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Exploring Labyrinthine Sound-Absorbing Composites in Additive Manufacturing: Prototyping, Testing, and Challenges

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Acoustic composites have long been prominent in sound absorption applications. A contemporary trend in acoustics entails exploring complex geometries as matrices and conventional acoustic materials as fillers. Recently, there has been a focus on harnessing the high tortuosity aspects of materials to enhance sound absorption properties [1]. The advent of 3D printing has significantly facilitated rapid prototyping of these materials and validation of their models.

This study focuses on critical aspects of prototyping and experimental testing of acoustic composites fabricated through additive manufacturing. Throughout the material fabrication process, various challenges such as leakages or fabrication errors may arise. These obstacles become evident during experimental validation, where errors can influence the acoustic properties of the material in diverse ways, sometimes yielding unexpected benefits. Throughout the research, commonly used methods for dealing with challenges encountered during experimentation were also verified.

During the process of material investigation, analytical and numerical modelling were conducted, alongside manufacturing and experimental validation of the designed sound-absorbing composite. Experimental trials were carried out employing an impedance tube using standard and unconventional techniques.

In conclusion, this study focuses on prototyping and experimentally testing acoustic composites fabricated through 3D printing. The material fabrication process presents various challenges, which can impact the acoustic properties of the material. The research includes analytical and numerical modelling, as well as experimental validation of the designed sound-absorbing composite using an impedance tube.

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