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A Numerical Method to Evaluate the Elastoplastic Material Properties of Fiber Reinforced Composite

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Abstract : The representative volume element (RVE) plays a central role in the mechanics of random heterogeneous materials with a view to predicting their effective properties. In this paper, a computational homogenization methodology, developed to determine effective linear elastic properties of composite materials, is extended to predict the effective nonlinear elastoplastic response of long fiber reinforced composite. Finite element simulations of volumes of different sizes and fiber volume fractures are performed for calculation of the overall response RVE. The dependencies of the overall stress-strain curves on the number of fibers inside the RVE are studied in the 2D cases. Volume averaged stress-strain responses are generated from RVEs and compared with the finite element calculations available in the literature at moderate and high fiber volume fractions. For these materials, the existence of an RVE is demonstrated for the sizes of RVE corresponding to 10–100 times the diameter of the fibers. In addition, the response of small size RVE is found anisotropic, whereas the average of all large ones leads to recover the isotropic material properties.

Keywords : homogenization, periodic boundary condition, elastoplastic properties, RVE
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