IABSE Symposium 2019 Guimarães
Towards a Resilient Built Environment - Risk and Asset Management
March 27-29, 2019, Guimarães, Portugal

Probabilistic Finite Element Model Updating of Civil Engineering Structures: A Comparative Study

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Abstract

Finite element (FE) model updating of civil engineering structures is usually performed under the modal domain. According to this approach, the value of the main physical parameters of the structure is modified in order to reduce the relative differences between the experimental and numerical modal parameters of the structure. To date, two methods are widely used to perform the FE model updating: (i) the maximum likelihood method and (ii) the Bayesian method. The second method is usually implemented via sampling methods. Thus, the FE model updating consists in determining an efficient sampling of each considered physical parameter of the model. Herein, two sampling techniques, the Metropolis-Hastings (M-H) algorithm and the Slice Sampling (SS) algorithm, are compared when they are implemented for the FE model updating of a laboratory steel footbridge.

Keywords: finite element model updating; computational statistics; Bayesian method, Metropolis-Hastings; Slice Sampling; civil engineering structures

1. Introduction

Finite element (FE) models are widely used to determine numerically the modal parameters of civil engineering structures. However, these numerical models often give results that differ from modal parameters obtained experimentally and therefore they need to be updated to better reflect the actual behaviour of these structures [1]. Among the different possible domain, FE model updating of civil engineering structure is usually performed under modal domain [2]. To date, FE model updating of civil engineering structures have been mainly performed via the maximum likelihood method [2]. However, this method presents three main shortcomings: (i) it does not allow charactering probabilistically the parameters of the finite element model, (ii) the regularization terms considered to control the complexity of the updated model are not always adequately defined, and (iii) the solution of the FE model updating problem may not be unique under this method. In order to overcome these

https://doi.org/10.2749/guimaraes.2019.1269
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