IMPLEMENTATION OF BAYESIAN MODEL UPDATING IN FIVE-STORY BUILDING

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ABSTRACT

Numerical modeling of structures often involves simplifications and theoretical assumptions, which may lead to decreased accuracy in simulation results. Model updating techniques have been developed to address this issue by minimizing the discrepancy between experimental data and the modeled structure output. Traditional deterministic approaches aim to obtain a single best estimate for each parameter but fail to capture the full range of variations due to the complexity of mechanical behavior and uncertainties in structural models.

This work presents the application of Bayesian Inference (BI) in the parametric updating of a five-story building model and the assessment of its associated uncertainty. A major advantage of this approach is the consideration of uncertainty in the experimental data, leading to a more accurate representation of the building's actual behavior. The Bayesian framework is employed to update model parameters using experimental data, specifically modal frequencies and mode shapes obtained from a full-scale reinforced concrete building tested on the NEES-UCSD shake table at University of California, San Diego, USA. In the implementation, it was incorporated an iterative updating approach for the covariance matrix, which provides a more comprehensive understanding of the correlations among modal parameters compared to the traditional use of an identity matrix. Additionally, there is a discussion about the implications of Bayesian modeling, highlighting the importance and consequences of employing a multivariate normal likelihood function in the analysis.

The results demonstrate that the Bayesian model updating approach enables a statistically rigorous fitting of model parameters, facilitating the characterization of uncertainty and enhancing confidence in the model's predictions. This methodology proves particularly valuable in engineering applications where precise model accuracy is paramount. Overall, this study showcases the significance of incorporating Bayesian Inference in the parametric updating of structural models, highlighting its ability to account for uncertainties and improve the accuracy of predictions. The findings contribute to the broader field of structural analysis and offer practical insights for engineers and researchers seeking to enhance the reliability and robustness of numerical models.