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The lowest vibration spectra of high-contrast composite structures

The lowest vibration modes of high-contrast elastic multi-component structures are discussed. Examples of such structures appear in various areas of modern engineering, including, in particular, layered structures, e.g. photovoltaic panels and laminated glass, see and references therein. Other prospective areas involve energy harvesting and robotics. The consideration starts from problems for elastic multi-component rods and membranes, which possess the first non-zero natural frequency tending to zero due to high contrast in material and geometrical parameters of the components. The approach relies on the concept of an "almost rigid body motion", performed by the stronger components subject to homogeneous Neumann type boundary conditions. A perturbation procedure provides both estimates for frequencies satisfying a polynomial equation of order equal to the number of stiff components, along with piecewise polynomial approximations for the eigenforms. Then, the analysis is extended to antiplane motions of layered waveguides and also of multi-layered cylindrical bodies of arbitrary cross section. Next, we consider problems of elasticity for layered structures, focussing on antisymmetric motion of a three-layered strongly inhomogeneous sandwich plate. The previous results for rods correspond to the phenomena of the lowest first shear cut-off frequency tending to zero, thus opening the room for two-mode low-frequency approximate theories for bending of high-contrast sandwich plates. Several practically important setups are considered, demonstrating the possibility of both uniform and non-uniform asymptotic approximations, leading to two distinct types of the governing plate equations.

Biography

Danila Prikazchikov has received his PhD from the University of Salford, UK. After working for several years as an Associate Professor at Bauman State Technical University, Moscow, he moved to Keele University, UK in 2013. He has co-authored around 50 publications, including a recent substantial chapter in "Advances in Applied Mechanics". His awards and honors include two Russian Presidential Fellowships for Young Scientists, along with visiting positions at City University of Hong-Kong and Anadolu University

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