A numerical method for homogenization in non-linear elasticity

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Abstract

In this work, homogenization of heterogeneous materials in the context of elasticity is addressed, where the effective constitutive behavior of a heterogeneous material is sought. Both linear and non-linear elastic regimes are considered. Central to the homogenizationprocess is the identification of a statistically representative volume element (RVE) for the heterogeneous material. In the linear regime, aspects of this identification is investigated and a numerical scheme is introduced to determine the RVE size. The approach followed in the linear regime is extended to the non-linear regime by introducing stress2̌013strain state characterization parameters. Next, the concept of a material map, where one identifies the constitutive behavior of a material in a discrete sense, is discussed together with its implementation in the finite element method. The homogenization of the non-linearly elastic heterogeneous material is then realized through the computation of its effective material map using a numerically identified RVE. It is shown that the use of material maps for the macroscopicanalysis of heterogeneous structures leads to significant reductions in computation time.

The complete document can be found here.