Bandgap calculation of elastic wave in 2D solid phononic crystals by the meshless generalized finite difference method

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Abstract

In this paper, a meshless generalized finite difference method is proposed to calculate the bandgaps of elastic waves in 2D solid phononic crystals with square and triangular lattice. Due to the periodicity of the structure, the computation domain is simplified into a unit-cell. the governing equations and the boundary conditions in the unit-cell are expressed by the linear combination of the values on the nearby collocation points, which is easy to operate and has strong applicability. By scanning the wave vectors on the boundaries of the irreducible Brillouin zone, the frequencies can be calculated through the generalized eigenvalue problem and the bandgaps are obtained. By the comparisons of numerical results with the PWE method, the high accuracy and efficiency of the proposed method in both the circular and the non-circular scatterers are verified. And the stability is proved by investigating the convergence in the examples of scattered nodes. Finally the effect of filling fraction and arm lengths of the arm-shaped scatterers on bandgaps is illustrated by some numerical examples.

Keywords: Generalized finite difference method, meshless collocation method, Taylor series expansion, moving least square method, 2D solid phononic crystal, anti-plane elastic wave