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Master's Thesis

Implementation and investigation of different correlation models in frequency transformed data based Bayesian updating

Motivation

In structural dynamics, one is interested in determining the dynamic response of a structure as a basis for design decisions to ensure safety and serviceability. An example would be a CLT plate as depicted on the right. When comparing computed model results to measurements conducted on existing structures, usually noticeable discrepancies are observed. Based on information contained in measurements, one can apply model updating techniques to infer on model parameters. One of these methods is Bayesian updating, where the problem is formulated in a probabilistic setting. Through Bayesian updating the probabilistic description of the system parameters conditional on the observed measurements can be found [1].

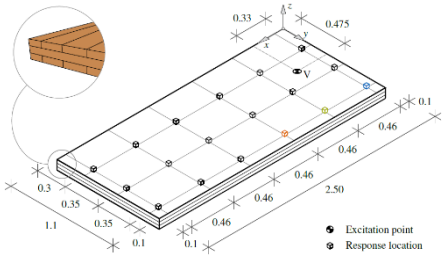

Figure 1: CLT plate with measurement setup.

When using frequency transformed data to describe the model misfit, as done in [2], a large number of observations are available that are possibly highly correlated in the spatial and frequency domain. In order to perform robust and accurate inference, this correlation has to be carefully understood and applied [3]. Since the model error is a complex quantity, another challenge is the rigorous description of the correlation for complex random variables.

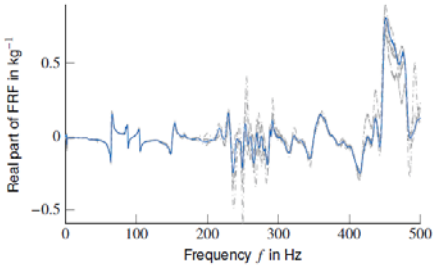

Figure 2: Measured FRF for the depicted CLT plate.

Tasks

- Get familiar with the Bayesian updating based on frequency response data
- Research existing publications on correlation functions for real and complex valued random variables
- Implement the correlation functions found in the previous literature review
- Perform an extensive parameter study and compare the results for different correlation model assumptions.

Supervisors

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References

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[3] Simoen E., Papadimitriou C., and Lombaert G., 2013,"On prediction error correlation in Bayesian model updating," Journal of Sound and Vibration, **332**(18), pp. 4136–4152.