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A Design of Active Elastic Metamaterial with Extreme Anisotropic Stiffness

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Abstract : Traditional elastic metamaterials have difficulties in achieving independent tunable working frequency in two orthogonal directions. In this work, we proposed a pragmatic active elastic metamaterial to obtain extreme anisotropic stiffness with a tunable working frequency range. Piezoelectric patches shunted with variable conductance are properly proposed in the microstructure unit cell to manipulate the effective elastic stiffness along two principal directions at the subwavelength scale. Simulation of manipulation of wave propagation in such metamaterials is performed. An experimental study is also conducted to validate the design, and the results are in good agreement with mathematic analysis and numerical predictions. The proposed active elastic metamaterial will bring forth significant guidelines for ultrasonic imaging technique, and the results are expected to offer novel and general design methodology for elastic metamaterials.

Keywords : microstructure, active elastic metamaterials, piezoelectric patches, experimental study
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