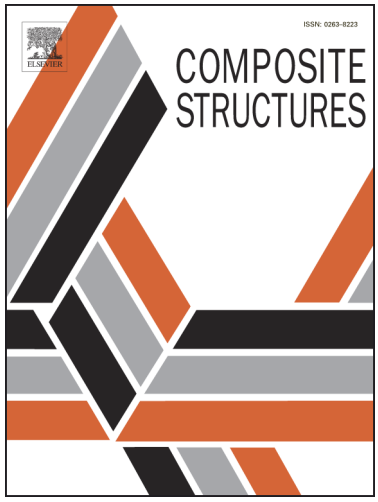

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Stochastic mechanics of metamaterials

T. Mukhopadhyay[a,*], S. Adhikari[a]

[a] *College of Engineering, Swansea University, Singleton Park, Swansea SA2 8PP, UK*

Abstract

The effect of stochasticity in mechanical behaviour of metamaterials is quantified in a probabilistic framework. The stochasticity has been accounted in the form of random material distribution and structural irregularity, which are often encountered due to manufacturing and operational uncertainties. An analytical framework has been developed for analysing the effective stochastic in-plane elastic properties of irregular hexagonal structural forms with spatially random variations of cell angles and intrinsic material properties. Probabilistic distributions of the in-plane elastic moduli have been presented considering both randomly homogeneous and randomly inhomogeneous stochasticity in the system, followed by an insightful comparative discussion. The ergodic behaviour in spatially irregular lattices is investigated as a part of this study. It is found that the effect of random micro-structural variability in structural and material distribution has considerable influence on mechanical behaviour of metamaterials.

Keywords: metamaterial; stochastic; hexagonal lattice; sensitivity; random micro-structure; ergodic

*Corresponding author
Email addresses: 800712@swansea.ac.uk (T. Mukhopadhyay), S.Adhikari@swansea.ac.uk (S. Adhikari)