known in algebra, probability theory, statistics, etc. are commonly used, for instance, for dimensionality reduction, matrix factorization, risk analysis, or prognosis. Mentioned techniques applied to vibration data are highly welcomed.

From mechanical perspective the model based approach involves, for instance, the knowledge of internal parameters of the mechanical system (gearbox, bearings, etc.) such as inertias, stiffness, damping, and presence of defects but also the external conditions like applied torque and speed. In most cases, the latter parameters are time-varying giving rise to nonstationary conditions. Simulation of the models leads to provision of time series responses with the possibility of several combinations of healthy and defected cases. System models enable more condensed diagnostic information with limited need for deep physical interpretation of each parameter.

The idea of this special issue is to strengthen the understanding of the inherent link between mathematical models and engineering applications within the condition monitoring framework. We would like to harvest the power of mathematical modelling techniques for more effective and practical real world applications of condition monitoring. At the same time, we are hoping to induce curiosity excitement for deeper understanding of the underlying mathematical principles. We are looking for inputs on diagnostic procedures with clear mathematical background; however, any of the mentioned-above stages of condition monitoring supported by novel mathematical models are welcome.

Potential topics include but are not limited to the following:

- Noise and vibration of machines
- Vibroacoustic diagnosis of machinery in nonstationary operations
- Signal processing and pattern recognition for CM
- Modelling of dynamics and faults in machinery
- Application of non-Gaussian distribution to diagnostic data modelling
- Heavy-tailed distributions-based diagnostic data modelling
- Statistical investigation for non-Gaussian/heavy-tailed processes/models: application to CM

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