Chair of Structural Mechanics
TUM Department of Civil, Geo and Environmental Engineering
Technical University of Munich

Master's Thesis

Efficient simulation of acoustic problems

Motivation

The correct assessment of sound propagation is vital for many engineering applications. For example, the loss factor of a wall between two rooms is very important in building acoustics. To be able to computationally model the frequency response of structures for high frequent excitations, a very fine spatial discretization is necessary. This results in large and computationally expensive models. Therefore, model order reduction (MOR) methods have been developed and used over the past years. These methods are suitable for different kinds of dynamic systems, for example acoustic systems.

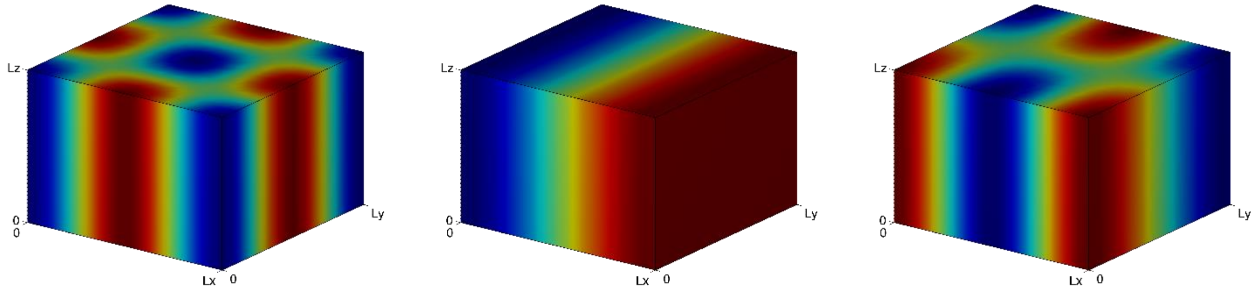

Fig. 1: Modal pressure distribution in acoustic cavities (from: Buchschmid M. ITM-Based FSI-Models for Rooms with Absorptive Boundaries [Dissertation]. München: Technische Universität München; 2011).

Tasks

In the scope of this master's thesis, the transmission loss of different wall constructions between two acoustic cavities is to be evaluated using different simulation methods. Starting from a simple 2d model, the complexity of the model should be increased up to full 3d models and complex wall setups between the cavities. MOR methods should be used for each model and their performance is to be assessed. The results are validated with examples available in literature.

Project stages:
- Introduction into bm-mfem, the chair's in-house FE framework and ANSYS
- Literature study to find appropriate validation examples for differently complex models
- Induction into a MOR method to reduce vibro-acoustic systems
- Verification of the models and assessment of MOR performance via comparative calculations

References
[1] Antoulas AC. Approximation of large-scale dynamical systems. Advances in design and control, Vol 6. Philadelphia: SIAM; 2005. 479 p.
[2] Cremer L, Heckl M. Structure-Borne Sound: Structural Vibrations and Sound Radiation at Audio Frequencies. Berlin, Heidelberg: Springer; 1973. 528 p.
[3] van de Walle A. The Power of Model Order Reduction in Vibroacoustics and its Applications in Model-based Sensing [PhD Thesis]. Leuven; 2018.

Supervisor
Quirin Aumann (Room N1155), quirin.aumann@tum.de