

# An adaptive method for homogenization in orthotropic nonlinear elasticity

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## Abstract

A database methodology is developed in order to characterize the constitutive behavior of macroscopically orthotropic, nonlinearly elastic composites. This methodology discretizes the material test space in terms of the eigenvalues of the macroscopic strain tensor and the orientation of its eigenvectors with respect to the axes of orthotropy. The macroscopic properties of the composite are extracted at points of this test space by subjecting a statistically representative sample of the composite to appropriate boundary conditions and are subsequently employed in an interpolation procedure which creates the so-called material map that characterizes the macroscopic behavior. The macroscopic tangent required in the finite element calculations are derived either by using the tangent induced by the map for the macroscopic stress or by explicitly computing a map for the tangent. The range of deformations over which a material map is applicable to a problem is enhanced by an adaptivescheme where a multi-level finite element method is employed at highly deformed regions of a finite element mesh where the map limits are exceeded.

**The complete document can be found [here](#).**