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

**Bachelor's Thesis**

# Experimental Study of a Locally Resonant Acoustic Metamaterial

## Motivation

Locally resonant acoustic metamaterials (LRAM) are a novel concept to mitigate structural vibrations: Being composed of periodic arrangements of carefully designed sub-structural units (see Fig. 1), LRAM exhibit unusual dynamic properties that can exceed the constraints of ordinary material properties [1]. Additive manufacturing procedures can induce variabilities in the material design and potentially affect the intended dynamic behavior. While numerous publications demonstrate the remarkable properties of LRAM within numerical works, their practical application remains a key issue. Therefore, experimental studies on manufactured materials are inevitable to validate numerical models and assess the actual metamaterial characteristics [2,3].

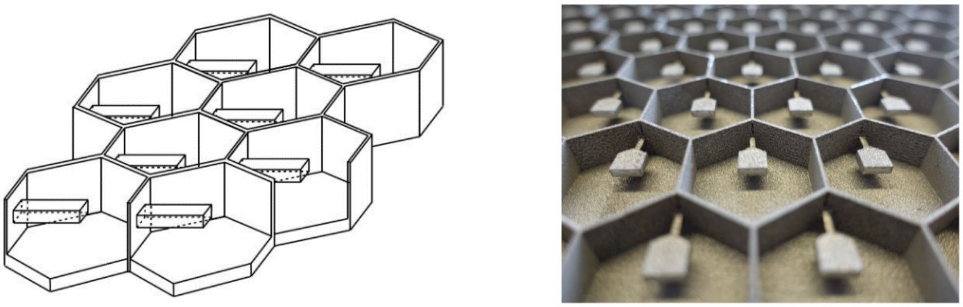

Fig. 1: Example of a locally resonant metamaterial design (left) and a corresponding material specimen (right) obtained from additive manufacturing.

## Tasks

In the scope of this Bachelor's thesis, an experimental setup for measurements of an acoustic metamaterials specimen shall be developed. After devising the setup, measurements on the dynamic properties of the metamaterial are conducted in the Chair's laboratory facility. The obtained measurement data shall be analyzed and visualized in Matlab/Python to assess the dynamic properties of the metamaterial specimen.

## Project stages:

- Literature study on locally resonant metamaterials and experimental setups
- Conception of a measurement campaign and performing measurements with a metamaterial specimen
- Measurement data acquisition and analysis in Matlab/ Python
- Extras: FE-modeling of the metamaterial specimen & numerical considerations

## References

[1] Haberman, Michael R.; Guild, Matthew D. (2016): Acoustic metamaterials. In *Physics Today* 69 (6), pp. 42–48. DOI: 10.1063/PT.3.3198.

[2] Song, Yubao *et al.* (2020): Vibration and sound properties of metamaterial sandwich panels with periodically attached resonators: Simulation and experiment study. In *Journal of Sound and Vibration* 489, p. 115644. DOI: 10.1016/j.jsv.2020.115644.

[3] Möser, Michael (2010): Messtechnik der Akustik. Berlin, Heidelberg: Springer Berlin Heidelberg.

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