Title: A design method for absorption of low-frequency noise using acoustic metamaterials

Abstract: This paper investigates the design method for absorbing and isolating low-frequency noise by utilizing the acoustic metamaterials, which consist of mass and membrane vibrators embedded into acoustic materials. Firstly, the unit cell model of the metamaterials is established to analyze characteristics of band-gaps, which is verified further by frequency domain response analysis. And then, the influence of geometric and material parameters of unit cells on the band-gap properties is investigated. Finally, the wave propagation in the metamaterials with finite periodic structures is simulated for the studies of the low-frequency noise isolation, and the effect of different group patterns of unit cells on the isolation of low-frequency noise is discussed. The results show that the greater the density difference between the mass and the base material is, the greater the number of band-gaps and each bandwidth become. And also, as the thickness of membrane increases, the number of band-gaps increases but the band-gaps are narrow and scattered. The finite periodic structures composed of uniform unit cells can hardly widen the low-frequency bandwidth by adjusting the parameters of the components. However, the non-uniform finite periodic structures composed of different unit cells can widen the band-gaps of the whole structure by adjusting parameters of different components.