# Long-wave propagation in multi-layered and multi-component high-contrast wave guides

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The presentation is focused on mathematical modelling of elastic structures, composed of alternating stiff and soft parts, arising in high-tech domains, including design of lightweight layered composites and manufacturing of soft robots. Unified asymptotic approach is developed for analysing waveguides with a strong longitudinal or transverse inhomogeneity, such as multi-span rods and multi-layered plates. For multi-span rods, it is shown that the lowest vibration modes correspond to almost rigid motions of the stiff components. Explicit approximate formulae are derived for the eigen frequencies and eigen forms [1,2], which are also relevant to thickness vibration of multi-layered plates. For the latter, several specific types of contrast, for which the cut off frequency of the first harmonic is close to zero are studied [3,4]. Two mode asymptotic polynomial expansions of the full dispersion relation approximating both the fundamental bending wave and the first harmonic, are derived. It is established that these can be either uniform or composite ones, valid only over non-overlapping vicinities of zero and the lowest cut off frequencies. The partial differential equations of motion associated with shortened dispersion relations, are also presented.

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3. J.Kaplunov, D.A.Prikazchikov, and L.A.Prikazchikova. Dispersion of elastic waves in strongly inhomogeneous three-layer plate. – Int. J. Solids Structures 113 (2017), 169-179.

4. L.A. Prikazchikova, Y. E. Aydın, B. Erbaş, and J. Kaplunov, Asymptotic analysis of anti-plane dynamic problem for a three-layered strongly inhomogeneous laminate. - Math. Mech. Solids https://doi.org/10.1177/1081286518790804