ΑΝΑΚΟΙΝΩΣΗ - ΠΡΟΣΚΛΗΣΗ
ΔΗΜΟΣΙΑ ΥΠΟΣΤΗΡΙΞΗ ΔΙΔΑΚΤΟΡΙΚΗΣ ΔΙΑΤΡΙΒΗΣ
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Προσκαλούμε τους μεταπτυχιακούς και προπτυχιακούς φοιτητές μας, τα μέλη Δ.Ε.Π., τους διδάσκοντες του Τμήματος και κάθε ενδιαφερόμενο, στη δημόσια υποστήριξη της Διδακτορικής Διατριβής του κ. Xinyu Jia με τίτλο:

BAYESIAN TOOLS FOR UNCERTAINTY QUANTIFICATION AND PROPAGATION IN STRUCTURAL DYNAMICS SIMULATIONS

The objective of this thesis is to develop a comprehensive Bayesian framework for uncertainty quantification and propagation (UQP) in engineering simulations based on physics-based models of dynamic structures and measurements collected during system operation. It introduces a hierarchical Bayesian modeling (HBM) framework to account for the uncertainty due to the variabilities that arise from model error, experimental data, manufacturing process, assembling process as well as nonlinear mechanisms activated under different loading conditions. First, it extends the HBM framework developing it further for model inference based on modal properties. Then, it generalizes the framework to nonlinear dynamical systems for calibration and quantification of uncertainties of parameters of nonlinear models. Finally, it advances the framework to account for multi-level physics-based modeling of systems and multi-level models of uncertainties using multi-level test data.

Asymptotic approximations are introduced, developed and incorporated into the HBM framework in order to gain more insights on the interpretation of diverse sources of uncertainties. Introducing such approximations can substantially reduce the computational burden of the HBM framework compared to the high computational effort required in a full sampling procedure. Simulated and experimental studies are conducted to verify the effectiveness of the proposed methodologies. It is shown that the proposed HBM framework provides a better account for the parameter uncertainties, distinguishing between irreducible and reducible uncertainties, while the conventional Bayesian modeling (CBM) framework often underestimates the uncertainties for the parameters and aggregates such uncertainties into model error.

Moreover, this thesis revisits the underestimation of uncertainties issues within a classical Bayesian point of view developing further data features-based models and presenting novel formulations for the constructions of the likelihood function. It is illustrated that the proposed methods offer consistent parameter uncertainties which is independent of the sampling rate used for the accurate representation of the same time history responses.

Furthermore, for the issues where the PDFs or statistics of the measurements are available, this thesis also presents a methodology under a hierarchical modeling setting for the model parameters to account for the uncertainty due to variability. As an alternative to HBM method, the presented approach is successfully applied to structural dynamical example and fatigue S-N curve analysis for the parameter estimation and predictions given the available statistics of the measured quantities. The proposed methodologies in this thesis have the great potential to be applied to other disciplines of engineering and science.

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