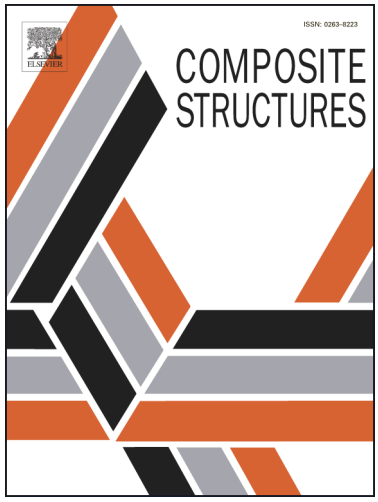

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Meng-Xin He, Jian-Qiao Sun

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Multi-objective Structural-acoustic Optimization of Beams Made of Functionally Graded Materials

Meng-Xin He [a] Jian-Qiao Sun [b]

[a] *Department of Mechanics*
Tianjin University, Tianjin, 300072, China
(hmx94309@gmail.com)

[b] *School of Engineering, University of California*
Merced, CA 95343, USA
Corresponding author and Honorary professor of Tianjin University.
(jqsun@ucmerced.edu)

Abstract

This paper presents a study of multi-objective structural-acoustic optimization of elastic beams made of functionally graded materials. The goal of this research is to discover the potentials to design multi-objective optimal volume fraction for better acoustic performance. The transfer matrix method is applied to obtain the structural-acoustic response of functionally graded beams. The hybrid of particle swarm optimization and cell mapping method is used to search for the Pareto optimal solutions. Two well-known distribution laws of material distribution are considered and compared with the spline interpolation of material distribution when spatially sampled material properties are used as design variables. Several cases are studied to demonstrate the multi-objective optimal design of functionally graded beams.

Key words: Structural-acoustic optimization; Axially functionally graded beam; Cell mapping method; Transfer matrix method; Multi-objective optimization.

1 Introduction

Optimal design of beam structures for better acoustic performance is an interesting research subject [1–3]. Changing material or geometric parameters can be an effective approach for noise reduction [2, 4]. Functionally graded materials (FGM) have spatially continuous variations of properties [5], which can be tailored to improve the ability of structures to reduce sound radiation [4]. The concept of FGM was originated in 1984 [6]. Studies on the design,