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Editorial

Special Issue on Advances in Metamaterials for Sound and Vibration Control

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Sound and vibration control represent critical issues in our society and research community. Metamaterials are a broad family of artificially structured materials with unusual effective properties and functionalities. The design of new metamaterials for sound and vibration control opens up a wide range of technical possibilities. Through the designed metamaterials, flexible manipulations of acoustic and elastic waves have been achieved, such as cloaking, beaming, diffusing, illusion, and holograms.

This Special Issue aims to shed light on new advances in the metamaterials field, including research on phononic crystals, acoustic metasurfaces, topological metamaterials, origami metamaterials, programmable metamaterials, random metamaterials, active metamaterials, and four-dimensional metamaterials, in the context of sound and vibration control.

A total of seven papers (six research papers and one review paper) representing various aspects of metamaterials field, including acoustic metasurfaces, acoustic micromembranes, phononic crystals, acoustic black hole, and topological metamaterials, are presented in this Special Issue. Liu et al. [1] proposed an I-shaped radial elastic metamaterial with ultra-low-frequency broadband characteristics and studied the propagation characteristics of the elastic waves in their quasi-static state. This material has potential to be applied to various aspects of the mechanical engineering fields, such as ultra-low-frequency vibration reduction. Ou and Zhao [2] analytically and numerically investigated the effects of leakages on the transmission properties of a Duct Helmholtz Resonator device based on acoustic metasurfaces. Mo et al. [3] presented theoretical and numerical studies of acoustic micromembranes that couple the vibrations of the supporting frame, providing a theoretical foundation for the design and large-scale, high-insulation assembly of acoustic micromembranes for blocking low-frequency noise. Zhang et al. [4] investigated the Weyl points of shear horizontal guided waves using one-dimensional phononic crystal plates, demonstrating the great potential of applicable one-dimensional plate structural systems for the detection of higher-dimensional topological phenomena. Lyu et al. [5] reported a new type of metamaterial plate with embedded acoustic black hole structures, which can enable in-plane, ultra-wide vibration isolation in the development of engineering equipment. Wang et al. [6] proposed an elliptical anti-tetrachiral honeycomb structure (E-antitet) with an in-plane negative Poisson's ratio and orthogonal anisotropy, which provides meaningful guidance for the design of chiral honeycomb structures. Zheng et al. [7] reviewed the main achievements of analogue Hall insulators, analogue spin Hall insulators, analogue valley Hall insulators, higher-order topological insulators, topological pumps, and topological lattice defects in mechanical systems and discussed the future development of topological mechanics.

Although the submission period for this Special Issue has now closed, more in-depth research in the field of metamaterials designed for sound and vibration control is underway, which aims to address the challenges that we are facing today, such as high-speed analog computing, ultrasensitive detection and sensing, efficient wave guiding, and low-frequency sound absorption and vibration control.

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