STOCHASTIC MODEL GENERATION AND SELECTION FOR DEVICE EMULATING STRUCTURAL MATERIAL NONLINEARITY

ABSTRACT

Structural identification is a useful tool for detecting damage and damage evolution in a structure. The initiation of damage in a structure and its subsequent growth are mainly associated with nonlinear behaviors. While linear dynamics of a structure are easy to simulate, nonlinear structural dynamics have more complex dynamics and amplitude dependence that do require more sophisticated simulation tools and identification methods compared to linear systems. Additionally, there are generally many more parameters in nonlinear models and the responses may not be sensitive to all of them for all inputs. To develop model selection methods, an experiment is conducted that uses an existing device with repeatable behavior and having an expected model from the literature. In this case, an MR damper is selected as the experimental device. The objective of this research is to develop and demonstrate a method to select the most appropriate model from a set of identified stochastic models of a nonlinear device. The method is developed using numerical example of a common nonlinear system, and is then implemented on an experimental structural system with unknown nonlinear properties. Bayesian methods are used because they provide a distinct advantage over many other existing methods due to their ability to generate a description of the parameters of the system given a set of observations. First, the selected model of the MR damper is simulated and used for demonstrating the results on a numerical example. Second, the model selection process is demonstrated on an experimental structure based on experimental data. This study explores the use of Bayesian approach for nonlinear structural identification and identifies a number of lessons for others aiming to employ Bayesian inference.