INSTITUTE OF FUNDAMENTAL TECHNOLOGICAL RESEARCH
AND COMMITTEE ON MECHANICS
POLISH ACADEMY OF SCIENCES

7th European Conference on Structural Control

Book of Abstracts and Selected Papers

Editors:

Jan Holnicki-Szulc, David Wagg and Łukasz Jankowski

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WARSAW 2022

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COMPARISON OF MODE MATCHING AND BAYESIAN APPROACH FOR PARAMETRIC IDENTIFICATION OF FRAMES WITH BOLTED CONNECTIONS

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Nowadays engineering studies require the use of the sophisticated finite element (FE) models consisting of hundreds if not thousands of degrees of freedom. However, using only such models does not allow for accurate reproduction of physical properties of real structures. To overcome this problem usually model updating (MU) techniques are employed.

MU usually has one of two goals:

1) modification of some parameters of the model in order to minimize error between output of the FE model and experimental data obtained from the real system, and
2) identification of some properties of the real system using both experimental data and updated FE model.

The former case relates to finding the model for performing simulations of the behaviour of the real system. In the later case MU can be applied in damage assessment process. Due to modelling uncertainties minimization of the error between measured and model output does not always provides the most accurate parametric identification.

In this research unknown parameters describing rotational stiffness of bolted connections in a frame structure are estimated. Effectiveness of the two competitive model updating methods are compared. The first is based on modal sensitivities and minimizes error between numerical and experimental modal data. It requires matching of the numerical modes with the experimental ones, hence it is often called mode matching. The second is based on probabilistic Bayesian framework. In this approach maximum a posteriori (MAP) estimate of the unknown parameters is searched. It provides an augmented optimization allowing for model updating without mode matching. Moreover, this method is intended for parametric identification and explicitly includes the modelling errors into the problem formulation. In this study vibration modes are obtained from laboratory-scale frame with uncertain bolted connections. It is shown that assembly imperfections have significant influence on the mode shapes of the frame. The results also show that the two methods for model updating provide significantly different values of the identified stiffness parameters for the investigated bolted connections.