



3-7 JULY 2023

HERAKLION, CRETE | GREECE

ACEX2023

16th International Conference on Advanced
Computational Engineering and Experimenting

ABSTRACT:

The sound of cellular materials: Experimental techniques for acoustic material characterization

Nowadays, aspects such as lightweight construction, energy savings and application-specific properties are the focus when selecting components. Metamaterials and cellular materials offer a large design space to optimize materials systems according to these requirements beyond what is possible solely based on bulk properties. While there are numerous approaches to the design and fabrication of functional materials, we focus our research on the development of physically-motivated methods for multi-scale characterization. Based on classical nondestructive testing techniques, we investigate novel methods for the acoustic characterization and quality assurance of complex materials, combining experimental mechanics with computational tools.

In this talk, I will give an overview of acoustic methods developed for metamaterials with a focus on additively manufactured metal lattice structures and open-porous metal hybrid foams from our collaborators. We studied a combination of classical resonance analysis and decay time observation to evaluate vibration behavior stimulated by a low energy impact. The base material, geometry as well as defects impact the acoustic spectrum as well as the decay time. For metamaterials the acoustic spectrum provides many opportunities for qualitative and quantitative analysis and the combination with simulations enables the interpretation of the occurring modes. In the case of the stochastic hybrid foams, the decay time is more promising and can be correlated to the coating thickness. Simulations allow of the sound field enable the optimization of the experimental setup.

Acoustic characterization of metal metamaterials is promising for the characterization of cellular materials to gain more insights into the material changes and damage stages. Due to its simplicity and low cost, it provides a basis for scaling up the technology of metal cellular materials for industrial applications.