Chair of Computational Modeling and Simulation
TUM Department of Civil, Geo and Environmental Engineering
Technical University of Munich

Modeling:
Mathematics:
Programming:
Science:

Software Lab:

Parametric Model Order Reduction with Machine Learning

Description

For many-query analyses like uncertainty quantification or optimization, repeated finite element simulations have to be performed, which are usually computationally very expensive. A reduction of the complexity of the finite element model can be achieved by performing model order reduction. To obtain good reduced models for different realizations of the model parameters, so-called parametric model order reduction (pMOR) can be used [1]. The objective of this project is to investigate, whether existing pMOR methods can be improved by combining them with machine learning (ML) algorithms such as neural networks, see, e.g., [2].

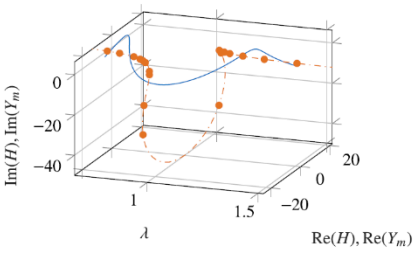

Figure 1: Approximation of FRF using polynomial chaos expansion

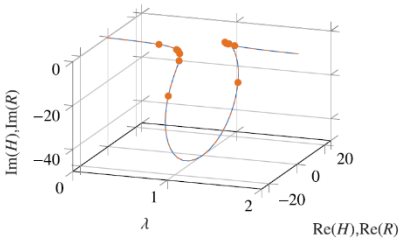

Figure 2:Approximation of FRF using rational approximation

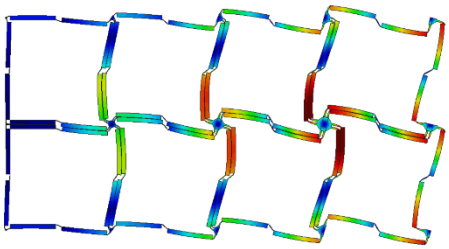

Figure 3: Optimized Acoustic Metamaterial

Task

Combine different pMOR methods with different ML algorithms:

- Literature review on pMOR and ML algorithms
- Implementation of combinations of different pMOR approaches with different ML methods
- Application and comparison of the methods to problems in structural dynamics
- Investigation of the efficiency of the methods in the context of uncertainty quantification and/or optimization

Supervisors

Felix Schneider and Sebastian Schopper, Chair of Structural Mechanics, TUM
felix.w.schneider@tum.de, sebastian.schopper@tum.de

References

[1] Benner, Peter; Gugercin, Serkan; Willcox, Karen (2015): A Survey of Projection-Based Model Reduction Methods for Parametric Dynamical Systems. In: SIAM Rev. 57 (4), S. 483–531.

[2] Bishop, Christopher M. (2006): Pattern Recognition and Machine Learning. Springer.