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MACROSCOPIC STIFFNESS OF NANOCOMPOSITES WITH RANDOM DISTRIBUTED CARBON NANOTUBES

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ABSTRACT

Composite structures are wide used in many engineering fields (aerospace, automotive, civil, ...), because of their hight value of the stiffness to weight ratio. Unfortunately, the whole composite production process provides final products that present uncertainties.

In this paper the solution of a nanocomposite periodic structure is investigated in the framework of the homogenization and stochastic techniques. A two scale asymptotic homogenization technique is used to obtain equivalent deterministic physical parameters of the body.

This method isolates a macro and micro-scale problem. The macro-scale problem describes the dynamic of the body, while the micro-scale problem gives the equivalent elastic parameters of the material.
The micro-scale is a unit cell of the structure made of the polymer matrix and of a carbon nanotube. This unit cell repeats itself periodically in the whole body. The homogenization technique makes use of this periodicity of the micro-scale to provides the homogenized equivalent elastic coefficients.

The geometric characteristics and the material properties of the nanotube are known in a statistical sense and a probability density function (pdf) is assumed to take into account this uncertainty. Consequently, the macro-scale material properties are random and their probability density functions are calculated by a Monte Carlo simulation.

An alternative solution is developed by a Design Of Experiment technique and it is compared to the Monte Carlo result.

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