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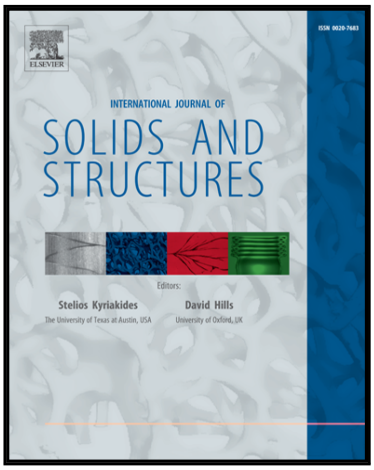

Method of fundamental solutions in micromechanics of elastic random structure composites

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Method of fundamental solutions in micromechanics of elastic random structure composites

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Abstract.

One considers linearly elastic composite media, which consist of a homogeneous matrix containing a statistically homogeneous random set of aligned homogeneous heterogeneities of non-canonical (i.e. nonellipsoidal) shape. The new general integral equations connecting the stress and strain fields in the point being considered with the stress and strain fields in the surrounding points are obtained for the random fields of heterogeneities. The method is based on a recently developed centering procedure where the notion of a *perturbator* is introduced in terms of boundary interface integrals that makes it possible to reconsider basic concepts of micromechanics such as effective field hypothesis, quasi-crystalline approximation, and the hypothesis of ellipsoidal symmetry. The results of this reconsideration are quantitatively estimated for some modeled composite reinforced by aligned homogeneous heterogeneities of non canonical shape. Some new effects are detected that are impossible in the framework of a classical background of micromechanics.

Keywords: Microstructures, elasticity, integral equations, meshfree method, effective moduli

1. Introduction

The prediction of the behavior of composite materials in terms of the mechanical properties of constituents and their microstructure is a central problem of micromechanics, which is evidently reduced to the estimation of stress fields in the constituents. Appropriate, but by no means exhaustive, references for the estimation of effective elastic moduli of statistically homogeneous media are provided by the reviews Willis (1981), Mura (1987), Nemat-Nasser and Hori (1993), Torquato (2002), and Milton (2002), Buryachenko (2007), Dvorak (2013). It appears today that variants of the effective medium method (Kröner, 1958; Hill, 1965) and the mean field method (Mori and Tanaka, 1973; Benveniste, 1987) are the most popular and widely used methods. Recently a new method has become known, namely the multiparticle effective field method (MEFM) was put forward and developed (see for references Buryachenko, 2007). The MEFM is based on the theory of functions of random variables and Green's functions. Within this method one constructs a hierarchy of statistical moment equations for conditional averages of the stresses in the inclusions. The hierarchy is then cut by introducing the notion of an effective field. This

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