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Editorial

The Use of Vibration Signals for Structural Health Monitoring, System Identification, Test Planning/Optimization, and Dynamic Model Validation/Updating

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Vibration signals are naturally available and can be readily measured from many types of engineering systems through a variety of low-cost data acquisition systems and sensors under normal operating or imposed excitation conditions. Based on the appropriate processing of the collected signals, rich information for the structural dynamics may be extracted and used for linear and nonlinear modeling, structural health monitoring, active vibration control, modal analysis, and further system insight that may lead to the design of improved performance, sustainability, safety, and comfort. The aim of this special issue is to collect studies in the state of the art for the abovementioned scientific areas with applications in engineering and preference given to actual systems and numerical and experimental procedures.

X. Wei et al. investigated the use of improved ensemble empirical mode decomposition based on singular value decomposition for filtering chaotic vibration signals in order to reduce noise. The superiority of the proposed method was demonstrated with simulated signal, two-degree-of-freedom chaotic vibration signals, and the experimental signals based on double potential well theory. F. Liu et al. proposed and tested a novel feature called phase space similarity for health monitoring of bearings. Based on vibration signals and this feature, a fault pattern recognition algorithm was performed to predict the remaining useful life estimation. E. J. Diehl and J. Tang presented an approach to the modeling and analysis of a benchmark two-stage gearbox test bed to characterize gear fault signature when processed with harmonic wavelet transform analysis. The results of the tests have the potential to render the fault detection and diagnosis for gearbox systems easier.

W. Wang et al. used acoustic emission to investigate the process of damage evolution in T700/6808 composite under tensile loading. The main damage contained was the matrix cracking and interface damage as well as the fiber breakage.

A. Concha and L. Alvarez-Icaza estimated the shear model of seismically excited, torsionally coupled building using acceleration data measured considering noisy and corrupt measurements of the ground and floors. A filtering strategy was used to eliminate the disturbance and to attenuate noise. C. G. Rodriguez et al. developed a nonlinear model with two-dimensional three degrees of freedom to evaluate motion under off-design operation conditions. With this model, a limit for springs failure was determined to evaluate whether it is necessary to replace springs or not. C. Xie et al. presented nonlinear aeroelastic models including geometrical nonlinearities, steady and unsteady nonplanar aerodynamics computations, and a structural model using finite element method. Those two aerodynamic models share the same aero mesh and allow the aerogrids to follow up with structural deflections via surface spline interpolation between structural and aerogrids. A wind tunnel test was conducted to validate and update this theoretical analysis framework, and reasonable agreement was obtained.

With these papers, the readers can enjoy different approaches in the use of vibration signals processing, damage detection, and identification for structural dynamics and engineering.

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