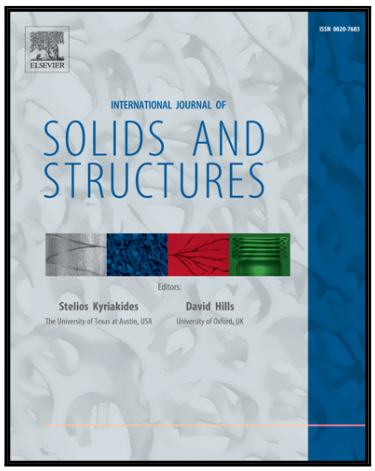

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Homogenisation by cylindrical RVEs with twisted-periodic boundary conditions for hybrid-yarn reinforced elastomers

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Abstract

A novel homogenisation method for heterogeneous structures containing a twist symmetry by means of RVEs with twisted-periodic boundary conditions is introduced. The method considers finite deformations and is applied to hybrid-yarn reinforced elastomers in order to compute the macroscopic elastic behaviour and the failure surface. The excellent numerical efficiency and parallelisability are shown in comparison to two classical homogenisation methods.

The yarn is modelled by a modified approach of Criscione et al. [1] in terms of an alternative set of physically based strain invariants. Its definition preserves the advantages of physically based invariants while allowing for a straight forward derivation of the stress and material tangent within the framework of the finite element method.

Keywords: hybrid yarn, homogenisation, twisted-periodic boundary conditions, finite element method

1. Introduction

Highly loaded elastomer components with designed textile reinforcements are state of the art in several applications, e.g. belts, tires, hose pipes. A main challenge is to balance

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