Palestra: Homogeniztion of strongly heterogeneous elastic composites Application to phononic crystals modeling

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Abstract- Phononic crystals are artificial crystals which mimic a crystalline atomic lattice, they are structured materials formed of periodic micro-structures. Recently they have received growing interest since they may exhibit interesting properties such as presence of band-gaps (a band-gap is a range of frequencies in which elastic or acoustic waves cannot propagate, it is surrounded, above and below, by propagating states); hence they are good candidates for wave-guides or filters. For example Vasseur and al. [1] have considered a two-dimensional binary solid-solid composite made of elastic arrays of Duralumin cylindrical inclusions embedded in a resin epoxy matrix and they showed that measured transmission exhibit absolute acoustic band gaps, see also [2]. In this talk we consider a three-dimensional composite material made of small inclusions periodically embedded in an elastic matrix, the whole structure presents strong heterogeneities between its different components. In the general framework of linearized elasticity we show that, when the size of the micro-structures tends to zero, the limit homogeneous structure presents, for some wavelengths, a negative mass density tensor. Hence we are able to rigorously justify the existence of forbidden bands. In particular, we show how to compute these band gaps and we illustrate the theoretical results with some numerical simulations. Some of our results are given in [3, 4].
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KeyWord:

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