8th World Conference on Structural Control and Monitoring (8WCSCM)
Orlando, FL, USA 5-8 June 2022

Structural Parameter Identification Under Unknown Seismic Displacement Inputs Via Markov Chain Monte Carlo Method

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Conventional parameter identification methods require the measurements of inputs. However, cases in which inputs are difficult or impossible to obtain are frequently encountered in practice. In this study, the Markov chain Monte Carlo (MCMC) method is applied to structural parameter identification under unknown seismic displacement inputs. In the method, the unknown structural parameters are identified by sampling from a Bayesian posterior distribution, and the probabilities of the distribution are calculated based on the state-space model using the Kalman filter (KF). Specifically, in the state-space model, a linear 3-step Generalized-α algorithm is employed for state variable predictions, and the input prediction is implemented by extrapolating the estimated inputs of past time instants. In the KF, the process noises are also regarded as unknown parameters and identified along with other structural parameters, which prevents tuning the process noise manually in the usual manner and makes the method applicable in practice. In this study, the method is first investigated numerically using a bridge pier model and is validated by a full-scale bridge pier experiment subsequently. The identified stiffness values of the bridge pier are compared with those considering known inputs, and the parameter variations under a series of earthquake excitations are reproduced.