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Low frequency acoustic properties of bilayer membrane acoustic metamaterial with magnetic oscillator

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Abstract:

A bilayer membrane acoustic metamaterial was proposed to overcome the influence of the mass law on traditional acoustic materials and obtain a lightweight thin-layer structure that can effectively isolate low frequency noise. The finite element analysis (FEA) results agree well with the experimental results. It is proved that the sound transmission losses (STLs) of the proposed structures are higher than those of same surface density acoustic materials. The introduction of the magnetic mass block is different from the traditional design method, in which only a passive mass block is fixed on the membrane. The magnetic force will cause tension in the membrane, increase membrane prestress, and improve overall structural stiffness. The effects of the geometry size on the STLs are discussed in detail. The kind of method presented in this paper can provide a new means for engineering noise control.

Keywords: Bilayer membrane acoustic metamaterial, Low frequency sound insulation, Sound transmission loss, Magnet oscillator

Phononic crystals and acoustic metamaterials are types of artificial composite material that can effectively control the propagation characteristics of vibration waves [1-4]. Similar to a phononic crystal, an acoustic metamaterial also has local resonance features. Although acoustic metamaterials are designed with a periodic structure, their