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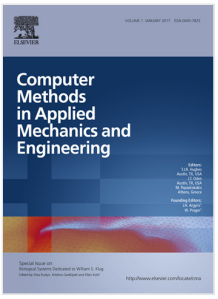

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Ta Duy Hien, Hyuk-Chun Noh

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Stochastic isogeometric analysis of free vibration of functionally graded plates considering material randomness

Ta Duy Hien* , Hyuk-Chun Noh**
Department of Civil and Environmental Engineering, Sejong University, Seoul, South Korea
* Email: tdhiengt@gmail.com
** Corresponding author (cpebach@sejong.ac.kr)

The paper is to develop stochastic isogeometric analysis for the free vibration of functionally graded plates with spatially varying random material properties. The isogeometric analysis method is employed in the new stochastic analysis scheme which is called Stochastic IsoGeometric Analysis (SIGA). The elastic modulus and mass density are modeled as homogeneous Gaussian random fields along the plane of structure. The governing equation of stochastic isogeometric analysis for free vibration of functionally graded plates is derived in conjunction with perturbation expansions to predict the first and the second moments of eigenvalues. In order to verify proposed method, the brute force Monte Carlo simulation is employed. The mean, variance, and COV (Coefficient of Variation) predicted by SIGA and those predicted by Monte Carlo simulation show good agreement. The numerical examples demonstrate that the randomness of material properties affects significantly the structural responses of the functionally graded plates. The correlation between elastic modulus and mass density is also observed to have significant effect on the response COV of eigenvalue.

KEYWORDS: *Stochastic isogeometric analysis, FGM plate, free vibration, random material properties.*

1. Introduction

The functionally graded material (FGM) is a material in which the volume fractions of two or more material components are created to vary continuously with position along the thickness direction. The functionally graded materials continuously improve structural performance by tailoring the material architecture at microscopic scales to optimize certain functional properties of structures. The most common functionally graded materials are metal/ceramic composites because the metallic part has superior fracture toughness and ceramic part has good thermal resistance. Actually, the concept of functionally graded materials is not new because it has been occurring in nature. Examples for natural FGMs: bones and bamboo tree are natural materials which have functional grading. As demonstrated