ASYMPTOTIC FORMULAE FOR THE LOWEST NATURAL FREQUENCIES OF STRONGLY INHOMOGENEOUS STRUCTURES

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1. General

An asymptotic methodology is developed for analysing the lowest eigenvalues for 1D and 2D scalar equations governing dynamic behaviour of layered elastic structures. As an example, harmonic vibrations of a composite rod, beam, or membrane consisting of several homogeneous layers are studied, [1].

Asymptotic formulae for the lowest eigenvalues are derived in case of strong contrast between the parameters characterising each of the layers, including their sizes, material stiffness and densities. Asymptotic results are compared, when possible, with exact ones. The proposed approach is extended to structures of arbitrary shape with variable material parameters. It appears to be useful for a mathematical justification of shear deformation engineering theories in case of multilayered plates with strong vertical inhomogeneity.

[1] J. Kaplunov, D. Prikazchikov, O. Sergushova, Multi-parametric analysis of the lowest natural frequencies of strongly inhomogeneous elastic rods, Journal of Sound and Vibration 366 (2016) 264-276.