

“Recent Advances in Random Vibrations of Nonlinear Systems for Reliability, Durability and Accelerated Testing”

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The response of nonlinear vibratory systems subject to stochastic excitation is very important in time-dependent reliability, random vibrations, durability, fatigue and accelerated life testing, among others. The input uncertainty must be quantified and propagated through the system to quantify the output uncertainty. Although the characterization of a stationary and Gaussian random process is straightforward, the characterization of a non-stationary and non-Gaussian input random process is very challenging. The propagation of the input uncertainty through the system is even more challenging since stochastic differential equations must be solved. Methodologies will be presented for random vibrations of nonlinear vibratory systems excited by non-Gaussian loads. The approach is based on Polynomial Chaos Expansion (PCE), Karhunen-Loeve (KL) expansion and Quasi Monte Carlo (QMC). The latter is used to estimate multi-dimensional integrals efficiently. The input and output random processes are characterized using a stochastic metamodel based on their first four moments (mean, standard deviation, skewness and kurtosis coefficients) and a correlation structure in order to generate sample realizations (trajectories). Examples will be presented to demonstrate the effectiveness of the developed methodology in reliability, durability and accelerated life testing.

Speaker Biography



Dr. Zissimos P. Mourelatos is currently a Professor of Mechanical Engineering at Oakland University where he holds the title of John F. Dodge Chair of Engineering and has served as the Chair of the Mechanical Engineering Department (2010-2014). Before joining Oakland University, he spent 18 years at the General Motors Research and Development Center. He received his PhD from the University of Michigan in 1985. Dr. Mourelatos conducts research in the areas of uncertainty quantification, design under uncertainty, structural reliability methods, reliability and warranty forecasting of repairable systems, Reliability-Based Design Optimization (RBDO), deterministic and random vibrations, and NVH (Noise, Vibration and Harshness). Dr. Mourelatos has published over 210 journal and conference publications and a book entitled, “Decision Making under Uncertainty using Limited Information.” He is the Editor-in-Chief of the International Journal of Reliability and Safety, an Associate Editor of the SAE International Journal of Materials and Manufacturing, and SAE International Journal of Commercial Vehicles. He has also served as an Associate Editor and Guest Co-Editor of the ASME Journal of Mechanical Design. Dr. Mourelatos is a Fellow of ASME and SAE.