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Unit cell angle rotation creates multifunctional acoustic metamaterial FREE

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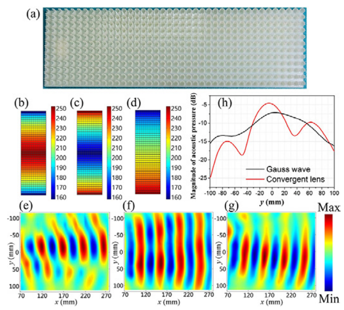
Researchers design tunable acoustic metamaterial based on rotating C-shaped unit cells to create three types of acoustic lenses—converging, diverging and deflection.



In acoustics, metamaterials are gaining traction for their ability to control and manipulate sound in applications ranging from acoustic cloaking and sound absorption to superlens imaging.

Most acoustic metamaterials, however, have a fixed frequency band range, which limits their functionality. Tunable acoustic metamaterials dependent on such parameters as temperature, electromagnets and mechanical deformations have been developed in attempts to address this shortcoming, but with few achieving multifunctionality using a single acoustic material.

Bai et al. have now designed a tunable acoustic metamaterial based on a new concept—rotating the angles of C-shaped anisotropic unit cells in the material.

The researchers designed the metamaterial using a photosensitive polymer resin to accommodate three types of acoustic lenses: converging, diverging and deflection.

Using 3D printing technology, they fabricated the unit cells on a 200 mm long, 60 mm wide lens that was 8 mm high. The unit cells were connected to pedestal structures embedded in the substrate's circular grooves, enabling each cell to rotate independently at 360 degrees.

“By rotating the C-shaped unit cell, continuous change of the refractive index can be obtained to create different functions in the same material,” said author Wei Xiang Jiang. “These functions can be switched in real time without changing the physical structure of the unit cell.”

Among other applications, such a multifunctional acoustic material could be used for more sophisticated impedance matching in medical imaging. Researchers next plan to design a computer-controlled motor array in which each unit cell is fixed to a motor so that the functions of the lens can be digitally predesigned.

Source: “Acoustic tunable metamaterials based on anisotropic unit cells,” by Lin Bai, Gang Yong Song, Wei Xiang Jiang, Qiang Cheng, and Tie Jun Cui, *Applied Physics Letters* (2019). The article can be accessed at https://doi.org/10.1063/1.5125735.