An ultra-accurate algorithm in the design of fluid/solid and solid/fluid phononics crystals

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Abstract

The paper presents an efficient and accurate algorithm to analyze the fluid/solid and solid/fluid phononic crystals (PCs) with fluid structure interaction (FSI). In the proposed mass-redistributed finite element method (MR-FEM) [1-6], the dispersion error in the longitudinal wave of fluid domain is minimized by re-distributing the mass in the mass matrix to "tune" the balance, while the lumped mass matrix is employed to analyze the elastic wave within the solid. In addition, different Bloch boundary conditions including the square and triangular lattice using MR-FEM are also formulated in this work. The accuracy of the proposed MR-FEM is verified by using the commercial software COMSOL, and the computational efficiency of MR-FEM is significantly greater than the conventional finite element methods (FEM) based on five different numerical examples. The excellent feature of MR-FEM has a great potential to extend 3D multi-physics domain of PCs.

Keywords: Phontonics Crystals; Fluid Structure Interaction; Numerical Method; Band Gap; Mass-redistributed Finite Element Method (MR-FEM)

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