Crack detection of beam-type structures following the Bayesian system identification framework

Heung Fai LAM

Building and Construction, City University of Hong Kong

paullam@cityu.edu.hk

Abstract

This paper puts forward a method for the detection of crack locations and extents on a structural member utilizing measured dynamic responses following the Bayesian probabilistic framework. In the proposed crack detection method a beam with different number of cracks is modeled using different classes of models. The Bayesian model class selection method is then applied to select the most plausible class of models in order to identify the number of cracks on the structural member. The objective of the proposed method is not to pinpoint the crack locations and extents but to calculate the posterior (updated) probability density function (PDF) of crack parameters (i.e., crack locations and extents). The method allows for the uncertainties introduced by measurement noise and modeling error to be handled explicitly. This paper presents not only the theoretical formulation of the proposed method but also numerical and experimental verifications. In the numerical case studies, noisy data generated by a Bernoulli-Euler beam with semi-rigid connections is used to demonstrate the procedures of the proposed method. The method is finally verified by measured dynamic responses of a cantilever beam utilizing a laser Doppler vibrometer.