Acoustic/elastic Willis media and their dynamic homogenization

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Abstract

Elastic (or acoustic) Willis medium refers to a generalized medium with coupling between stress and particle velocity, momentum and strain, similar to bianisotropic materials for electromagnetic waves. The Willis coupling coefficient is mainly originated from asymmetric (local), or non-local interaction of material microstructure or active materials. The special coupling relationship endows Willis media stronger wave control capabilities, but their microstructure design still faces huge challenges. The talk will introduce relevant progress. First, for a two-dimensional spring-mass system, I will explain how to customize the elastic local Willis coupling coefficients through unit cell design, and validate the design through examining asymmetric reflections unique for Willis materials. Then I will present a nonlocal dynamic homogenization scheme based on the multiple scattering method for acoustic metamaterials, two types of acoustic interface waves are predicted and verified through experiments.

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