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< PREVIOUS ARTICLE NEXT ARTICLE >

Review Articles

Homogenization Techniques and Micromechanics. A Survey and Perspectives

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Abstract

In this paper, we present a critical survey on homogenization theory and related techniques applied to micromechanics. The validation of homogenization results, the characterization of composite materials and the optimal design of complex structures are issues of great technological importance and are viewed here as a combination of mathematical and mechanical homogenization. The mathematical tools for modeling sequentially layered composites are explained. The influence of initial and boundary conditions on the effective properties in nonlinear problems is clarified and the notion of stability by homogenization is analyzed. Multiscale micromechanics methods are outlined and the classical as well as the emerging analytical and computational techniques are presented. Computation of effective static and dynamical properties of materials with linear or nonlinear constitutive equations is closely related to the development of generalized theories such as the strain-gradient mechanics. Selected applications of these techniques are outlined. Moreover, the extension of kinetic techniques in homogenization and the related inverse imaging problem are presented.

Topics: Composite materials , Micromechanics (Engineering) , Design , Boundary-value problems , Elasticity , Imaging , Modeling , Functions , Equations , Wave propagation

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