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Recovery of two-phase microstructures of planar isotropic elastic composites

Abstract
The isotropic elastic mixtures composed of two isotropic materials of the bulk moduli and shear moduli are characterized by the effective bulk and shear moduli. In the planar problems the theoretically
admissible pairs, for given volume fraction ρ 0 of material, lie within a rectangular domain of vertices determined by the Hashin-Shtrikman bounds. The tightest bounds in 2D known up till now are due to
Cherkaev and Gibiansky (CG). The microstructures corresponding to the interior of the CG area can be of arbitrary rank, in the meaning of the hierarchical homogenization. In the present paper a family of composites is constructed of the underlying microstructures of rank 1. The consideration is confined to the microstructures possessing rotational symmetry of angle 120^0. To find the effective moduli the homogenization method is used: the local basic cell problems are set on a cell Y of the shape of a hexagonal domain. The periodicity conditions refer to the opposite sides of Y. Such a non-conventional basic cell choice generates automatically the family of isotropic mixtures. The subsequent points are found by solving the inverse homogenization problems with the isoperimetric condition expressing the amounts of both the materials within the cell. The isotropy conditions, usually explicitly introduced into the inverse homogenization formulation, do not appear, as being fulfilled by the microstructure construction. The method put forward makes it possible to localize each admissible pair by appropriate choice of the layout of both the constituents within the repetitive sub-domain of Y.
Keywords: isotropic composites, inverse homogenization, recovery of microstructures.