Chiral Lattice Hinge Metamaterial for multi-broadband vibroacoustics

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ABSTRACT

We present a lattice metamaterialinspired to the topology of Peano curves and defined by patterns of slits that follow a rotational symmetry (chiral) configuration. The chiral pattern of the slits creates a series of hinges by that produce deformation mechanisms for the lattice due to bending of the ribs. The metamaterial has a marginal negative Poisson's ratio and an isotropic uniaxial stiffness. The chiral hinge lattice is almost one order of magnitude more compliant than other configurations with patterned slits and - contrary to other chiral Cosserat media - exhibits an in-plane shear stiffness closer to the one prescribed by classical elasticity for elastic isotropic continua. The planar topology of the lattice is conducive to highly tailored phononic behavior, with bandgaps depending upon the slit to rib length ratios. When undergoing bending the global deformation of the lattice induce partial stick-slip interactions in the compressed cells that enhance the global damping behavior. We present a series of experimental and FE simulations that show the mechanical and vibroacoustics behavior of these peculiar mechanical metamaterials.

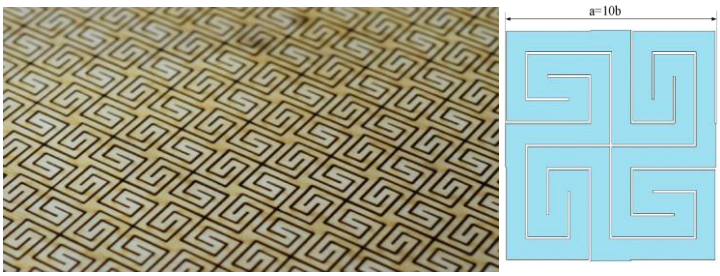

Fig1. *Chiral lattice hinge plate and a unit cell with a rib/slit length ratio of 10*