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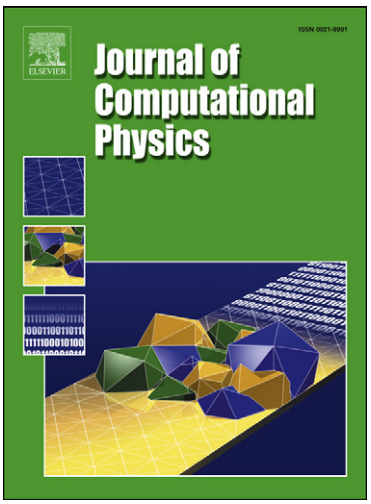

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Hui Zheng, Chuanzeng Zhang, Yuesheng Wang, Jan Sladek, Vladimir Sladek

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A meshfree local RBF collocation method for anti-plane transverse elastic wave propagation analysis in 2D phononic crystals

Hui Zheng[1], Chuanzeng Zhang[1,*], Yuesheng Wang[2], Jan Sladek[3] and Vladimir Sladek[3]
[1]Department of Civil Engineering, University of Siegen, D-57068 Siegen, Germany
[2]Institute of Engineering Mechanics, Beijing Jiaotong University, Beijing 100044, China
[3]Institute of Construction and Architecture, Slovak Academy of Sciences, 84503 Bratislava, Slovakia

Abstract: In this paper, a meshfree or meshless local radial basis function (RBF) collocation method is proposed to calculate the band structures of two-dimensional (2D) anti-plane transverse elastic waves in phononic crystals. Three new techniques are developed for calculating the normal derivatives of the field quantity required by the treatment of the boundary conditions, which improve the stability of the local RBF collocation method significantly. The general form of the local RBF collocation method for a unit-cell with periodic boundary conditions is proposed, where the continuity conditions on the interface between the matrix and the scatterer are taken into account. The band structures or dispersion relations can be obtained by solving the eigenvalue problem and sweeping the boundary of the irreducible first Brillouin zone. The proposed local RBF collocation method is verified by using the corresponding results obtained with the finite element method. For different acoustic impedance ratios, various scatterer shapes, scatterer arrangements (lattice forms) and material properties, numerical examples are presented and discussed to show the performance and the efficiency of the developed local RBF collocation method compared to the FEM for computing the band structures of 2D phononic crystals.

Key words: Local RBF collocation method, meshfree or meshless method, two-dimensional phononic crystals, band structures, anti-plane transverse elastic waves

1. Introduction

Phononic crystals (PCs) are periodic composite structures which have received great attentions in recent years [1]. Special interests are such artificial periodic composite structures which lead to acoustic/elastic wave band-gaps or stop-bands. Band-gaps or stop-bands are such frequency ranges, in which the acoustic/elastic wave propagation is forbidden. By changing the shape, the arrangement and the material properties of the scatterers in the matrix, different wave band-gaps can be achieved and applied to develop novel acoustic filters, ultrasonic silent blocks, acoustic mirrors, and so on. Due to the promising applications of the phononic crystals, numerical techniques are often necessary to investigate the wave propagation property in phononic crystals. One of the key issues is to compute the band structures and search for the complete phononic band-gaps.

*Corresponding author, Tel.: +49 271 7402173, Fax: +49 271 7404073, Email: c.zhang@uni-siegen.de