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# Topology optimization of 2D phononic band gap crystals based on BESO methods

**Yangfan Li[1], Xiaodong Huang[1], Fei Meng[1], Shiwei Zhou[1]**

[1] Centre for Innovative Structures and Materials, School of Civil, Environmental and Chemical Engineering, RMIT University, GPO Box 2476, Melbourne, VIC, 3001, Australia,
huang.xiaodong@rmit.edu.au;

## Abstract

Phononic band gap crystals, which could prohibit the propagations of elastic waves in certain frequency, are consisted of periodically distributed inclusions embedded in a matrix with high contrast in mechanical properties. In recent years, systematic design of phononic band gap crystals has attracted increasing attention due to their wide applications such as sound insulation, waveguides, or acoustic wave filtering. Toward an efficient and reliable optimization for phononic structures, we present a new topology optimization algorithm based on bi-directional evolutionary structural optimization (BESO) method and finite element analysis to maximize phononic band gaps. The optimization of maximizing the relative band gap size between two appointed neighbour bands starts from a unit cell without any band gap and then gradually adjusts the distribution of two materials in the following iteration steps based on the sensitivity analysis and BESO algorithm until the convergence criterions are satisfied. Various patterns of optimal phononic structures for both out-of-plane shear waves and are in-plane mixed waves presented. Numerical results show that the proposed algorithm is very effective and efficient.

**Keywords:** Phononic Band Gap Crystals, Topology Optimization, Bi-directional Evolutionary Structural Optimization (BESO).