The Generalized Multipole Technique for Two-Dimensional Phononic Crystals

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A method based on the generalized multipole technique (GMT) is developed for calculation of the band structures of elastic waves in two-dimensional phononic crystals which are composed of arbitrarily shaped cylinders embedded in a host medium. The scattered fields in the cylinder and host in one unit cell are expressed as superposition of the fields radiated by adequate sources located outside the corresponding domains. These sources (termed fictitious sources) have no physical existence and can be either multipole or monopole sources. In order to find the eigenvalues of the problem, besides the fictitious sources, an extra monopole source is introduced which acts as the external excitation. By applying the Bloch theory to the unit cell boundary and varying the frequency of the excitation, the eigenvalues can be localized as the extreme points of an appropriately chosen function. Detailed numerical computations for various systems show some advantages of the present method.

Keywords: Generalized multipole technique, phononic crystal, Band structure, Bloch theory